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OAK RIDGE NATIONAL LABORATORY

LOCKHEED MARTIN

Environmental Sciences Division

Laboratory Evaluation of In Situ Chemical Oxidation for Groundwater Remediation, Test Area North, Operable Unit 1-07B, Idaho National Engineering and Environmental Laboratory

Volume Two - Appendices C, D, and E

S. R. Cline
J. M. Giaquinto
M. K. McCracken
D. L. Denton
R. C. Starr

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ORNL/TM-13711/V2

ENVIRONMENTAL SCIENCES DIVISION

LABORATORY EVALUATION OF IN SITU CHEMICAL OXIDATION FOR GROUNDWATER REMEDIATION, TEST AREA NORTH, OPERABLE UNIT 1-07B, IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

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PREFACE

These appendices support the results and discussion of the laboratory work performed to evaluate the feasibility of in situ chemical oxidation for Idaho National Environmental and Engineering Laboratory's (INEEL) Test Area North (TAN) which is contained in ORNL/TM-13711/V1. This volume contains Appendices C-E.

Appendix C is a compilation of all recorded data and mathematical calculations made to interpret the data. For the Task 3 and Task 4 work, the spreadsheet column definitions are included immediately before the actual spreadsheet pages and are listed as "Sample Calculations/Column Definitions" in the table of contents.

Appendix D includes the chronological order in which the experiments were conducted and the final project costs through October 1998.

Appendix E is a compilation of the monthly progress reports submitted to INEEL during the course of the project.

APPENDIX C: CALCULATIONS

Experiment: 2a-3-B Reactor Performance
Calibration Curve Date: 4/22/98
Experiment Start Date: 5/12/98

For additional comments, see Laboratory Notebook B000025

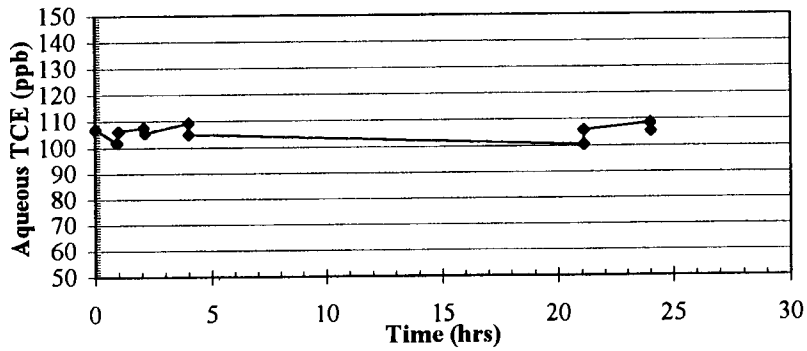
Pages: **55-56**

Experiment Description:
Tested a 500 mL flask(29/42 S.T.) with ORBO tube adapter/teflon sleeve assembly at 100 ppb TCE in DI water and obtained a mass balance.
This Adapter utilized a Teflon Stopcock to close off the ORBO tube and sampling port while not in use. A 10" long needle was used for sampling
All sample extractions placed on horizontal shaker for 2 hours.

Appears to be no significant difference between plastic and glass syringe sampling

TCE SPIKE SOLUTION INFORMATION

Solution: DI Water
Volume of Solution in Flask 0.5003 liters
Mass of TCE Added: 0.0607 mg (added 60.7 uL of a SAT. TCE soln-assuming it was 1000ppm)
Spike Concentration: 121 ppb
Equiliabrated at 12C
Start: 5/12/98 13:10 End: 5/13/98 11:10 Equilibration Time (hrs) 22.00
TEST START TIME: 5/13/98 11:10



Exp. 2a-3-B Reactor Performance For additional comments, see Laboratory Notebook B000025 Pages: **55-56**

ORNL No.	Sampling Time	Sample Name	Time (hrs)	Hexane (mL)	Sample (mL)	GC Conc. TCE (ppb)	Flag	Sample TCE (ppb)	TCE (mg) In Aliquot	Remaining Vol (mL)
338	5/13/98 11:10	2a-3b-t0-p	0.00	4.923	4.924	107		107.0	0.001	495.38
339	5/13/98 11:12	2a-3b-t0-g	0.03	5.006	4.961	106		107.3	0.001	490.42
340	5/13/98 12:07	2a-3b-t1hr-p	0.95	5.006	5.232	106		102	0.001	485.18
341	5/13/98 12:10	2a-3b-t1hr-g	1.00	5.045	4.829	102		106	0.001	480.35
342	5/13/98 13:16	2a-3b-t2hr-p	2.10	5.005	4.974	107		108	0.001	475.38
343	5/13/98 13:18	2a-3b-t2hr-g	2.13	5.015	5.227	110		105	0.001	470.15
344	5/13/98 15:10	2a-3b-t4hr-p	4.00	5.000	5.166	113		109	0.001	464.99
345	5/13/98 15:11	2a-3b-t4hr-g	4.02	4.967	5.211	110		105	0.001	459.78
346	5/14/98 8:15	2a-3b-t21hr-p	21.08	4.973	4.933	100		100	0.000	454.84
347	5/14/98 8:15	2a-3b-t21hr-g	21.08	4.918	4.904	106		106	0.001	449.94
348	5/14/98 11:10	2a-3b-t24hr-p	24.00	4.880	4.835	108		109	0.001	445.10
349	5/14/98 11:11	2a-3b-t24hr-g	24.02	4.914	4.731	102		106	0.000	440.37

Beginning TCE mass (mg)
0.054

Final TCE mass in Reactor (mg)
0.046

Total Mass of TCE in Aliquots (mg)
0.006

Total mass of TCE on ORBO tubes (mg)
0.000

0.053 Total Mass Recovered (mg)
98.7 % Recovered

p-for plastic syringe
g-for glass syringe

average	stdev
106	3
Count	
12	

					(g Charcoal)				
350	5/14/98 11:12	2a-3b-charcoal	24.03	4.945	0.092	ND	U	0	0 mg TCE
351	5/14/98 11:14	2a-3b-charcoal	24.07	4.962	0.049	ND	U	0	0 mg TCE

Charcoal Desorption (ORBO) tube extraction Data

%Diff glass/Plastic Syringe

339	5/13/98 11:12	2a-3b-t0-g	0.03	5.006	4.961	106	107	0.3
338	5/13/98 11:10	2a-3b-t0-p	0.00	4.923	4.924	107	107	
341	5/13/98 12:10	2a-3b-t1hr-g	1.00	5.045	4.829	102	106	4.0
340	5/13/98 12:07	2a-3b-t1hr-p	0.95	5.006	5.232	106	102	
347	5/14/98 8:15	2a-3b-t21hr-g	21.08	4.918	4.904	106	106	5.3
346	5/14/98 8:15	2a-3b-t21hr-p	21.08	4.973	4.933	100	100	
349	5/14/98 11:11	2a-3b-t24hr-g	24.02	4.914	4.731	102	106	-2.9
348	5/14/98 11:10	2a-3b-t24hr-p	24.00	4.880	4.835	108	109	
343	5/13/98 13:18	2a-3b-t2hr-g	2.13	5.015	5.227	110	105	-2.0
342	5/13/98 13:16	2a-3b-t2hr-p	2.10	5.005	4.974	107	108	
345	5/13/98 15:11	2a-3b-t4hr-g	4.02	4.967	5.211	110	105	-4.0
344	5/13/98 15:10	2a-3b-t4hr-p	4.00	5.000	5.166	113	109	

0.1 Avg. % Difference

Experiment: 2b-1, Hexane Extraction Time

For additional comments, see Laboratory Notebook B000025

Pages: **16-20**

Calibration Curve Date: 1/30/98

Experiment Start Date: 2/17/98

Experiment Description:

In this test, an equilibrated mixture of TCE spiked TAN 40 GW was equilibrated with reactive zone media and then extracted with hexane for various time periods before sample collection. During sample collection, aliquots of both the hexane layer and aqueous layer was taken.

~~Furthermore, a portion of the aqueous layer was also filtered (0.45 micron) prior to analysis~~

All aqueous/filtered aqueous samples were extracted w/hexane and placed on a horizontal shaker for an additional 30 minutes prior to analysis

The extractions were performed at room temperature

NOTE: the filtered samples are not used in computations. The filters have been found to absorb TCE, making the data obtained invalid.

TCE SPIKE SOLUTION INFORMATION

Prepared a saturated TCE solution using DI water and allowed to equilibrate overnite

added approximately 260 uL of the saturated TCE solution to 259.43 mL of TAN 40 groundwater

The TAN 40 gw was already sparged and cooled to 15C and was allowed to mix for a few minutes prior to initial sampling.

The TAN 40 Gw was then dispensed into vials containing crushed basalt or sediment and allowed to equilibrate overnight at 12-15C.

Initial TCE Concentration

ORNL#	Sample Name	Collection Time	Volume Hexane (mL)	Vol Aqueous Sample (mL)	GC TCE (ug/L)	Sample TCE (ug/L)				
									avg-1sd	718.81
59	2b-1-59-T0	2/18/98 11:15	4.908	5.007	734.19	719.609266	AVG	STDEV		
60	2b-1-60-T0	2/18/98 11:15	4.914	4.990	734.72	723.472195	721.54	2.731503076		
									avg+1sd	724.27

Container	Soil Mass (g)	Contents	TAN 40 GW Volume (mL)	Initial TCE Mass (ug)	Total Mass (grams)	Extraction Container	Hexane Vol (mL)	Total Mass Transferred (g)	EXT Start Time=0	Wt% Transferred
Vial1	10.567	sediment & spiked GW	37.351	26.9503	47.918	Bottle1	39.652	46.964	2/19/98 13:20	98.01
Vial2	10.094	sediment & spiked GW	38.025	27.4366	48.119	Bottle2	40.53	47.11	2/19/98 13:23	97.90
Vial3	10.889	Crushed basalt & spiked GW	38.214	27.5730	49.103	Bottle3	40.364	48.614	2/19/98 13:25	99.00
Vial4	10.354	Crushed basalt & spiked GW	39.265	28.3313	49.619	Bottle4	39.864	48.9	2/19/98 13:36	98.55
Vial5	0	Spiked GW Only	42.038	30.3321	42.038	Bottle5	40.061	41.464	2/19/98 13:38	98.63
Vial6	0	Spiked GW Only	41.747	30.1222	41.747	Bottle6	40.53	41.208	2/19/98 13:39	98.71
			(assuming GW spg=1.0)							

Exp. 2b-1, Hexane Extraction Time For additional comments, see Laboratory Notebook B000025 Pages: 16-20

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
61	2B-1-B1-T5-A	Aqueous	1	2/19/98 13:28	8	2.878	2.918	346		342	0.9964
67	2B-1-B1-T30-A	Aqueous	1	2/19/98 13:49	29	2.912	2.862	91		92	0.2638
73	2B-1-B1-T2HR-A	Aqueous	1	2/19/98 15:18	118	2.921	3.095	5	U	5	0.0144
79	2B-1-B1-T24HR-A	Aqueous	1	2/20/98 14:00	1480	2.942	3.188	0	ND	0	0.0000
85	2B-1-B1-T5-H	Hexane Layer	1	2/19/98 13:27	7	NA	NA	253		253	0.2531
91	2B-1-B1-T30-H	Hexane Layer	1	2/19/98 13:48	28	NA	NA	440		440	0.4400
97	2B-1-B1-T2HR-H	Hexane Layer	1	2/19/98 15:17	117	NA	NA	517		517	0.5168
103	2B-1-B1-T24HR-H	Hexane Layer	1	2/20/98 14:00	1480	NA	NA	548		548	0.5478
~~109~~	~~2B-1-B1-T5-F~~	~~Filtered Aqueous~~	~~1~~	~~2/19/98 13:28~~	~~8~~	~~2.997~~	~~3.015~~	~~264~~		~~342~~	1.0297
~~115~~	~~2B-1-B1-T30-F~~	~~Filtered Aqueous~~	~~1~~	~~2/19/98 13:49~~	~~29~~	~~2.947~~	~~2.988~~	~~64~~		~~92~~	0.2755
~~121~~	~~2B-1-B1-T2HR-F~~	~~Filtered Aqueous~~	~~1~~	~~2/19/98 15:18~~	~~118~~	~~2.964~~	~~2.245~~	~~0~~	~~ND~~	~~5~~	0.0104
~~127~~	~~2B-1-B1-T24HR-F~~	~~Filtered Aqueous~~	~~1~~	~~2/20/98 14:00~~	~~1480~~	~~2.967~~	~~2.354~~	~~0~~	~~ND~~	~~0~~	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aqu vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	39.65	10.04	37.351	12.76	0	22.79
30min	38.65	17.01	31.418	2.90	2.2791	22.18
2hrs	37.65	19.46	25.569	0.12	3.2584	22.83
24hrs	36.65	20.08	20.229	0.00	3.7999	23.88

MASS BALANCE

26.9503 ug Initial TCE
2.5901 ug TCE in Aq. aliquots
1.758 ug TCE in Hexane aliquots
22.6026 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
14.687 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

35.65 mL hexane volume left in bottle
19.53 ug TCE left in hexane phase
Total Recoved (ug)
88.60 Total wt% Recovered

Exp. 2b-1, Hexane Extraction Time

For additional comments, see Laboratory Notebook B000025

Pages: 16-20

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
62	2B-1-B2-T5-A	Aqueous	2	2/19/98 13:31	8	2.954	2.986	245.10		242	0.7241
68	2B-1-B2-T30-A	Aqueous	2	2/19/98 13:51	28	2.940	3.184	30.55		28	0.0898
74	2B-1-B2-T2HR-A	Aqueous	2	2/19/98 15:20	117	2.955	2.967	5.42	U	5	0.0160
80	2B-1-B2-T24HR-A	Aqueous	2	2/20/98 14:00	1477	2.962	3.035	0.00	ND	0	0.0000
86	2B-1-B2-T5-H	Hexane Layer	2	2/19/98 13:31	8	NA	NA	347.14		347	0.3471
92	2B-1-B2-T30-H	Hexane Layer	2	2/19/98 13:50	27	NA	NA	518.95		519	0.5189
98	2B-1-B2-T2HR-H	Hexane Layer	2	2/19/98 15:19	116	NA	NA	575.76		576	0.5758
104	2B-1-B2-T24HR-H	Hexane Layer	2	2/20/98 14:00	1477	NA	NA	603.88		604	0.6039
~~110~~	~~2B-1-B2-T5-F~~	~~Filtered Aqueous~~	~~2~~	~~2/19/98 13:31~~	~~8~~	~~2.988~~	~~2.949~~	~~174.65~~		242	0.7151
~~116~~	~~2B-1-B2-T30-F~~	~~Filtered Aqueous~~	~~2~~	~~2/19/98 13:51~~	~~28~~	~~2.961~~	~~3.187~~	~~23.26~~		28	0.0899
~~122~~	~~2B-1-B2-T2HR-F~~	~~Filtered Aqueous~~	~~2~~	~~2/19/98 15:20~~	~~117~~	~~2.961~~	~~2.952~~	~~0.00~~	~~ND~~	5	0.0159
~~128~~	~~2B-1-B2-T24HR-F~~	~~Filtered Aqueous~~	~~2~~	~~2/20/98 14:00~~	~~1477~~	~~2.964~~	~~2.913~~	~~18.60~~		0	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aque vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	40.53	14.06972052	38.025	9.22	0	23.29
30min	39.53	20.51398003	32.090	0.91	1.7863	23.21
2hrs	38.53	22.18402073	25.719	0.14	2.4849	24.81
24hrs	37.53	22.66348649	19.800	0.00	3.0927	25.76

MASS BALANCE

27.4366 ug Initial TCE
1.6508 ug TCE in Aq. aliquots
2.046 ug TCE in Hexane aliquots
23.7400 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
3.264 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

36.53 mL hexane volume left in bottle
22.06 ug TCE left in hexane phase

93.88 Total wt% Recovered

Exp. 2b-1, Hexane Extraction Time

For additional comments, see Laboratory Notebook B000025

Pages: 16-20

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
63	2B-1-B3-T5-A	Aqueous	3	2/19/98 13:34	9	2.978	3.436	371.58		322	1.1064
69	2B-1-B3-T30-A	Aqueous	3	2/19/98 13:54	29	2.953	3.542	151.63		126	0.4478
75	2B-1-B3-T2HR-A	Aqueous	3	2/19/98 15:22	117	2.935	3.237	5.71	U	5	0.0168
81	2B-1-B3-T24HR-A	Aqueous	3	2/20/98 14:01	1476	2.944	3.253	0.00	ND	0	0.0000
87	2B-1-B3-T5-H	Hexane Layer	3	2/19/98 13:34	9	NA	NA	326.45		326	0.3265
93	2B-1-B3-T30-H	Hexane Layer	3	2/19/98 13:52	27	NA	NA	487.10		487	0.4871
99	2B-1-B3-T2HR-H	Hexane Layer	3	2/19/98 15:21	116	NA	NA	574.16		574	0.5742
105	2B-1-B3-T24HR-H	Hexane Layer	3	2/20/98 14:01	1476	NA	NA	573.92		574	0.5739
~~111~~	~~2B-1-B3-T5-F~~	~~Filtered Aqueous~~	~~3~~	~~2/19/98 13:34~~	~~9~~	~~2.982~~	~~2.428~~	~~207.70~~		~~322~~	0.7819
~~117~~	~~2B-1-B3-T30-F~~	~~Filtered Aqueous~~	~~3~~	~~2/19/98 13:53~~	~~28~~	~~2.944~~	~~2.217~~	~~51.50~~		~~126~~	0.2803
~~123~~	~~2B-1-B3-T2HR-F~~	~~Filtered Aqueous~~	~~3~~	~~2/19/98 15:22~~	~~117~~	~~2.956~~	~~2.433~~	~~0.00~~	~~ND~~	~~5~~	0.0126
~~129~~	~~2B-1-B3-T24HR-F~~	~~Filtered Aqueous~~	~~3~~	~~2/20/98 14:01~~	~~1476~~	~~2.967~~	~~2.841~~	~~0.00~~	~~ND~~	~~0~~	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aque vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	40.36	13.17684031	38.214	12.31	0	25.48
30min	39.36	19.17403541	32.350	4.09	2.2147	25.48
2hrs	38.36	22.02704188	26.591	0.14	3.4298	25.59
24hrs	37.36	21.44376279	20.921	0.00	4.0334	25.48

MASS BALANCE

27.5730 ug Initial TCE
2.6457 ug TCE in Aq. aliquots
1.962 ug TCE in Hexane aliquots
22.9657 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
4.186 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

36.36 mL hexane volume left in bottle
20.87 ug TCE left in hexane phase

92.40 Total wt% Recovered

Exp. 2b-1, Hexane Extraction Time For additional comments, see Laboratory Notebook B000025 Pages: 16-20

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
64	2B-1-B4-T5-A	Aqueous	4	2/19/98 13:41	5	2.956	2.768	412.13		440	1.2182
70	2B-1-B4-T30-A	Aqueous	4	2/19/98 13:56	20	2.945	3.383	286.85		250	0.8449
76	2B-1-B4-T2HR-A	Aqueous	4	2/19/98 15:24	108	2.947	2.988	5.41	U	5	0.0159
82	2B-1-B4-T24HR-A	Aqueous	4	2/20/98 14:02	1466	2.952	3.038	0.00	ND	0	0.0000
88	2B-1-B4-T5-H	Hexane Layer	4	2/19/98 13:41	5	NA	NA	218.82		219	0.2188
94	2B-1-B4-T30-H	Hexane Layer	4	2/19/98 13:55	19	NA	NA	397.26		397	0.3973
100	2B-1-B4-T2HR-H	Hexane Layer	4	2/19/98 15:23	107	NA	NA	592.60		593	0.5926
106	2B-1-B4-T24HR-H	Hexane Layer	4	2/20/98 14:02	1466	NA	NA	593.87		594	0.5939
~~112~~	~~2B-1-B4-T5-F~~	~~Filtered Aqueous~~	~~4~~	~~2/19/98 13:41~~	~~5~~	~~2.974~~	~~3.416~~	~~308.97~~		~~440~~	1.5034
~~118~~	~~2B-1-B4-T30-F~~	~~Filtered Aqueous~~	~~4~~	~~2/19/98 13:56~~	~~20~~	~~2.970~~	~~2.982~~	~~143.27~~		~~250~~	0.7447
~~124~~	~~2B-1-B4-T2HR-F~~	~~Filtered Aqueous~~	~~4~~	~~2/19/98 15:24~~	~~108~~	~~2.962~~	~~2.981~~	~~0.00~~	~~ND~~	~~5~~	0.0159
~~130~~	~~2B-1-B4-T24HR-F~~	~~Filtered Aqueous~~	~~4~~	~~2/20/98 14:02~~	~~1466~~	~~2.968~~	~~2.710~~	~~34.66~~		~~0~~	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aque vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	39.86	8.723163427	39.265	17.28	0	26.00
30min	38.86	15.43894512	33.081	8.26	2.9404	26.64
2hrs	37.86	22.43811458	26.716	0.14	4.9273	27.51
24hrs	36.86	21.89256919	20.747	0.00	5.5517	27.44

MASS BALANCE

28.3313 ug Initial TCE
4.3431 ug TCE in Aq. aliquots
1.803 ug TCE in Hexane aliquots
22.1857 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
4.065 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

35.86 mL hexane volume left in bottle
21.30 ug TCE left in hexane phase

96.87 Total wt% Recovered

Exp. 2b-1, Hexane Extraction Time

For additional comments, see Laboratory Notebook B000025

Pages:

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
65	2B-1-B5-T5-A	Aqueous	5	2/19/98 13:44	6	2.943	2.874	318.93		327	0.9385
71	2B-1-B5-T30-A	Aqueous	5	2/19/98 13:58	20	2.961	2.957	94.25		94	0.2790
77	2B-1-B5-T2HR-A	Aqueous	5	2/19/98 15:26	108	2.948	3.302	0.00	ND	0	0.0000
83	2B-1-B5-T24HR-A	Aqueous	5	2/20/98 14:02	1464	2.983	2.614	0.00	ND	0	0.0000
89	2B-1-B5-T5-H	Hexane Layer	5	2/19/98 13:43	5	NA	NA	352.21		352	0.3522
95	2B-1-B5-T30-H	Hexane Layer	5	2/19/98 13:57	19	NA	NA	583.70		584	0.5837
101	2B-1-B5-T2HR-H	Hexane Layer	5	2/19/98 15:25	107	NA	NA	648.96		649	0.6490
107	2B-1-B5-T24HR-H	Hexane Layer	5	2/20/98 14:02	1464	NA	NA	645.51		646	0.6455
~~113~~	~~2B-1-B5-T5-F~~	~~Filtered Aqueous~~	~~5~~	~~2/19/98 13:44~~	~~6~~	~~2.935~~	~~2.857~~	~~210.03~~		~~327~~	0.9330
~~119~~	~~2B-1-B5-T30-F~~	~~Filtered Aqueous~~	~~5~~	~~2/19/98 13:58~~	~~20~~	~~2.945~~	~~2.379~~	~~51.19~~		~~94~~	0.2245
~~125~~	~~2B-1-B5-T2HR-F~~	~~Filtered Aqueous~~	~~5~~	~~2/19/98 15:26~~	~~108~~	~~2.938~~	~~2.278~~	~~0.00~~	~~ND~~	~~0~~	0.0000
~~131~~	~~2B-1-B5-T24HR-F~~	~~Filtered Aqueous~~	~~5~~	~~2/20/98 14:02~~	~~1464~~	~~2.968~~	~~3.254~~	~~0.00~~	~~ND~~	~~0~~	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aque vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	40.06	14.10977938	42.038	13.73	0	27.84
30min	39.06	22.79981586	36.307	3.43	2.2238	28.45
2hrs	38.06	24.69997755	30.971	0.00	3.3110	28.01
24hrs	37.06	23.92312488	25.391	0.00	3.9599	27.88

MASS BALANCE

30.3321 ug Initial TCE
2.3751 ug TCE in Aq. aliquots
2.230 ug TCE in Hexane aliquots
25.7267 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
7.817 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

36.06 mL hexane volume left in bottle
23.28 ug TCE left in hexane phase

91.93 Total wt% Recovered

Exp. 2b-1, Hexane Extraction Time

For additional comments, see Laboratory Notebook B000025

ORNL GC #	Sample Name	Sample Type	Bottle #	Collect Time	Elapsed Time (min)	Hexane Vol (mL)	Vol Aqueous Sample (mL)	GC Value (ug/L)	FLAG	TCE Conc. (ug/L)	TCE Mass in Aliquot (ug)
66	2B-1-B6-T5-A	Aqueous	6	2/19/98 13:46	7	2.929	2.974	230.92		227	0.6764
72	2B-1-B6-T30-A	Aqueous	6	2/19/98 14:00	21	2.974	2.919	60.62		62	0.1803
78	2B-1-B6-T2HR-A	Aqueous	6	2/19/98 15:28	109	2.945	3.071	0.00	ND	0	0.0000
84	2B-1-B6-T24HR-A	Aqueous	6	2/20/98 14:03	1464	2.962	2.658	0.00	ND	0	0.0000
90	2B-1-B6-T5-H	Hexane Layer	6	2/19/98 13:46	7	NA	NA	464.47		464	0.4645
96	2B-1-B6-T30-H	Hexane Layer	6	2/19/98 13:59	20	NA	NA	634.28		634	0.6343
102	2B-1-B6-T2HR-H	Hexane Layer	6	2/19/98 15:27	108	NA	NA	673.87		674	0.6739
108	2B-1-B6-T24HR-H	Hexane Layer	6	2/20/98 14:03	1464	NA	NA	670.46		670	0.6705
~~114~~	~~2B-1-B6-T5-F~~	~~Filtered Aqueous~~	~~6~~	~~2/19/98 13:46~~	~~7~~	~~2.948~~	~~2.993~~	~~202.09~~		~~227~~	0.6807
~~120~~	~~2B-1-B6-T30-F~~	~~Filtered Aqueous~~	~~6~~	~~2/19/98 14:00~~	~~21~~	~~2.979~~	~~3.084~~	~~42.22~~		~~62~~	0.1905
~~126~~	~~2B-1-B6-T2HR-F~~	~~Filtered Aqueous~~	~~6~~	~~2/19/98 15:28~~	~~109~~	~~2.955~~	~~2.941~~	~~0.00~~	~~ND~~	~~0~~	0.0000
~~132~~	~~2B-1-B6-T24HR-F~~	~~Filtered Aqueous~~	~~6~~	~~2/20/98 14:03~~	~~1464~~	~~2.959090909~~	~~3.010~~	~~58.51~~		~~0~~	0.0000

	Actual Hex vol (mL)	Act TCE mass in Hex (ug)	Act. Aque vol (mL)	Act. TCE mass in Aque. (ug)	Summed masses in aliquots (ug)	Cum Mass (ug)
5min	40.53	18.8248227	41.747	9.50	0	28.32
30min	39.53	25.07296854	35.780	2.21	1.8216	29.10
2hrs	38.53	25.96408392	29.777	0.00	2.8267	28.79
24hrs	37.53	25.16251409	23.765	0.00	3.5005	28.66

MASS BALANCE

30.1222 ug Initial TCE
1.7279 ug TCE in Aq. aliquots
2.443 ug TCE in Hexane aliquots
25.9512 ug TCE left in Bottle

Must assume mass of solids filtered is neglible
Assume complete transfer of vial contents to extraction bottle
6.472 mL aqueous volume left in bottle
0 ug TCE left in aqueous phase

36.53 mL hexane volume left in bottle
24.49 ug TCE left in hexane phase

95.16 Total wt% Recovered

Experiment: 2b-3, Sludge Hexane Ext Test
Calibration Curve Date: 1/30/98 and 4/22/98
Experiment Start Date: 4/8/98

For additional comments, see the RMAL Laboratory Research Notebook

Experiment Description:
In this test, an equilibrated mixture of TCE spiked TSF05 GW was equilibrated with TSF05 sludge and then extracted with hexane for various time periods before sample collection. During sample collection, aliquots of both the hexane layer and aqueous layer was taken.
~~Furthermore, a portion of the aqueous layer was also filtered (0.45 micron) prior to analysis~~
All aqueous/filtered aqueous samples were extracted w/hexane and placed on a horizontal shaker for an additional 30 minutes prior to analysis
The extractions were performed at room temperature

NOTE: the filtered samples are not used in computations.
The filters have been found to absorb TCE, making the data obtained invalid

TCE SPIKE SOLUTION INFORMATION

4/8/98 09:30: Started equilibration of solutions at 4 C. Due to problems with the incubator shaker did not start shaking the samples continuously. Samples were hand shaken at various times throughout the work day.

Initial TCE Concentration

ORNL#	Sample Name	Collection Ti	Volume Hexane (m	Vol Aqueous Sample (mL)	GC TCE (ug/L)	Sample TCE (ug/L)	FLAG		
243R	2b-3-spikeA		5.000	5.000	79,058	79,058			
244R	2b-3-spikeB		5.000	5.000	75,757	75,757		77,407	ppb
			(ASSUMED VALUES-RMAL did not Determine Gravimetrically)					2334.209181	

Steven Robert Cline: Analyzed several days later also.

Container	Soil Mass (g)	Contents	TSF05 GW Volume (m	Initial TCE Mass (ug)	Total Mass (grams)	Extraction Container	Hexane Vol (mL)	Total Mass Transferred (g)	EXT Start Time=0	Wt% Transferred
Vial1	9.948	Dried Sludge	34.50	2670	44.443	TSF-05-1	41.49242	43.404	4/9/98 8:45	97.66
Vial2	10.130	Dried Sludge	35.56	2753	45.692	TSF-05-2	41.22121	44.932	4/9/98 8:45	98.34
Vial3	0.000	Spiked GW	43.08	3335	43.083	TSF-05-3	41.02879	42.763	4/9/98 8:45	99.26
Vial4	0.000	Spiked GW	42.54	3293	42.540	TSF-05-4	40.9697	42.979	4/9/98 8:45	101.03
			(assuming GW spg=1.0)							

4/9/98 08:45: Transferred the entire contents of each 40 mL vial into 125 mL extraction vials containing 40 mL of hexane.
Placed 125 vials onto shaker and started extraction at 08:45 at 250 rpm.

Experi 2b-3, Sludge Hexane Ext Test For additional comments, see the RMAL Laboratory Research Notebook

CONTAINER#1

ORNL GC #	Sample Name	Sample Typ	Bottl	Collect Time	Elapsed Time (min	Hexane Vol (mL)	Vol of sam Sample (m	Hexane Layer DF	GC Value (ug/L)	FLAG	Sample TCE Con (ug/L)	TCE Mass in Aliquot (	Mass in both Aq. Aliq	%of Initi	Vol of Phase at sampling (mL)	ug TCE in Phase at Sa	%of Initial
249R	TSF-05-1-30-A	Aqueous	1	4/9/98 9:24	39	3.135	2.402	NA	1763		2,301	5.52624	13.0012	0.5%	34.496	79.364	3%
259R	SF-05-1-2hr-A	Aqueous	1	4/9/98 10:52	127	3.150	2.773	NA	1140		1,294	3.58955	7.12992	0.3%	32.023	41.452	2%
269R	SF-05-1-4hr-A	Aqueous	1	4/9/98 12:48	243	3.111	2.983	NA	1519		1,584	4.726	8.12751	0.3%	26.001	41.193	2%
279R	SF-05-1-24hr-A	Aqueous	1	4/10/98 8:22	1417	3.088	3.105	NA	3470		3,451	10.7148	16.0601	0.6%	20.283	69.992	3%
245	TSF-05-1-30-H	Hexane	1	4/9/98 9:18	33	10.358	0.080	129.981	437		56,831	4.56369			41.492	2358.048	88%
255	SF-05-1-2hr-HE	Hexane	1	4/9/98 10:47	122	9.842	0.082	121.296	615		74,569	6.10112			41.412	3088.072	116%
265	SF-05-1-4hr-HE	Hexane	1	4/9/98 12:45	240	10.333	0.077	134.725	640		86,201	6.66096			41.330	3562.699	133%
275	F-05-1-24hr-H	Hexane	1	4/10/98 8:15	1410	10.283	0.071	145.404	688		100,052	7.12488			41.253	4127.428	155%
~~253~~	~~TSF-05-1-30-A~~	~~Aq-filtered~~	~~1~~	~~4/9/98 9:24~~	~~39~~	~~3.123~~	~~3.249~~	~~NA~~	~~399~~		383	1.24486					
~~263~~	~~F-05-1-2hr-AQ~~	~~Aq-filtered~~	~~1~~	~~4/9/98 10:52~~	~~127~~	~~3.121~~	~~2.735~~	~~NA~~	~~140~~		159	0.43612			aliq	aqueous	hex	total
~~273~~	~~F-05-1-4hr-AQ~~	~~Aq-filtered~~	~~1~~	~~4/9/98 12:48~~	~~243~~	~~3.091~~	~~2.147~~	~~NA~~	~~100~~		144	0.30834			0%	3%	88%	92%
~~283~~	~~-05-1-24hr-AQ~~	~~Aq-filtered~~	~~1~~	~~4/10/98 8:22~~	~~1417~~	~~3.085~~	~~1.549~~	~~NA~~	~~49~~		98	0.15179			0%	2%	116%	117%
															0%	2%	133%	135%
															1%	3%	155%	158%

Steven Robert Cline: assumes conc of second aqueous sample equals that of the first (ie, didn't use the filtered sample data)

Steven Robert Cline: Did not use filtered values.

hexane conc increased 48 ppb bet. 4 & 24 hrs
but DF changed it to approx 20,000 ppb increase

CONTAINER #2

ORNL GC #	Sample Name	Sample Typ	Bottl	Collect Time	Elapsed Time (min	Hexane Vol (mL)	Vol of sam Sample (m	Hexane Layer DF	GC Value (ug/L)	FLAG	Sample TCE Con (ug/L)	TCE Mass in Aliquot (	Mass in both Aq. Aliq	%of Initi	Vol of Phase at sampling (mL)	ug TCE in Phase at Sa	%of Initial
250R	TSF-05-2-30-A	Aqueous	2	4/9/98 9:26	41	3.14	3.11	NA	1303		1,318	4.09513	7.96626	0.3%	35.562	46.857	1.7%
260R	TSF-05-2-2hr-A	Aqueous	2	4/9/98 10:55	130	3.12	2.88	NA	1203		1,301	3.7466	6.68246	0.2%	32.387	42.148	1.5%
270R	TSF-05-2-4hr-A	Aqueous	2	4/9/98 12:49	244	3.08	3.16	NA	1472		1,435	4.5394	7.85643	0.3%	26.570	38.121	1.4%
280R	TSF-05-2-24hr-	Aqueous	2	4/10/98 8:24	1419	3.08	3.56	NA	4184		3,622	12.908	16.9934	0.6%	21.150	76.602	2.8%
246	TSF-05-2-30-H	Hexane	2	4/9/98 9:18	33	10.45	0.08	128.778	543		69,987	5.72621			41.221	2884.950	104.8%
256	TSF-05-2-2hr-H	Hexane	2	4/9/98 10:47	122	10.38	0.07	153.200	674		103,325	7.0449			41.139	4250.736	154.4%
266	TSF-05-2-4hr-H	Hexane	2	4/9/98 12:45	240	10.32	0.08	129.509	713		92,343	7.41542			41.071	3792.638	137.8%
276	TSF-05-2-24hr-	Hexane	2	4/10/98 8:15	1410	10.33	0.07	155.886	759		118,310	7.88737			40.991	4849.654	176.2%
~~254~~	~~TSF-05-2-30-A~~	~~Aq-filtered~~	~~2~~	~~4/9/98 9:26~~	~~41~~	~~3.12~~	~~2.94~~	~~NA~~	~~287~~		287	0.84249					
~~264~~	~~TSF-05-2-2hr-A~~	~~Aq-filtered~~	~~2~~	~~4/9/98 10:55~~	~~130~~	~~3.12~~	~~2.26~~	~~NA~~	~~118~~		118	0.26688			aliq	aqueous	hex	total
~~274~~	~~TSF-05-2-4hr-A~~	~~Aq-filtered~~	~~2~~	~~4/9/98 12:49~~	~~244~~	~~3.10~~	~~2.31~~	~~NA~~	~~120~~		120	0.27817			0%	2%	105%	107%
~~284~~	~~TSF-05-2-24hr-~~	~~Aq-filtered~~	~~2~~	~~4/10/98 8:24~~	~~1419~~	~~3.08~~	~~1.13~~	~~NA~~	~~43~~		43	0.04828			0%	2%	154%	156%
															0%	1%	138%	139%
															1%	3%	176%	180%

Steven Robert Cline: assumes conc of second aqueous sample equals that of the first (ie, didn't use the filtered sample data)

Steven Robert Cline: Did not use filtered values.

hex conc. incr 46 ppb bet 4 & 24 hrs
but DF caused a 26,000 ppb increase

Experi 2b-3, Sludge Hexane Ext Test For additional comments, see the RMAL Laboratory Research Notebook

CONTAINER #3

ORNL GC #	Sample Name	Sample Typ	Bottl	Collect Time	Elapsed Time (min	Hexane Vol (mL)	Vol of sam Sample (m	Hexane Layer DF	GC Value (ug/L)	FLAG	Sample TCE Con (ug/L)	TCE Mass in Aliquot (ug)	%of Initial	Vol of Phase at sampling	ug TCE in Phase at Sa	%of Initial
251	TSF-05-3-30-A	Aqueous	3	4/9/98 9:19	34	3.138	2.967	NA	194		206	0.60984	0.02%	43.083	8.855	0.3%
261	TSF-05-3-2hr-A	Aqueous	3	4/9/98 10:49	124	3.121	2.728	NA	169		193	0.52638	0.02%	40.039	7.726	0.2%
271	TSF-05-3-4hr-A	Aqueous	3	4/9/98 12:47	242	3.109	3.018	NA	183		188	0.56856	0.02%	37.311	7.029	0.2%
281	TSF-05-3-24hr-	Aqueous	3	4/10/98 8:20	1415	3.089	2.993	NA	193		199	0.59608	0.02%	34.293	6.830	0.2%
247R	TSF-05-3-30-H	Hexane	3	4/9/98 9:18	33	10.336	0.085	122.821	898		110,333	9.36157		41.029	4526.823	136%
257R	TSF-05-3-2hr-H	Hexane	3	4/9/98 10:47	122	10.394	0.080	130.434	895		116,740	9.37461		40.944	4779.814	143%
267R	TSF-05-3-4hr-H	Hexane	3	4/9/98 12:45	240	10.302	0.076	136.980	896		122,784	9.30184		40.864	5017.412	150%
277R	TSF-05-3-24hr-	Hexane	3	4/10/98 8:15	1410	10.302	0.077	134.314	917		123,196	9.5197		40.788	5024.908	151%

hex conc. increased 21 ppb bet 4 & 24 hrs
but DF caused a 412 ppb increase

aliq	aqueous	hex	total
0%	0.3%	136%	136%
0%	0.2%	143%	144%
0%	0.2%	150%	151%
0%	0.2%	151%	151%

CONTAINER #4

252	TSF-05-4-30-A	Aqueous	4	4/9/98 9:19	34	3.118	2.982	NA	195		204	0.6092	0.02%	42.540	8.691	0.3%
262	TSF-05-4-2hr-A	Aqueous	4	4/9/98 10:49	124	3.113636	2.963	NA	177		186	0.55101	0.02%	39.486	7.343	0.2%
272	TSF-05-4-4hr-A	Aqueous	4	4/9/98 12:47	242	3.1	2.985	NA	184		191	0.57122	0.02%	36.523	6.989	0.2%
282	TSF-05-4-24hr-	Aqueous	4	4/10/98 8:20	1415	3.066667	2.986	NA	195		200	0.59816	0.02%	33.538	6.718	0.2%
248R	TSF-05-4-30-H	Hexane	4	4/9/98 9:18	33	10.417	0.081818	128.315	903		115,830	9.47697		40.970	4745.507	144.1%
258R	TSF-05-4-2hr-H	Hexane	4	4/9/98 10:47	122	10.36818	0.083333	125.418	900		112,927	9.41056		40.888	4617.332	140.2%
268R	TSF-05-4-4hr-H	Hexane	4	4/9/98 12:45	240	10.28485	0.072727	142.417	906		129,074	9.38717		40.805	5266.787	159.9%
278R	TSF-05-4-24hr-	Hexane	4	4/10/98 8:15	1410	10.26818	0.071212	145.191	849		123,239	8.7761		40.732	5019.742	152.4%

hex conc dropped 57ppb between 4 and 24hrs
but DF caused a 5835 ppb decrease

aliq	aqueous	hex	total
0.02%	0.26%	144.11%	144.40%
0.02%	0.22%	140.22%	140.46%
0.02%	0.21%	159.94%	160.17%
0.02%	0.20%	152.44%	152.66%

Experiment: 2b-3b, Sludge Hexane Ext Test For additional comments, see the RMAL Laboratory Research Notebook

Calibration Curve Date: 8/26/98
Experiment Start Date: 9/14/98

Experiment Description:
TSF05 Media was spiked with TCE (approx 1000 ppb) and then equilibrated overnight (12degrees C)
Then extraction with hexane (1:1) began. Aliquots of the hexane phase were collected with time to determine the extent of recovery and to determine if recovery is significantly affected by extraction time

The extractions were performed at room temperature

Steven Robert Cline: Gravimetric Data

Steven Robert Cline: Gravimetric Data

Steven Robert Cline: Assuming 0.04 mL of a saturated TCE soln (approx 1100 ppm) added to each vial

Steven Robert Cline: assuming tce mass neglible. Spg assumed=1 (Gravimetric Data)

Steven Robert Cline: Col 2 + Col 6

Steven Robert Cline: Gravimetric Data

Steven Robert Cline: Col 7-Col 12

1	2	3	4	5	6	7	8	9	10	11	12	13
Container	Soil Mass (g)	Contents	TSF05 GW Volume (m	Initial TCE mass (mg)	GW Volume (mL)	Total Weight (g)	Init. Aq. TCE (ppb)	Equil Start Time=0	Hexane Vol (mL)	Total Mass Transferred (g)	Not Transferred (g)	Wt% Transferred
Vial1	LOST SAMPLE-VIAL BROKE											
Vial2	10.275	Dried Sludge/GW		0.044	36.971	47.246	1190.12199	9/14/98 13:01	39.508182	46.579	0.667	0.9858824
Vial3	10.231	Dried Sludge/GW		0.044	37.347	47.578	1178.14015	9/14/98 13:02	39.52803	46.769	0.809	0.9829963
Vial4	0	Spiked GW Only		0.044	42.699	42.699	1030.4691	9/14/98 13:03	39.526364	42.416	0.283	0.9933722

9/15/98 8:05
Placed 125 vials onto shaker and started extraction at 250 rpm.

Steven Robert Cline: Col 5/Col 6 (& Conversion Factors)

Most Columns on the following page are self explanatory except for the following:

Col 21 is the GC value of the GC sample listed in Cols 14 and 15 (It is linked to this file from the G.C. spreadsheets)
Col 23= Col 21 x Col 19 x conversion factors to yield TCE mass of the aliquot (ug)
Col 24 is the Volume of Sample remaining in the reactor at the time of the current sampling
Col 25= Col 21 x Col 24 x conversion factors to yield TCE mass in the Reactor at the current sampling (ug)
Col 26= running total of Col 23
Col 27= Col 25 + Col 26
Cols 28,29&30: Cols 24,25&26 expressed in %Recovered Thus, these values assume 44ug TCE Initially in each Reactor

Experimen 2b-3b, Sludge Hexane For additional comments, see the RMAL Laboratory Research Notebook

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CONTAINER #2																
ORNL GC #	Sample Name	Bottle No	Collect Time	Elapsed Time (hrs)	Hex Aliquot Vol (mL)	Hexane Sample DF	GC Value (ppb)	FLAG	TCE in Aliquot(ug)	Vol Hex (mL)	TCE sample (ug)	TCE in Prev Aliquots (ug)	Total TCE (ug)	Sample %Rec	Aliquot %Rec	Total TCE %Rec
1999	2b-3b-2-2hrs	2	9/15/98 10:10	2.1	1.0	1.000	1,142		1.142080179	39.51	45.1	0	45.1	103%	0%	103%
2000	2b-3b-2-4hrs	2	9/15/98 12:10	4.1	1.0	1.000	1,168		1.167837153	38.51	45.0	1.142080179	46.1	102%	3%	105%
2001	2b-3b-2-6hrs	2	9/15/98 14:10	6.1	1.0	1.000	1,175	E	1.17491047	37.51	44.1	2.309917331	46.4	100%	5%	105%
2002	2b-3b-2-20hrs	2	9/16/98 7:00	22.9	1.0	1.000	1,195	E	1.195232877	36.51	43.6	3.484827801	47.1	99%	8%	107%
2003	2b-3b-2-24hrs	2	9/16/98 8:10	24.1	1.0	1.000	1,189	E	1.188969427	35.51	42.2	4.680060678	46.9	96%	11%	107%
2014	2b-3b-2-48hrs	2	9/17/98 8:10	48.1	1.0	1.000	1,201	E	1.200605823	34.51	41.4	5.869030106	47.3	94%	13%	107%
															Average:	106%
CONTAINER #3																
ORNL GC #	Sample Name	Bottle No	Collect Time	Elapsed Time (hrs)	Hex Aliquot Vol (mL)	Hexane Sample DF	GC Value (ppb)	FLAG	TCE in Aliquot(ug)	Vol Hex (mL)	TCE sample (ug)	TCE in Prev Aliquots (ug)	Total TCE (ug)	Sample %Rec	Aliquot %Rec	Total TCE %Rec
2004	2b-3b-2-2hrs	3	9/15/98 10:10	2.1	1.0	1.000	1,152		1.151764088	39.53	45.5	0	45.5	103%	0%	103%
2005	2b-3b-2-4hrs	3	9/15/98 12:10	4.1	1.0	1.000	1,153		1.152968679	38.53	44.4	1.151764088	45.6	101%	3%	104%
2006	2b-3b-2-6hrs	3	9/15/98 14:10	6.1	1.0	1.000	1,175	E	1.175198149	37.53	44.1	2.304732767	46.4	100%	5%	105%
2007	2b-3b-2-20hrs	3	9/16/98 7:00	22.9	1.0	1.000	1,192	E	1.191745162	36.53	43.5	3.479930916	47.0	99%	8%	107%
2008	2b-3b-2-24hrs	3	9/16/98 8:10	24.1	1.0	1.000	1,190	E	1.190126835	35.53	42.3	4.671676079	47.0	96%	11%	107%
2015	2b-3b-2-48hrs	3	9/17/98 8:10	48.1	1.0	1.000	1,199	E	1.198602632	34.53	41.4	5.861802913	47.2	94%	13%	107%
															Average:	106%
CONTAINER #4																
ORNL GC #	Sample Name	Bottle No	Collect Time	Elapsed Time (hrs)	Hex Aliquot Vol (mL)	Hexane Sample DF	GC Value (ppb)	FLAG	TCE in Aliquot(ug)	Vol Hex (mL)	TCE sample (ug)	TCE in Prev Aliquots (ug)	Total TCE (ug)	Sample %Rec	Aliquot %Rec	Total TCE %Rec
2009	2b-3b-2-2hrs	4	9/15/98 10:10	2.1	1.0	1.000	1,167		1.166700168	39.53	46.1	0	46.1	105%	0%	105%
2010	2b-3b-2-4hrs	4	9/15/98 12:10	4.1	1.0	1.000	1,173	E	1.173180169	38.53	45.2	1.166700168	46.4	103%	3%	105%
2011	2b-3b-2-6hrs	4	9/15/98 14:10	6.1	1.0	1.000	1,172	E	1.172301638	37.53	44.0	2.339880337	46.3	100%	5%	105%
2012	2b-3b-2-20hrs	4	9/16/98 7:00	22.9	1.0	1.000	1,172	E	1.17176783	36.53	42.8	3.512181976	46.3	97%	8%	105%
2013	2b-3b-2-24hrs	4	9/16/98 8:10	24.1	1.0	1.000	1,173	E	1.172642839	35.53	41.7	4.683949805	46.3	95%	11%	105%
2016	2b-3b-2-48hrs	4	9/17/98 8:10	48.1	1.0	1.000	1,179	E	1.179453478	34.53	40.7	5.856592645	46.6	93%	13%	106%
															Average:	105%

1169 THE LARGEST CALB. STANDARD CONCENTRATION

Minimum	27.00 ug
Maximum	47.30 ug
Difference	20.30 ug

1	2	3	4	5	6	7	8	9	10
General Data						Sample Data			
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio

Time elapsed since oxidation addition (T=0)

The Target/Desired Sampling Time (since T=0) for each sample.

Initial Amt added *(determined gravimetrically assuming spg=1)*

Desc. Of Reactor Contents

Amt of solid phase TAN site *material added (Gravimetric Determination)*

Approx. 6.5 mL

Running total of aliquot volume removed from each reactor

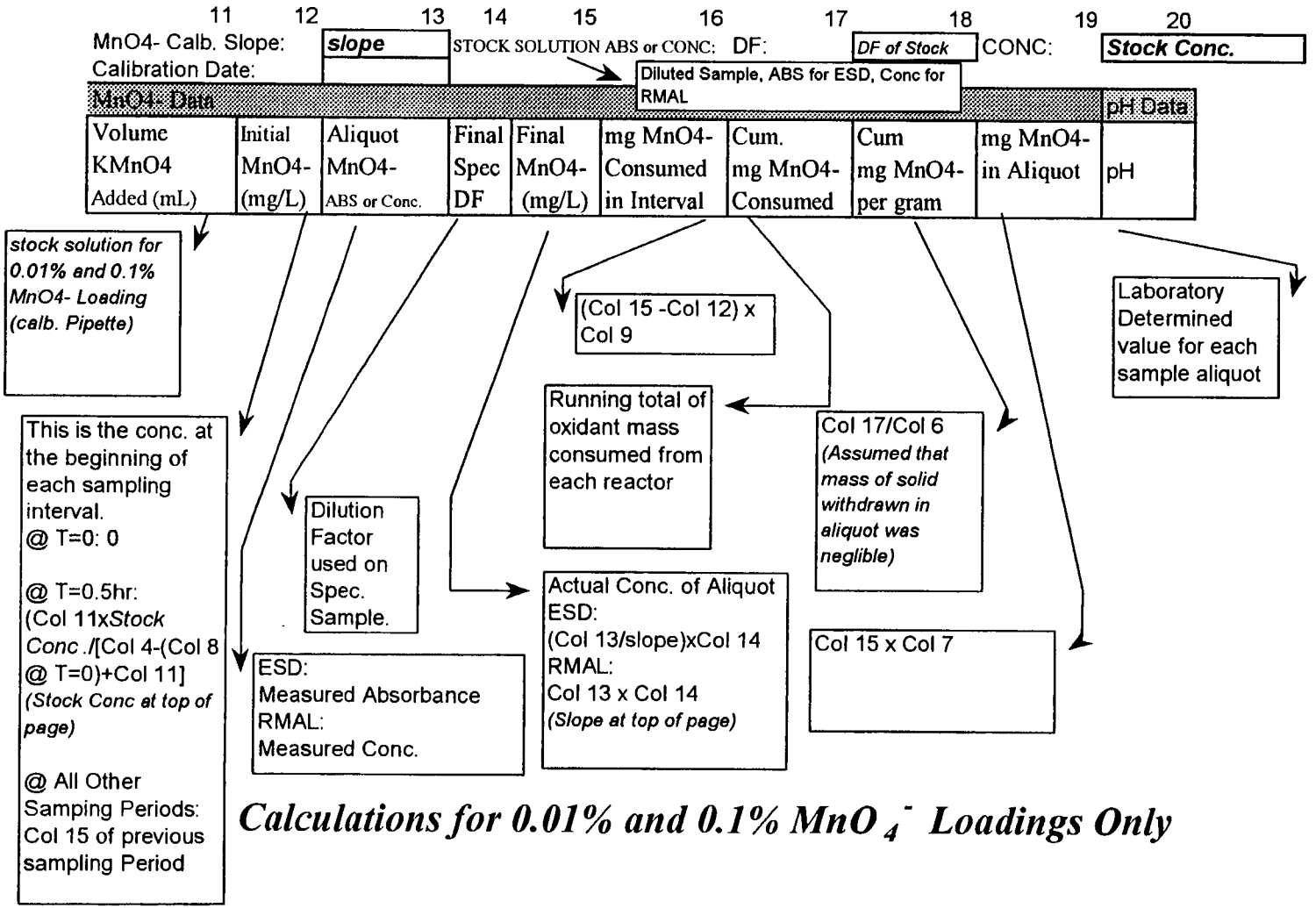
Col 5/Col 7 *(Assumed that mass of solid withdrawn in aliquot was neglible)*

Computed for each sampling interval as: Col 4-Col 8+Col 11

(col 8 from prev. sampling period; Col 11 not used for 1% & 3% MnO4 loadings)

Prepared by: S.R. Cline

Last Updated: 11/22/98



Prepared by: S.R. Cline

Last Updated: 11/22/98

MnO4- Calb. Slope: *slope*
Calibration Date:

11	12	13	14	15	16	17	18	19	20
MnO4- Data									pH Data
KMnO4 Added (mg)	Initial MnO4- (mg/L)	Final MnO4- ABS or Conc.	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4- per gram	mg MnO4- in Aliquot	pH

Determined gravimetrically

This is the conc. at the beginning of each sampling interval.
@ T=0: 0

@ T=0.5hr:
(Col 11/(Col 4- Col 8@ T=0))x(119/158)

Where (119/158) ratio is mole fraction of MnO_4 to $KMnO_4$

@ All Other Samping Periods:
Col 15 of previous sampling Period

Dilution Factor used on Spec. Sample.

ESD:
Measured Absorbance
RMAL:
Measured Conc.

(Col 15 -Col 12) x Col 9

Running total of oxidant mass consumed from each reactor

Actual Conc. of Aliquot
ESD:
(Col 13/slope)xCol 14
RMAL:
Col 13 x Col 14
(slope at top of page)

Col 17/Col 6
(Assumed that mass of solid withdrawn in aliquot was neglible)

Col 15 x Col 7

Laboratory Determined value for each sample aliquot

Calculations for 1% and 3% MnO_4^- Loadings Only

Prepared by: S.R. Cline

Last Updated: 11/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. Repeated 3a-R1 For additional comments, see Laboratory Notebook B000025 75-77

MnO4- Calb. Slope: 0.022 STOCK SOLUTION ABS: 0.514 DF: 1666.667 CONC: 38384.029 mg/L MnO4-

Calibration Date: 06/10/98

						Sample Data														pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consume in Interva	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Reading
1	0.00	Initial	199.905	DI WATER	0	6.5	6.5	199.9	NA	0	0.0	NA	NA	99.0	0.0	0.0	0.00	0.0	NT
1	0.58	30min	199.905	DI WATER	0	6.5	13	193.9	NA	0.5	99.0	0.423	5	94.8	0.8	0.8	0.00	0.6	NT
1	1.00	1 hour	199.905	DI WATER	0	6.5	19.5	187.4	NA	0.5	94.8	0.415	5	93.0	0.3	1.2	0.01	0.6	NT
1	2.03	2 hours	199.905	DI WATER	0	6.5	26	180.9	NA	0.5	93.0	0.394	5	88.3	0.9	2.0	0.01	0.6	NT
1	4.02	4hours	199.905	DI WATER	0	6.5	32.5	174.4	NA	0.5	88.3	0.413	5	92.5	-0.7	1.3	0.01	0.6	NT
1	20.42	20 hours	199.905	DI WATER	0	6.5	39	167.9	NA	0.5	92.5	0.408	5	91.4	0.2	1.4	0.01	0.6	NT
1	23.50	24 hours	199.905	DI WATER	0	6.5	45.5	161.4	NA	0.5	91.4	0.415	5	93.0	-0.3	1.2	0.01	0.6	NT
2	0.00	Initial	199.946	GW	0	6.5	6.5	199.9	NA	0	0.0	NA	NA	99.0	0.0	0.0	0.00	0.0	NT
2	0.58	30min	199.946	GW	0	6.5	13	193.9	NA	0.5	99.0	0.423	5	94.8	0.8	0.8	0.00	0.6	NT
2	1.00	1 hour	199.946	GW	0	6.5	19.5	187.4	NA	0.5	94.8	0.417	5	93.4	0.3	1.1	0.01	0.6	NT
2	2.03	2 hours	199.946	GW	0	6.5	26	180.9	NA	0.5	93.4	0.419	5	93.9	-0.1	1.0	0.00	0.6	NT
2	4.02	4hours	199.946	GW	0	6.5	32.5	174.4	NA	0.5	93.9	0.429	5	96.1	-0.4	0.6	0.00	0.6	NT
2	20.42	20 hours	199.946	GW	0	6.5	39	167.9	NA	0.5	96.1	0.426	5	95.4	0.1	0.7	0.00	0.6	NT
2	23.50	24 hours	199.946	GW	0	6.5	45.5	161.4	NA	0.5	95.4	0.411	5	92.1	0.5	1.2	0.01	0.6	NT
3	0.00	Initial	198.257	CB/GW	50.034	6.5	6.5	198.3	4.0	0	0.0	NA	NA	99.8	0.0	0.0	0.00	0.0	NT
3	0.58	30min	198.257	CB/GW	50.034	6.5	13	192.3	3.8	0.5	99.8	0.405	5	90.7	1.7	1.7	0.03	0.6	NT
3	1.00	1 hour	198.257	CB/GW	50.034	6.5	19.5	185.8	3.7	0.5	90.7	0.392	5	87.8	0.5	2.3	0.05	0.6	NT
3	2.03	2 hours	198.257	CB/GW	50.034	6.5	26	179.3	3.6	0.5	87.8	0.382	5	85.6	0.4	2.7	0.05	0.6	NT
3	4.02	4hours	198.257	CB/GW	50.034	6.5	32.5	172.8	3.5	0.5	85.6	0.375	5	84.0	0.3	3.0	0.06	0.5	NT
3	20.42	20 hours	198.257	CB/GW	50.034	6.5	39	166.3	3.3	0.5	84.0	0.309	5	69.2	2.5	5.4	0.11	0.4	NT
3	23.50	24 hours	198.257	CB/GW	50.034	6.5	45.5	159.8	3.2	0.5	69.2	0.293	5	65.6	0.6	6.0	0.12	0.4	NT
4	0.00	Initial	198.9	CB/GW	50.001	6.5	6.5	198.9	4.0	0	0.0	NA	NA	99.5	0.0	0.0	0.00	0.0	NT
4	0.58	30min	198.9	CB/GW	50.001	6.5	13	192.9	3.9	0.5	99.5	0.405	5	90.7	1.7	1.7	0.03	0.6	NT
4	1.00	1 hour	198.9	CB/GW	50.001	6.5	19.5	186.4	3.7	0.5	90.7	0.395	5	88.5	0.4	2.1	0.04	0.6	NT
4	2.03	2 hours	198.9	CB/GW	50.001	6.5	26	179.9	3.6	0.5	88.5	0.382	5	85.6	0.5	2.6	0.05	0.6	NT
4	4.02	4hours	198.9	CB/GW	50.001	6.5	32.5	173.4	3.5	0.5	85.6	0.379	5	84.9	0.1	2.7	0.05	0.6	NT
4	20.42	20 hours	198.9	CB/GW	50.001	6.5	39	166.9	3.3	0.5	84.9	0.315	5	70.6	2.4	5.1	0.10	0.5	NT
4	23.50	24 hours	198.9	CB/GW	50.001	6.5	45.5	160.4	3.2	0.5	70.6	0.295	5	66.1	0.7	5.9	0.12	0.4	NT

LastUpdated: 11/3/98

Prepared by: S.R. Cline

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: Repeated 3a-R1 For additional comments, see Laboratory Notebook B000025 Pages: 75-77

Experiment Start Date: 6/10/98

Comments:
This procedure was re performed using a new MnO4 calb curve and the oxidant was added via a 4% stock solution
Collected a 6-7 mL aliquot at each sampling period.

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. Repeated 3a-R1 For additional comments, see Laboratory Notebook B000025 75-77

MnO4- Calb. Slope: 0.022 STOCK SOLUTION ABS: 0.514 DF: 1666.667 CONC: 38384.029 mg/L MnO4-

Calibration Date: 06/10/98

						Sample Data					MnO4 Data								pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO Consume in Interva	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Reading
5	0.00	Initial	199.124	AB/GW	49.859	6.5	6.5	199.1	4.0	0	0.0	NA	NA	99.4	0.0	0.0	0.00	0.0	NT
5	0.58	30min	199.1	AB/GW	49.9	6.5	13	193.1	3.9	0.5	99.4	0.428	5	95.9	0.7	0.7	0.01	0.6	NT
5	1.00	1 hour	199.1	AB/GW	49.9	6.5	19.5	186.6	3.7	0.5	95.9	0.421	5	94.3	0.3	1.0	0.02	0.6	NT
5	2.03	2 hours	199.1	AB/GW	49.9	6.5	26	180.1	3.6	0.5	94.3	0.411	5	92.1	0.4	1.4	0.03	0.6	NT
5	4.02	4hours	199.1	AB/GW	49.9	6.5	32.5	173.6	3.5	0.5	92.1	0.42	5	94.1	-0.4	1.0	0.02	0.6	NT
5	20.42	20 hours	199.1	AB/GW	49.9	6.5	39	167.1	3.4	0.5	94.1	0.375	5	84.0	1.7	2.7	0.05	0.5	NT
5	23.50	24 hours	199.1	AB/GW	49.9	6.5	45.5	160.6	3.2	0.5	84.0	0.352	5	78.9	0.8	3.5	0.07	0.5	NT
6	0.00	Initial	200.168	AB/GW	49.9	6.5	6.5	200.2	4.0	0	0.0	NA	NA	98.8	0.0	0.0	0.00	0.0	NT
6	0.58	30min	200.2	AB/GW	49.9	6.5	13	194.2	3.9	0.5	98.8	0.431	5	96.6	0.4	0.4	0.01	0.6	NT
6	1.00	1 hour	200.2	AB/GW	49.9	6.5	19.5	187.7	3.8	0.5	96.6	0.424	5	95.0	0.3	0.7	0.01	0.6	NT
6	2.03	2 hours	200.2	AB/GW	49.9	6.5	26	181.2	3.6	0.5	95.0	0.414	5	92.7	0.4	1.1	0.02	0.6	NT
6	4.02	4hours	200.2	AB/GW	49.9	6.5	32.5	174.7	3.5	0.5	92.7	0.426	5	95.4	-0.5	0.7	0.01	0.6	NT
6	20.42	20 hours	200.2	AB/GW	49.9	6.5	39	168.2	3.4	0.5	95.4	0.391	5	87.6	1.3	2.0	0.04	0.6	NT
6	23.50	24 hours	200.2	AB/GW	49.9	6.5	45.5	161.7	3.2	0.5	87.6	0.366	5	82.0	0.9	2.9	0.06	0.5	NT
7	0.00	Initial	199.859	SED1/GW	50	6.5	6.5	199.9	4.0	0	0.0	NA	NA	99.0	0.0	0.0	0.00	0.0	NT
7	0.58	30min	199.9	SED1/GW	50.0	6.5	13	193.9	3.9	0.5	99.0	0.364	5	81.5	3.4	3.4	0.07	0.5	NT
7	1.00	1 hour	199.9	SED1/GW	50.0	6.5	19.5	187.4	3.7	0.5	81.5	0.343	5	76.8	0.9	4.3	0.09	0.5	NT
7	2.03	2 hours	199.9	SED1/GW	50.0	6.5	26	180.9	3.6	0.5	76.8	0.322	5	72.1	0.9	5.1	0.10	0.5	NT
7	4.02	4hours	199.9	SED1/GW	50.0	6.5	32.5	174.4	3.5	0.5	72.1	0.309	5	69.2	0.5	5.6	0.11	0.4	NT
7	20.42	20 hours	199.9	SED1/GW	50.0	6.5	39	167.9	3.4	0.5	69.2	0.233	5	52.2	2.9	8.5	0.17	0.3	NT
7	23.50	24 hours	199.9	SED1/GW	50.0	6.5	45.5	161.4	3.2	0.5	52.2	0.229	5	51.3	0.1	8.6	0.17	0.3	NT
8	0.00	Initial	199.613	SED1/GW	50.087	6.5	6.5	199.6	4.0	0	0.0	NA	NA	99.1	0.0	0.0	0.00	0.0	NT
8	0.58	30min	199.6	SED1/GW	50.1	6.5	13	193.6	3.9	0.5	99.1	0.378	5	84.7	2.8	2.8	0.06	0.6	NT
8	1.00	1 hour	199.6	SED1/GW	50.1	6.5	19.5	187.1	3.7	0.5	84.7	0.365	5	81.8	0.5	3.3	0.07	0.5	NT
8	2.03	2 hours	199.6	SED1/GW	50.1	6.5	26	180.6	3.6	0.5	81.8	0.348	5	78.0	0.7	4.0	0.08	0.5	NT
8	4.02	4hours	199.6	SED1/GW	50.1	6.5	32.5	174.1	3.5	0.5	78.0	0.341	5	76.4	0.3	4.3	0.09	0.5	NT
8	20.42	20 hours	199.6	SED1/GW	50.1	6.5	39	167.6	3.3	0.5	76.4	0.293	5	65.6	1.8	6.1	0.12	0.4	NT
8	23.50	24 hours	199.6	SED1/GW	50.1	6.5	45.5	161.1	3.2	0.5	65.6	0.271	5	60.7	0.8	6.9	0.14	0.4	NT

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: Repeated 3a-R2 For additional comments, see Laboratory Notebook B000025 Pages: 82-84

Experiment Start Date: 6/22/98

Comments:
This procedure was re performed using a new MnO4 calb curve and the oxidant was added via a 4% stock solution
Collected a 6-7 mL aliquot at each sampling period.

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Exp. Repeated 3a-R2 For additional comments, see Laboratory Notebook B000025 82-84

MnO4- Calb. Slope: 0.022 STOCK SOLUTION ABS: 0.263 DF: 3333.333 CONC: 39280.16 mg/L MnO4-

Calibration Date: 06/10/98

						Sample Data					MnO4 Data									pH Data
Flask No.	RXN Time (hrs	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consume in Interva	Cum. mg MnO4 Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Reading
1	0.00	Initial		200.0	DI WATER	0	6.5	6.5	200.0	NA	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0	NT
1	0.57	30min		200.0	DI WATER	0	6.5	13	198.5	NA	5	989.4	0.435	50	974.5	3.0	3.0	0.01	6.3	NT
1	1.10	1 hour		200.0	DI WATER	0	6.5	19.5	192.0	NA	5	974.5	0.419	50	938.7	6.9	9.8	0.05	6.1	NT
1	2.32	2 hours		200.0	DI WATER	0	6.5	26	185.5	NA	5	938.7	0.428	50	958.9	-3.7	6.1	0.03	6.2	NT
1	4.23	4hours		200.0	DI WATER	0	6.5	32.5	179.0	NA	5	958.9	0.421	50	943.2	2.8	8.9	0.04	6.1	NT
1	21.15	20 hours		200.0	DI WATER	0	6.5	39	172.5	NA	5	943.2	0.424	50	949.9	-1.2	7.7	0.04	6.2	NT
1	24.10	24 hours		200.0	DI WATER	0	6.5	45.5	166.0	NA	5	949.9	0.391	50	876.0	12.3	20.0	0.10	5.7	NT
2	0.00	Initial		200.0	GW	0	6.5	6.5	200.0	NA	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0	NT
2	0.57	30min		200.0	GW	0	6.5	13	198.5	NA	5	989.4	0.435	50	974.5	3.0	3.0	0.01	6.3	NT
2	1.10	1 hour		200.0	GW	0	6.5	19.5	192.0	NA	5	974.5	0.419	50	938.7	6.9	9.8	0.05	6.1	NT
2	2.32	2 hours		200.0	GW	0	6.5	26	185.5	NA	5	938.7	0.407	50	911.8	5.0	14.8	0.07	5.9	NT
2	4.23	4hours		200.0	GW	0	6.5	32.5	179.0	NA	5	911.8	0.414	50	927.5	-2.8	12.0	0.06	6.0	NT
2	21.15	20 hours		200.0	GW	0	6.5	39	172.5	NA	5	927.5	0.422	50	945.4	-3.1	8.9	0.04	6.1	NT
2	24.10	24 hours		200.0	GW	0	6.5	45.5	166.0	NA	5	945.4	0.402	50	900.6	7.4	16.4	0.08	5.9	NT
3	0.00	Initial		200.0	CB/GW	50.5	6.5	6.5	200.0	4.0	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0	NT
3	0.57	30min		200.0	CB/GW	50.5	6.5	13	198.5	3.9	5	989.4	0.435	50	974.5	3.0	3.0	0.06	6.3	NT
3	1.10	1 hour		200.0	CB/GW	50.5	6.5	19.5	192.0	3.8	5	974.5	0.434	50	972.3	0.4	3.4	0.07	6.3	NT
3	2.32	2 hours		200.0	CB/GW	50.5	6.5	26	185.5	3.7	5	972.3	0.415	50	929.7	7.9	11.3	0.22	6.0	NT
3	4.23	4hours		200.0	CB/GW	50.5	6.5	32.5	179.0	3.5	5	929.7	0.432	50	967.8	-6.8	4.5	0.09	6.3	NT
3	21.15	20 hours		200.0	CB/GW	50.5	6.5	39	172.5	3.4	5	967.8	0.413	50	925.2	7.3	11.8	0.23	6.0	NT
3	24.10	24 hours		200.0	CB/GW	50.5	6.5	45.5	166.0	3.3	5	925.2	0.401	50	898.4	4.5	16.3	0.32	5.8	NT
4	0.00	Initial		200.0	CB/GW	50.31	6.5	6.5	200.0	4.0	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0	NT
4	0.57	30min		200.0	CB/GW	50.31	6.5	13	198.5	3.9	5	989.4	0.432	50	967.8	4.3	4.3	0.09	6.3	NT
4	1.10	1 hour		200.0	CB/GW	50.31	6.5	19.5	192.0	3.8	5	967.8	0.406	50	909.6	11.2	15.5	0.31	5.9	NT
4	2.32	2 hours		200.0	CB/GW	50.31	6.5	26	185.5	3.7	5	909.6	0.413	50	925.2	-2.9	12.6	0.25	6.0	NT
4	4.23	4hours		200.0	CB/GW	50.31	6.5	32.5	179.0	3.6	5	925.2	0.417	50	934.2	-1.6	11.0	0.22	6.1	NT
4	21.15	20 hours		200.0	CB/GW	50.31	6.5	39	172.5	3.4	5	934.2	0.406	50	909.6	4.3	15.2	0.30	5.9	NT
4	24.10	24 hours		200.0	CB/GW	50.31	6.5	45.5	166.0	3.3	5	909.6	0.398	50	891.6	3.0	18.2	0.36	5.8	NT

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. Repeated 3a-R2 For additional comments, see Laboratory Notebook B000025 82-84

MnO4- Calb. Slope: 0.022 STOCK SOLUTION ABS: 0.263 DF: 3333.333 CONC: 39280.16 mg/L MnO4-

Calibration Date: 06/10/98

							Sample Data													pH Data
Flask No.	RXN Time (hrs	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consume in Interva	Cum. mg MnO4 Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Reading
5	0.00	Initial		200.0	AB/GW	49.98	6.5	6.5	200.0	4.0	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0 NT
5	0.57	30min		200.0	AB/GW	50.0	6.5	13	198.5	4.0	5	989.4	0.435	50	974.5	3.0	3.0	0.06	6.3 NT
5	1.10	1 hour		200.0	AB/GW	50.0	6.5	19.5	192.0	3.8	5	974.5	0.427	50	956.6	3.4	6.4	0.13	6.2 NT
5	2.32	2 hours		200.0	AB/GW	50.0	6.5	26	185.5	3.7	5	956.6	0.406	50	909.6	8.7	15.1	0.30	5.9 NT
5	4.23	4hours		200.0	AB/GW	50.0	6.5	32.5	179.0	3.6	5	909.6	0.413	50	925.2	-2.8	12.3	0.25	6.0 NT
5	21.15	20 hours		200.0	AB/GW	50.0	6.5	39	172.5	3.5	5	925.2	0.416	50	932.0	-1.2	11.2	0.22	6.1 NT
5	24.10	24 hours		200.0	AB/GW	50.0	6.5	45.5	166.0	3.3	5	932.0	0.4	50	898.1	6.0	17.1	0.34	5.8 NT
6	0.00	Initial		200.0	AB/GW	49.96	6.5	6.5	200.0	4.0	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0 NT
6	0.57	30min		200.0	AB/GW	50.0	6.5	13	198.5	4.0	5	989.4	0.43	50	963.3	5.2	5.2	0.10	6.3 NT
6	1.10	1 hour		200.0	AB/GW	50.0	6.5	19.5	192.0	3.8	5	963.3	0.411	50	920.8	8.2	13.4	0.27	6.0 NT
6	2.32	2 hours		200.0	AB/GW	50.0	6.5	28	185.5	3.7	5	920.8	0.406	50	909.6	2.1	15.4	0.31	5.9 NT
6	4.23	4hours		200.0	AB/GW	50.0	6.5	32.5	179.0	3.6	5	909.6	0.426	50	954.4	-8.0	7.4	0.15	6.2 NT
6	21.15	20 hours		200.0	AB/GW	50.0	6.5	39	172.5	3.5	5	954.4	0.415	50	929.7	4.3	11.7	0.23	6.0 NT
6	24.10	24 hours		200.0	AB/GW	50.0	6.5	45.5	166.0	3.3	5	929.7	0.41	50	918.5	1.9	13.5	0.27	6.0 NT
7	0.00	Initial		200.0	SED1/GW	50.07	6.5	6.5	200.0	4.0	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0 NT
7	0.57	30min		200.0	SED1/GW	50.1	6.5	13	198.5	4.0	5	989.4	0.42	50	940.9	9.6	9.6	0.19	6.1 NT
7	1.10	1 hour		200.0	SED1/GW	50.1	6.5	19.5	192.0	3.8	5	940.9	0.412	50	923.0	3.4	13.1	0.26	6.0 NT
7	2.32	2 hours		200.0	SED1/GW	50.1	6.5	26	185.5	3.7	5	923.0	0.422	50	945.4	-4.2	8.9	0.18	6.1 NT
7	4.23	4hours		200.0	SED1/GW	50.1	6.5	32.5	179.0	3.6	5	945.4	0.41	50	918.5	4.8	13.7	0.27	6.0 NT
7	21.15	20 hours		200.0	SED1/GW	50.1	6.5	39	172.5	3.4	5	918.5	0.398	50	891.6	4.6	18.4	0.37	5.8 NT
7	24.10	24 hours		200.0	SED1/GW	50.1	6.5	45.5	166.0	3.3	5	891.6	0.395	50	884.9	1.1	19.5	0.39	5.8 NT
8	0.00	Initial		200.0	SED1/GW	45	6.5	6.5	200.0	4.4	0	0.0	NA	NA	989.4	0.0	0.0	0.00	0.0 NT
8	0.57	30min		200.0	SED1/GW	45.0	6.5	13	198.5	4.4	5	989.4	0.428	50	958.9	6.1	6.1	0.13	6.2 NT
8	1.10	1 hour		200.0	SED1/GW	45.0	6.5	19.5	192.0	4.3	5	958.9	0.419	50	938.7	3.9	9.9	0.22	6.1 NT
6	2.32	2 hours		200.0	SED1/GW	45.0	6.5	26	185.5	4.1	5	938.7	0.424	50	949.9	-2.1	7.9	0.17	6.2 NT
8	4.23	4hours		200.0	SED1/GW	45.0	6.5	32.5	179.0	4.0	5	949.9	0.414	50	927.5	4.0	11.9	0.26	6.0 NT
8	21.15	20 hours		200.0	SED1/GW	45.0	6.5	39	172.5	3.8	5	927.5	0.412	50	923.0	0.8	12.6	0.28	6.0 NT
6	24.10	24 hours		200.0	SED1/GW	45.0	6.5	45.5	166.0	3.7	5	923.0	0.388	50	869.2	8.9	21.6	0.48	5.7 NT

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: Repeated 3a-R3 For additional comments, see Laboratory Notebook B000025 Pages: 85-86

Experiment Start Date: 6/25/98

Comments:
Re-performed after a new calibration curve was prepared.
Collected a 6-7 mL aliquot at each sampling period.
(still performed by adding solid KMnO4)
Laboratory notebook does indicate that the dilutions for the 1 and 2 time points was made using an adjustible pipette. Dilutions for the other time points were made using a 10uL Hamilton syringe for better accuracy.

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. Repeated 3a-R3 For additional comments, see Laboratory Notebook B000025

MnO4- Calb. Slope: 0.022

Calibration Date: 06/10/98

					Sample Data															pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (g	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4- per g or mL	mg MnO4- in Aliquot	pH Reading
1	0	Initial	200.006	DI Water	0	6.5	6.5	200.0	NA	0	0	NA	NA	10355.2	0.0	0.0	0.00	0.0	NT
1	0.92	1 hour	200.006	DI Water	0	6.5	13	193.5	NA	2660.5	10355	0.429	500	9611	144.0	144.0	0.72	62.5	NT
1	2.08	2 hours	200.006	DI Water	0	8.5	19.5	167.0	NA	2660.5	9611	0.425	500	9521	16.8	160.8	0.80	61.9	NT
1	3.33	3 hours	200.006	DI Water	0	6.5	26	180.5	NA	2660.5	9521	0.454	500	10171	-117.3	43.5	0.22	66.1	NT
1	4.17	4 hours	200.006	DI Water	0	6.5	32.5	174.0	NA	2660.5	10171	0.452	500	10126	7.8	51.3	0.26	65.8	NT
1	19.67	20 hours	200.006	DI Water	0	6.5	39	167.5	NA	2660.5	10126	0.391	500	8760	228.9	280.2	1.40	56.9	NT
1	23.92	24 hours	200.006	DI Water	0	6.5	45.5	161.0	NA	2660.5	8760	0.408	500	9140	-61.3	218.9	1.09	59.4	NT
2	0	Initial	199.67	GW	0	6.5	6.5	199.7	NA	0	0	NA	NA	10368.1	0.0	0.0	0.00	0.0	NT
2	0.92	1 hour	199.67	GW	0	6.5	13	193.2	NA	2659.2	10368	0.438	500	9813	107.3	107.3	0.54	63.8	NT
2	2.08	2 hours	199.67	GW	0	8.5	19.5	186.7	NA	2659.2	9813	0.272	500	6094	694.2	801.5	4.01	39.6	NT
2	3.33	3 hours	199.67	GW	0	6.5	26	160.2	NA	2659.2	6094	0.439	500	9835	-674.1	127.5	0.64	63.9	NT
2	4.17	4 hours	199.67	GW	0	6.5	32.5	173.7	NA	2659.2	9835	0.446	500	9992	-27.2	100.2	0.50	64.9	NT
2	19.67	20 hours	199.67	GW	0	6.5	39	167.2	NA	2659.2	9992	0.441	500	9880	18.7	118.9	0.60	64.2	NT
2	23.92	24 hours	199.67	GW	0	6.5	45.5	160.7	NA	2659.2	9880	0.44	500	9857	3.6	122.5	0.61	64.1	NT
3	0	Initial	200.06	CB/GW	50.055	6.5	6.5	200.1	4.0	0	0	NA	NA	10350.8	0.0	0.0	0.00	0.0	NT
3	0.92	1 hour	200.06	CB/GW	50.055	6.5	13	193.6	3.9	2660.1	10351	0.443	500	9925	82.5	82.5	1.65	64.5	NT
3	2.08	2 hours	200.06	CB/GW	50.055	6.5	19.5	187.1	3.7	2660.1	9925	0.453	500	10149	-41.9	40.6	0.81	66.0	NT
3	3.33	3 hours	200.06	CB/GW	50.055	6.5	26	180.8	3.6	2660.1	10149	0.46	500	10305	-28.3	12.3	0.25	67.0	NT
3	4.17	4 hours	200.06	CB/GW	50.055	6.5	32.5	174.1	3.5	2660.1	10305	0.447	500	10014	50.7	63.0	1.26	65.1	NT
3	19.67	20 hours	200.06	CB/GW	50.055	6.5	39	167.6	3.3	2660.1	10014	0.442	500	9902	18.8	81.7	1.63	64.4	NT
3	23.92	24 hours	200.06	CB/GW	50.055	6.5	45.5	161.1	3.2	2660.1	9902	0.449	500	10059	-25.3	56.5	1.13	65.4	NT
4	0	Initial	199.972	CB/GW	50	6.5	6.5	200.0	4.0	0	0	NA	NA	10357.0	0.0	0.0	0.00	0.0	NT
4	0.92	1 hour	199.972	CB/GW	50	6.5	13	193.5	3.9	2660.5	10357	0.44	500	9857	96.7	96.7	1.93	64.1	NT
4	2.08	2 hours	199.972	CB/GW	50	6.5	19.5	187.0	3.7	2660.5	9857	0.451	500	10104	-46.1	50.6	1.01	65.7	NT
4	3.33	3 hours	199.972	CB/GW	50	6.5	26	180.5	3.8	2660.5	10104	0.446	500	9992	20.2	70.8	1.42	64.9	NT
4	4.17	4 hours	199.972	CB/GW	50	6.5	32.5	174.0	3.5	2660.5	9992	0.452	500	10126	-23.4	47.4	0.95	65.8	NT
4	19.67	20 hours	199.972	CB/GW	50	6.5	39	167.5	3.3	2660.5	10126	0.443	500	9925	33.8	81.2	1.62	64.5	NT
4	23.92	24 hours	199.972	CB/GW	50	6.5	45.5	161.0	3.2	2660.5	9925	0.438	500	9813	18.0	99.2	1.98	63.8	NT

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. Repeated 3a-R3 For additional comments, see Laboratory Notebook B000025

MnO4- Calb. Slope: 0.022

Calibration Date: 06/10/98

							Sample Data													pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Reading
5	0	Initial	199.729	AB/GW	50.181	6.5	6.5	199.7	4.0	0	0	NA	NA	10371.2	0.0	0.0	0.00	0.0	NT
5	0.92	1 hour	199.7	AB/GW	50.2	6.5	13	193.2	3.9	2660.8	10371	0.315	500	7057	640.4	640.4	12.76	45.9	NT
5	2.08	2 hours	199.7	AB/GW	50.2	6.5	19.5	186.7	3.7	2660.8	7057	0.449	500	10059	-560.6	79.8	1.59	65.4	NT
5	3.33	3 hours	199.7	AB/GW	50.2	6.5	26	180.2	3.6	2660.8	10059	0.458	500	10281	-36.3	43.5	0.87	66.7	NT
5	4.17	4 hours	199.7	AB/GW	50.2	6.5	32.5	173.7	3.5	2660.8	10261	0.455	500	10193	11.7	55.2	1.10	66.3	NT
5	19.67	20 hours	199.7	AB/GW	50.2	6.5	39	167.2	3.3	2660.8	10193	0.449	500	10059	22.5	77.7	1.55	65.4	NT
5	23.92	24 hours	199.7	AB/GW	50.2	6.5	45.5	160.7	3.2	2660.8	10059	0.45	500	10081	-3.6	74.1	1.48	65.5	NT
6	0	Initial	199.889	AB/GW	50.05	6.5	6.5	199.7	4.0	0	0	NA	NA	10370.2	0.0	0.0	0.00	0.0	NT
6	0.92	1 hour	199.7	AB/GW	50.1	6.5	13	193.2	3.9	2660	10370	0.315	500	7057	640.1	640.1	12.79	45.9	NT
6	2.08	2 hours	199.7	AB/GW	50.1	6.5	19.5	186.7	3.7	2660	7057	0.45	500	10081	-564.6	75.5	1.51	65.5	NT
6	3.33	3 hours	199.7	AB/GW	50.1	6.5	26	180.2	3.6	2660	10081	0.458	500	10261	-32.3	43.2	0.86	66.7	NT
6	4.17	4 hours	199.7	AB/GW	50.1	6.5	32.5	173.7	3.5	2660	10261	0.452	500	10126	23.3	66.5	1.33	65.8	NT
6	19.67	20 hours	199.7	AB/GW	50.1	6.5	39	187.2	3.3	2660	10126	0.45	500	10081	7.5	74.0	1.48	65.5	NT
6	23.92	24 hours	199.7	AB/GW	50.1	6.5	45.5	160.7	3.2	2660	10081	0.445	500	9969	18.0	92.0	1.84	64.8	NT
7	0	Initial	199.742	SED1/GW	50.002	6.5	6.5	199.7	4.0	0	0	NA	NA	10365.8	0.0	0.0	0.00	0.0	NT
7	0.92	1 hour	199.7	SED1/GW	50.0	6.5	13	193.2	3.9	2659.6	10366	0.454	500	10171	37.6	37.6	0.75	66.1	NT
7	2.08	2 hours	199.7	SED1/GW	50.0	6.5	19.5	186.7	3.7	2659.6	10171	0.467	500	10462	-54.4	-16.7	-0.33	68.0	NT
7	3.33	3 hours	199.7	SED1/GW	50.0	6.5	26	180.2	3.6	2659.6	10462	0.455	500	10193	48.5	31.7	0.63	66.3	NT
7	4.17	4 hours	199.7	SED1/GW	50.0	6.5	32.5	173.7	3.5	2659.6	10193	0.457	500	10238	-7.8	23.9	0.48	66.5	NT
7	19.67	20 hours	199.7	SED1/GW	50.0	6.5	39	167.2	3.3	2659.6	10238	0.442	500	9902	56.2	80.1	1.60	64.4	NT
7	23.92	24 hours	199.7	SED1/GW	50.0	6.5	45.5	160.7	3.2	2659.6	9902	0.456	500	10216	-50.4	29.7	0.59	66.4	NT
8	0	Initial	199.642	SED1/GW	50.02	6.5	6.5	199.6	4.0	0	0	NA	NA	10377.8	0.0	0.0	0.00	0.0	NT
8	0.92	1 hour	199.6	SED1/GW	50.0	6.5	13	193.1	3.9	2661.3	10378	0.468	500	10485	-20.6	-20.6	-0.41	68.2	NT
8	2.08	2 hours	199.6	SED1/GW	50.0	6.5	19.5	186.6	3.7	2661.3	10485	0.468	500	10485	0.0	-20.6	-0.41	68.2	NT
8	3.33	3 hours	199.6	SED1/GW	50.0	6.5	26	180.1	3.6	2661.3	10485	0.481	500	10328	28.3	7.6	0.15	67.1	NT
6	4.17	4 hours	199.6	SED1/GW	50.0	6.5	32.5	173.6	3.5	2661.3	10328	0.481	500	10328	0.0	7.6	0.15	67.1	NT
8	19.67	20 hours	199.6	SED1/GW	50.0	6.5	39	167.1	3.3	2661.3	10328	0.445	500	9969	59.9	67.5	1.35	64.8	NT
8	23.92	24 hours	199.6	SED1/GW	50.0	6.5	45.5	160.6	3.2	2661.3	9969	0.453	500	10149	-28.8	38.7	0.77	66.0	NT

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 3b-R1

For additional comments, see RMAL Laboratory Notebook

Comments:

	Total Carbon %		Inorganic Carbon %		TOC %	
Sample	Result	Error	Result	Error	Result	Error
3b-R1-3	4.89	0.489	1.47	0.147	3.42	0.342
3b-R1-4	3.83	0.383	1.19	0.119	2.64	0.264
INEEL Dry	8.11	0.811	1.44	0.144	6.67	0.667

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. 3b-R1 For additional comments, see RMAL Laboratory Notebook

MnO4- Calb. Slope: 0.046

Calibration Date: 5/5/98 5/5/98

Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Sample Data: Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (m	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consume in Interva	Cum. mg Mn Consu	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot	pH Data: pH Reading
1	0.01	Initial	398	GW	0	6.5	6.5	398.0	NA	0.0	0.0	NA	NA	102.2	0.0	0.0	0.00	0.0	7.89
1	0.17	10 min	398	GW	0	6.5	13	391.5	NA	53.1	102.2	in RMAL	5	97.5	1.8	1.8	0.00	0.6	7.93
1	0.80	48 min	398	GW	0	6.5	19.5	385.0	NA	53.1	97.5	in RMAL	5	100.0	-1.0	0.9	0.00	0.7	7.95
1	1.30	1.5 hours	398	GW	0	6.5	26	378.5	NA	53.1	100.0	in RMAL	5	100.0	0.0	0.9	0.00	0.7	8.00
1	2.30	2.5 hours	398	GW	0	6.5	32.5	372.0	NA	53.1	100.0	in RMAL	5	101.0	-0.4	0.5	0.00	0.7	8.03
1	5.00	5 hours	398	GW	0	6.5	39	365.5	NA	53.1	101.0	in RMAL	5	100.5	0.2	0.7	0.00	0.7	8.02
1	24.00	24 hours	398	GW	0	6.5	45.5	359.0	NA	53.1	100.5	in RMAL	5	101.0	-0.2	0.5	0.00	0.7	8.17
2	0	Initial	401	GW	0	6.5	6.5	401.0	NA	0.0	0.0	NA	NA	101.2	0.0	0.0	0.00	0.0	7.89
2	0.17	10 min	401	GW	0	6.5	13	394.5	NA	53.0	101.2	in RMAL	5	86.0	6.0	6.0	0.01	0.6	7.98
2	0.80	48 min	401	GW	0	6.5	19.5	388.0	NA	53.0	86.0	in RMAL	5	100.0	-5.4	0.6	0.00	0.7	7.98
2	1.30	1.5 hours	401	GW	0	6.5	26	381.5	NA	53.0	100.0	in RMAL	5	100.0	0.0	0.6	0.00	0.7	8.00
2	2.30	2.5 hours	401	GW	0	6.5	32.5	375.0	NA	53.0	100.0	in RMAL	5	100.0	0.0	0.6	0.00	0.7	8.03
2	5.00	5 hours	401	GW	0	6.5	39	368.5	NA	53.0	100.0	in RMAL	5	99.5	0.2	0.7	0.00	0.6	8.05
2	24.00	24 hours	401	GW	0	6.5	45.5	362.0	NA	53.0	99.5	in RMAL	5	99.0	0.2	0.9	0.00	0.6	8.25
3	0.01	Initial	403	TSF Sludge	107	6.5	6.5	403.0	3.8	0.0	0.0	NA	NA	101.4	0.0	0.0	0.00	0.0	7.10
3	0.17	10 min	403	TSF Sludge	107	6.5	13	396.5	3.7	53.4	101.4	in RMAL	5	0.0	40.2	40.2	0.38	0.0	6.94
3	0.80	48 min	403	TSF Sludge	107	6.5	19.5	390.0	3.6	53.4	0.0	in RMAL	5	0.0	0.0	40.2	0.38	0.0	6.75
3	1.30	1.5 hours	403	TSF Sludge	107	6.5	28	383.5	3.6	53.4	0.0	in RMAL	5	0.0	0.0	40.2	0.38	0.0	6.73
3	2.30	2.5 hours	403	TSF Sludge	107	6.5	32.5	377.0	3.5	53.4	0.0	in RMAL	5	0.0	0.0	40.2	0.38	0.0	6.64
3	5.00	5 hours	403	TSF Sludge	107	6.5	39	370.5	3.5	53.4	0.0	in RMAL	5	0.0	0.0	40.2	0.38	0.0	6.62
3	24.00	24 hours	403	TSF Sludge	107	6.5	45.5	364.0	3.4	53.4	0.0	in RMAL	5	0.0	0.0	40.2	0.38	0.0	6.59
4	0	Initial	396	TSF Sludge	112	6.5	6.5	396.0	3.5	0.0	0.0	NA	NA	101.9	0.0	0.0	0.00	0.0	7.66
4	0.17	10 min	396	TSF Sludge	112	6.5	13	389.5	3.5	52.7	101.9	in RMAL	5	0.0	39.7	39.7	0.35	0.0	7.22
4	0.80	48 min	396	TSF Sludge	112	6.5	19.5	383.0	3.4	52.7	0.0	in RMAL	5	0.0	0.0	39.7	0.35	0.0	7.18
4	1.30	1.5 hours	396	TSF Sludge	112	6.5	26	376.5	3.4	52.7	0.0	in RMAL	5	0.0	0.0	39.7	0.35	0.0	7.19
4	2.30	2.5 hours	396	TSF Sludge	112	6.5	32.5	370.0	3.3	52.7	0.0	in RMAL	5	0.0	0.0	39.7	0.35	0.0	7.11
4	5.00	5 hours	396	TSF Sludge	112	6.5	39	363.5	3.2	52.7	0.0	in RMAL	5	0.0	0.0	39.7	0.35	0.0	7.13
4	24.00	24 hours	396	TSF Sludge	112	6.5	45.5	357.0	3.2	52.7	0.0	in RMAL	5	0.0	0.0	39.7	0.35	0.0	7.18

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 3b-R2

For additional comments, see RMAL Laboratory Notebook

Experiment Start Date: 5/7/98

Comments:

	Total Carbon %		Inorganic Carbon %		TOC %	
Sample	Result	Error	Result	Error	Result	Error
3b-R2-3	3.04	0.304	0.673	0.0673	2.367	0.2367
3b-R2-4	2.42	0.242	1.12	0.112	1.3	0.13
INEEL Dry	8.11	0.811	1.44	0.144	6.67	0.667

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Exp. 3b-R2 For additional comments, see RMAL Laboratory Notebook

MnO4- Calb. Slope: 0.046

Calibration Date: 5/5/98 5/5/98

								Sample Data												pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot		pH Reading
1	0.01	Initial	399	GW	0	6.5	6.5	399.0	NA	0.0	0.0	NA	NA	1016.4	0.0	0.0	0.00	0.0		7.89
1	0.17	10 min	399	GW	0	6.5	13	392.5	NA	529.7	1016.4	in RMAL	50	825.0	75.1	75.1	0.19	5.4		8.05
1	0.80	48 min	399	GW	0	6.5	19.5	386.0	NA	529.7	825.0	in RMAL	50	985.0	-61.8	13.4	0.03	6.4		8.07
1	1.30	1.5 hours	399	GW	0	6.5	26	379.5	NA	529.7	985.0	in RMAL	50	1000.0	-5.7	7.7	0.02	6.5		8.08
1	2.30	2.5 hours	399	GW	0	6.5	32.5	373.0	NA	529.7	1000.0	in RMAL	50	1000.0	0.0	7.7	0.02	6.5		8.09
1	5.00	5 hours	399	GW	0	6.5	39	366.5	NA	529.7	1000.0	in RMAL	50	995.0	1.8	9.5	0.02	6.5		8.09
1	24.00	24 hours	399	GW	0	6.5	45.5	360.0	NA	529.7	995.0	in RMAL	50	975.0	7.2	16.7	0.04	6.3		8.27
2	0	Initial	396	GW	0	6.5	6.5	396.0	NA	0.0	0.0	NA	NA	1016.5	0.0	0.0	0.00	0.0		7.89
2	0.17	10 min	396	GW	0	6.5	13	389.5	NA	525.7	1016.5	in RMAL	50	765.0	90.2	90.2	0.23	5.1		8.05
2	0.80	48 min	396	GW	0	6.5	19.5	383.0	NA	525.7	765.0	in RMAL	50	980.0	-74.7	15.5	0.04	6.4		8.05
2	1.30	1.5 hours	396	GW	0	6.5	26	376.5	NA	525.7	980.0	in RMAL	50	1000.0	-7.5	8.0	0.02	6.5		8.08
2	2.30	2.5 hours	396	GW	0	6.5	32.5	370.0	NA	525.7	1000.0	in RMAL	50	1005.0	-1.9	6.1	0.02	6.5		8.10
2	5.00	5 hours	396	GW	0	6.5	39	363.5	NA	525.7	1005.0	in RMAL	50	995.0	3.6	9.8	0.02	6.5		8.12
2	24.00	24 hours	396	GW	0	6.5	45.5	357.0	NA	525.7	995.0	in RMAL	50	1010.0	-5.4	4.4	0.01	6.6		8.16
3	0.01	Initial	397	TSF Sludge	107	6.5	6.5	397.0	3.7	0.0	0.0	NA	NA	1016.6	0.0	0.0	0.00	0.0		7.38
3	0.17	10 min	397	TSF Sludge	107	6.5	13	390.5	3.6	527.1	1016.6	in RMAL	50	0.0	397.0	397.0	3.71	0.0		7.00
3	0.80	48 min	397	TSF Sludge	107	6.5	19.5	384.0	3.6	527.1	0.0	in RMAL	50	0.0	0.0	397.0	3.71	0.0		7.01
3	1.30	1.5 hours	397	TSF Sludge	107	6.5	26	377.5	3.5	527.1	0.0	in RMAL	50	0.0	0.0	397.0	3.71	0.0		7.01
3	2.30	2.5 hours	397	TSF Sludge	107	6.5	32.5	371.0	3.5	527.1	0.0	in RMAL	50	0.0	0.0	397.0	3.71	0.0		7.00
3	5.00	5 hours	397	TSF Sludge	107	6.5	39	364.5	3.4	527.1	0.0	in RMAL	50	0.0	0.0	397.0	3.71	0.0		7.04
3	24.00	24 hours	397	CB/GW	107	6.5	45.5	358.0	3.3	527.1	0.0	in RMAL	50	0.0	0.0	397.0	3.71	0.0		7.06
4	0	Initial	393	TSF Sludge	117	6.5	6.5	393.0	3.4	0.0	0.0	NA	NA	1017.4	0.0	0.0	0.00	0.0		7.33
4	0.17	10 min	393	TSF Sludge	117	6.5	13	386.5	3.3	522.1	1017.4	in RMAL	50	0.0	393.2	393.2	3.36	0.0		7.00
4	0.80	48 min	393	TSF Sludge	117	6.5	19.5	380.0	3.2	522.1	0.0	in RMAL	50	0.0	0.0	393.2	3.36	0.0		6.94
4	1.30	1.5 hours	393	TSF Sludge	117	6.5	26	373.5	3.2	522.1	0.0	in RMAL	50	0.0	0.0	393.2	3.36	0.0		6.96
4	2.30	2.5 hours	393	TSF Sludge	117	6.5	32.5	367.0	3.1	522.1	0.0	in RMAL	50	0.0	0.0	393.2	3.36	0.0		6.93
4	5.00	5 hours	393	TSF Sludge	117	6.5	39	360.5	3.1	522.1	0.0	in RMAL	50	0.0	0.0	393.2	3.36	0.0		6.96
4	24.00	24 hours	393	CB/GW	117	6.5	45.5	354.0	3.0	522.1	0.0	in RMAL	50	0.0	0.0	393.2	3.36	0.0		7.03

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 3b-R3 For additional comments, see RMAL Laboratory Notebook

Experiment Start Date: 5/7/98

Comments:

	Total Carbon %		Inorganic Carbon %		TOC %	
Sample	Result	Error	Result	Error	Result	Error
3b-R3-3	1.75	0.175	0.835	0.0835	0.915	0.0915
3b-R3-4	2.29	0.229	2.26	0.226	0.03	0.003
INEEL Dry	8.11	0.611	1.44	0.144	6.67	0.667

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. 3b-R3 For additional comments, see RMAL Laboratory Notebook

MnO4- Calb. Slope: 0.046

Calibration Date: 5/5/98 5/5/98

							Sample Data														pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot			pH Reading
1	0.01	Initial	399	GW	0	6.5	6.5	399.0	NA	0.0	0.0	NA	NA	10167.4	0.0	0.0	0.00	0.0			7.89
1	0.17	10 min	399	GW	0	6.5	13	392.5	NA	5298.8	10187.4	in RMAL	500	10200.0	-12.8	-12.8	-0.03	66.3			8.60
1	0.50	30 min	399	GW	0	6.5	19.5	386.0	NA	5298.6	10200.0	in RMAL	500	10200.0	0.0	-12.8	-0.03	66.3			8.64
1	1.00	1 hour	399	GW	0	6.5	26	379.5	NA	5298.6	10200.0	in RMAL	500	10300.0	-38.0	-50.7	-0.13	67.0			8.64
1	2.00	2.5 hours	399	GW	0	6.5	32.5	373.0	NA	5298.6	10300.0	in RMAL	500	10200.0	37.3	-13.4	-0.03	66.3			8.66
1	4.00	4hours	399	GW	0	6.5	39	366.5	NA	5298.6	10200.0	in RMAL	500	10150.0	18.3	4.9	0.01	66.0			8.64
1	24.00	24 hours	399	GW	0	6.5	45.5	360.0	NA	5298.6	10150.0	in RMAL	500	10250.0	-36.0	-31.1	-0.08	66.6			8.65
2	0.01	Initial	399	GW	0	6.5	6.5	399.0	NA	0.0	0.0	NA	NA	10187.6	0.0	0.0	0.00	0.0			7.97
2	0.17	10 min	399	GW	0	6.5	13	392.5	NA	5298.7	10167.6	in RMAL	500	10150.0	6.9	6.9	0.02	66.0			8.66
2	0.50	30 min	399	GW	0	6.5	19.5	386.0	NA	5298.7	10150.0	in RMAL	500	10250.0	-38.6	-31.7	-0.08	66.6			8.64
2	1.00	1 hour	399	GW	0	6.5	26	379.5	NA	5298.7	10250.0	in RMAL	500	10350.0	-38.0	-69.6	-0.17	67.3			8.69
2	2.00	2.5 hours	399	GW	0	6.5	32.5	373.0	NA	5298.7	10350.0	in RMAL	500	10250.0	37.3	-32.3	-0.08	66.6			8.69
2	4.00	4hours	399	GW	0	6.5	39	366.5	NA	5298.7	10250.0	in RMAL	500	10300.0	-18.3	-50.7	-0.13	67.0			8.69
2	24.00	24 hours	399	GW	0	6.5	45.5	360.0	NA	5298.7	10300.0	in RMAL	500	10250.0	18.0	-32.7	-0.08	66.6			8.65
3	0.01	Initial	401	TSF Sludge	103	6.5	6.5	401.0	3.9	0.0	0.0	NA	NA	10166.9	0.0	0.0	0.00	0.0			7.82
3	0.17	10 min	401	TSF Sludge	103	6.5	13	394.5	3.8	5325.3	10166.9	in RMAL	500	5900.0	1683.3	1683.3	16.34	38.4	Consumption Rate		7.27
3	0.50	30 min	401	TSF Sludge	103	6.5	19.5	388.0	3.8	5325.3	5900.0	in RMAL	500	6550.0	-252.2	1431.1	13.89	42.6	mg/hr		7.48
3	1.00	1 hour	401	TSF Sludge	103	6.5	26	381.5	3.7	5325.3	6550.0	in RMAL	500	5550.0	381.5	1812.6	17.60	36.1	763		7.64
3	2.00	2.5 hours	401	TSF Sludge	103	6.5	32.5	375.0	3.6	5325.3	5550.0	in RMAL	500	4450.0	412.5	2225.1	21.60	28.9	412.5		7.75
3	4.00	4hours	401	TSF Sludge	103	6.5	39	368.5	3.6	5325.3	4450.0	in RMAL	500	3165.0	473.5	2698.6	26.20	20.6	236.76		7.95
3	24.00	24 hours	401	CB/GW	103	6.5	45.5	362.0	3.5	5325.3	3165.0	in RMAL	20	302.0	1036.4	3735.0	36.26	2.0	51.82		8.00
4	0	Initial	402	TSF Sludge	106	6.5	6.5	402.0	3.8	0.0	0.0	NA	NA	10166.3	0.0	0.0	0.00	0.0			7.71
4	0.17	10 min	402	TSF Sludge	106	6.5	13	395.5	3.7	5338.5	10168.3	in RMAL	500	5450.0	1865.3	1865.3	17.60	35.4	Consumption Rate		8.34
4	0.50	30 min	402	TSF Sludge	106	6.5	19.5	389.0	3.7	5338.5	5450.0	in RMAL	500	5900.0	-175.1	1690.2	15.95	38.4	mg/hr		7.49
4	1.00	1 hour	402	TSF Sludge	106	6.5	26	382.5	3.6	5338.5	5900.0	in RMAL	500	4565.0	510.6	2200.9	20.76	29.7	1021.3		7.66
4	2.00	2.5 hours	402	TSF Sludge	106	6.5	32.5	376.0	3.5	5338.5	4565.0	in RMAL	500	3230.0	502.0	2702.8	25.50	21.0	501.96		7.81
4	4.00	4hours	402	TSF Sludge	106	6.5	39	369.5	3.5	5338.5	3230.0	in RMAL	500	1905.0	489.6	3192.4	30.12	12.4	244.79		7.94
4	24.00	24 hours	402	CB/GW	106	6.5	45.5	363.0	3.4	5338.5	1905.0	in RMAL	5	0.0	691.5	3883.9	36.64	0.0	34.576		7.94

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 3b-R4 For additional comments, see RMAL Laboratory Notebook

Experiment Start Date: 5/7/98

Comments:

	Total Carbon %		Inorganic Carbon %		TOC %	
Sample	Result	Error	Result	Error	Result	Error
3b-R4-3	1.35	0.135	0.474	0.0474	0.876	0.0876
3b-R4-4	1.51	0.151	0.406	0.0406	1.104	0.1104
INEEL Dry	8.11	0.811	1.44	0.144	6.67	0.667

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Exp. 3b-R4 For additional comments, see RMAL Laboratory Notebook

MnO4- Calb. Slope: 0.046

Calibration Date: 5/5/98 5/5/98

							Sample Data													pH Data
Flask No.	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Mass KMnO4 Added (n	Initial MnO4- (mg/L)	Aliquot MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4 per g or mL	mg MnO4- in Aliquot		pH Reading
1	0.01	Initial	400	GW	0	6.5	6.5	400.0	NA	0.0	0	NA	NA	30502	0.0	0.0	0.00	0.0		8.07
1	0.17	10 min	400	GW	0	6.5	13	393.5	NA	15936.4	30502	in RMAL	2000	30000.0	197.7	197.7	0.49	195.0		9.00
1	0.50	30 min	400	GW	0	6.5	19.5	387.0	NA	15936.4	30000	in RMAL	2000	30200.0	-77.4	120.3	0.30	196.3		9.00
1	1.00	1 hour	400	GW	0	6.5	26	380.5	NA	15936.4	30200	in RMAL	2000	30200.0	0.0	120.3	0.30	196.3		9.01
1	2.00	2 hours	400	GW	0	6.5	32.5	374.0	NA	15936.4	30200	in RMAL	2000	30400.0	-74.8	45.5	0.11	197.6		8.99
1	4.00	4hours	400	GW	0	6.5	39	367.5	NA	15936.4	30400	in RMAL	2000	30400.0	0.0	45.5	0.11	197.6		9.00
1	24.00	24 hours	400	GW	0	6.5	45.5	361.0	NA	15936.4	30400	in RMAL	2000	30200.0	72.2	117.7	0.29	196.3		8.97
2	0.01	Initial	399	GW	0	6.5	6.5	399.0	NA	0.0	0	NA	NA	30504	0.0	0.0	0.00	0.0		8.10
2	0.17	10 min	399	GW	0	6.5	13	392.5	NA	15896.5	30504	in RMAL	2000	30400.0	40.7	40.7	0.10	197.6		9.00
2	0.50	30 min	399	GW	0	6.5	19.5	386.0	NA	15896.5	30400	in RMAL	2000	30600.0	-77.2	-36.5	-0.09	198.9		8.99
2	1.00	1 hour	399	GW	0	6.5	26	379.5	NA	15896.5	30600	in RMAL	2000	30600.0	0.0	-36.5	-0.09	198.9		9.01
2	2.00	2 hours	399	GW	0	6.5	32.5	373.0	NA	15896.5	30600	in RMAL	2000	30800.0	-74.6	-111.1	-0.28	200.2		9.01
2	4.00	4hours	399	GW	0	6.5	39	366.5	NA	15896.5	30800	in RMAL	2000	30800.0	0.0	-111.1	-0.28	200.2		9.00
2	24.00	24 hours	399	GW	0	6.5	45.5	360.0	NA	15896.5	30800	in RMAL	2000	30600.0	72.0	-39.1	-0.10	198.9		8.96
3	0.01	Initial	398	TSF Sludge	105	6.5	6.5	398.0	3.8	0.0	0	NA	NA	30505	0.0	0.0	0.00	0.0		7.90
3	0.17	10 min	398	TSF Sludge	105	6.5	13	391.5	3.7	15856.7	30505	in RMAL	2000	17440.0	5114.9	5114.9	48.71	113.4	Consumption Rate	7.60
3	0.50	30 min	398	TSF Sludge	105	6.5	19.5	385.0	3.7	15856.7	17440	in RMAL	2000	19020.0	-608.3	4506.6	42.92	123.6	mg/hr	7.49
3	1.00	1 hour	398	TSF Sludge	105	6.5	26	378.5	3.6	15856.7	19020	in RMAL	2000	23800.0	-1809.2	2697.4	25.69	154.7		7.51
3	2.00	2 hours	398	TSF Sludge	105	6.5	32.5	372.0	3.5	15856.7	23800	in RMAL	2000	22000.0	669.6	3367.0	32.07	143.0	669.6	7.79
3	4.00	4hours	398	TSF Sludge	105	6.5	39	365.5	3.5	15856.7	22000	in RMAL	2000	18060.0	1440.1	4807.1	45.78	117.4	720.04	7.91
3	24.00	24 hours	398	CB/GW	105	6.5	45.5	359.0	3.4	15856.7	18060	in RMAL	2000	9700.0	3001.2	7808.3	74.36	63.1	150.06	8.27
3	95.17	96 hours	398	CB/GW	105	6.5	52	352.5	3.4	15856.7	9700	in RMAL	200	2480.0	2545.1	10353.4	98.60	16.1	35.762	
4	0	Initial	399	TSF Sludge	104	6.5	6.5	399.0	3.8	0.0	0	NA	NA	30504	0.0	0.0	0.00	0.0		7.65
4	0.17	10 min	399	TSF Sludge	104	6.5	13	392.5	3.8	15896.5	30504	in RMAL	2000	21200.0	3651.7	3651.7	35.11	137.8	Consumption Rate	7.45
4	0.50	30 min	399	TSF Sludge	104	6.5	19.5	386.0	3.7	15896.5	21200	in RMAL	2000	23600.0	-926.4	2725.3	26.20	153.4	mg/hr	7.44
4	1.00	1 hour	399	TSF Sludge	104	6.5	26	379.5	3.6	15896.5	23600	in RMAL	2000	25200.0	-607.2	2118.1	20.37	163.8		7.56
4	2.00	2 hours	399	TSF Sludge	104	6.5	32.5	373.0	3.6	15896.5	25200	in RMAL	2000	23200.0	746.0	2864.1	27.54	150.8	746	7.73
4	4.00	4hours	399	TSF Sludge	104	6.5	39	366.5	3.5	15896.5	23200	in RMAL	2000	20400.0	1026.2	3890.3	37.41	132.6	513.1	7.91
4	24.00	24 hours	399	CB/GW	104	6.5	45.5	360.0	3.5	15896.5	20400	in RMAL	2000	14040.0	2289.6	6179.9	59.42	91.3	114.48	8.09
4	94.87	96 hours	399	CB/GW	104	6.5	52	353.5	3.4	15896.5	14040	in RMAL	200	7560.0	2290.7	8470.6	81.45	49.1	32.415	8.21

Prepared by: S.R. Cline

LastUpdated: 11/3/98

1	2	3	4	5	6	7	8	9	10	11
[illegible]							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio

Date and Time Sample Aliquot is Collected

Time elapsed since oxidation addition (T=0)

Unique Sample ID. (Task#-Run#-Time-Reactor#-a/b)

Where a&b represent duplicate samples if applicable

Initial Amt added *(determined gravimetrically assuming spg=1)*

Desc. Of Reactor Contents

Amt of solid phase TAN site *material added (Gravimetric Determination)*

ESD: Determined Gravimetrically RMAL: Assumed 10 mL collected

Running total of aliquot volume removed from each reactor

Col 5/Col 7 *(Assumed that mass of solid withdrawn in aliquot was neglible)*

Computed for each sampling interval as: Col 5-Col 9+Col 12

(col 9 from prev. sampling period; Col 12 not used for 1% & 3% MnO4 loadings)

12 13 14 15 16 17 18 19 20 21

MnO4- Calb. Slope: *slope* STOCK SOLUTION ABS or CONC: DF: *DF of Stock* CONC: *Stock Conc.*

Calibration Date: 4/8/98

Diluted Sample, ABS for ESD, Conc for RMAL

MnO4- Data									pH Data
Volume Stock MnO4- Added (mL)	Initial MnO4- (mg/L)	Final MnO4- ABS or Conc.	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4- per gram	mg MnO4- in Aliquot	pH

1.25 mL or 12.5 mL for 0.01% or 0.1% MnO_4 loadings *(calb. Pipette)*

This is the conc. at the beginning of each sampling interval.
@ T=0: 0

@ T=0.5hr:
(Col 12x*Stock Conc.*/[Col 5-(Col 9 @ T=0)+Col 12]
(Stock Conc at top of page)

@ All Other Sampling Periods: Col 16 of previous sampling Period

Dilution Factor used on Spec. Sample.

ESD:
Measured Absorbance
RMAL:
Measured Conc.

(Col 16 -Col 13) x Col 10

Running total of oxidant mass consumed from each reactor

Actual Conc. of Aliquot
ESD:
(Col 14/slope)xCol 15
RMAL:
Col 14 x Col 15
(Slope at top of page)

Col 18/Col 7
(Assumed that mass of solid withdrawn in aliquot was neglible)

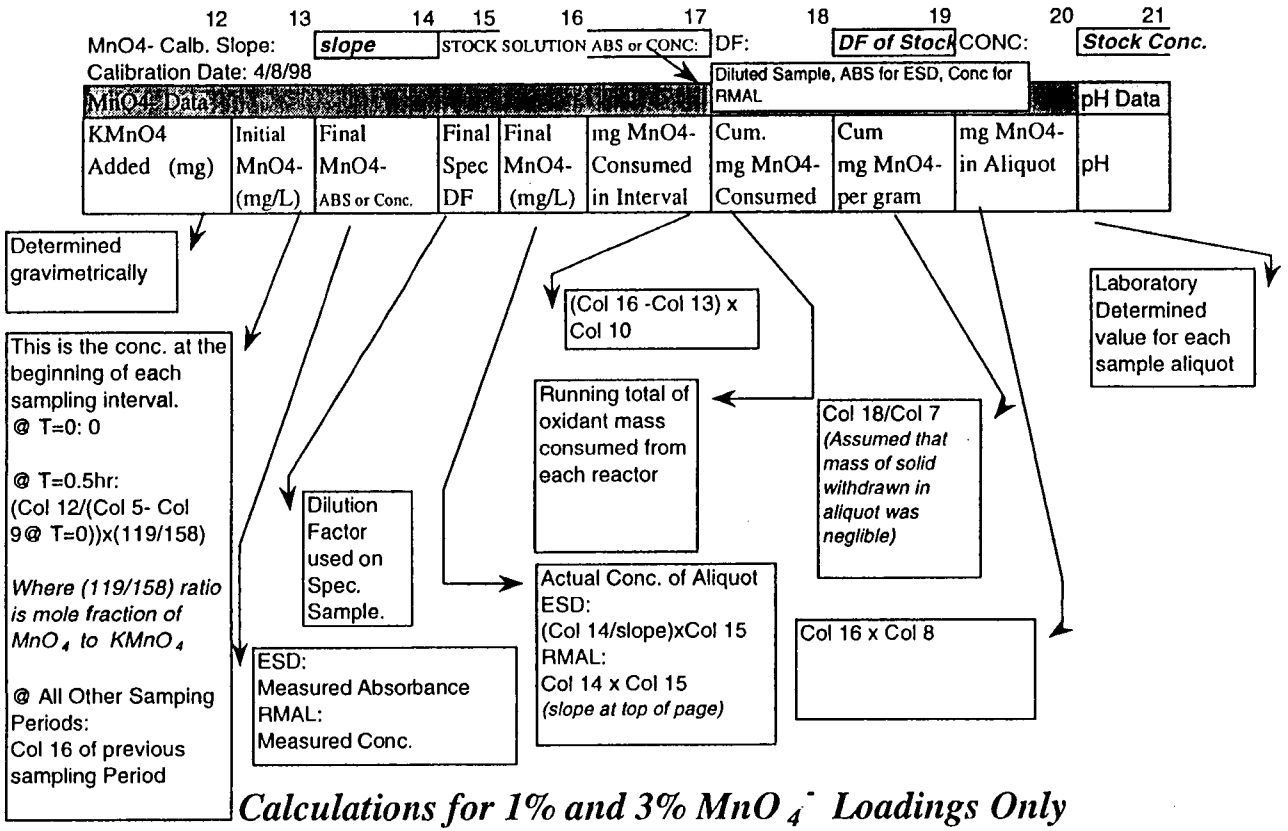
Col 16 x Col 8

Laboratory Determined value for each sample aliquot

Calculations for 0.01% and 0.1% MnO_4^- Loadings Only

Prepared by: S.R. Cline

Last Updated: 11/8/98



Calculations for 1% and 3% MnO_4^- Loadings Only

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init Aq TCE Oxidized In Interval	% of Total TCE Oxidized In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot	%Diff	AVG (ppb)	STDEV (ppb)

Unique number for each GC sample

Actual Conc. of the Aliquot

This value is linked from the GC data files and represents: (GC Area Count/AVG CF)x DF

Qualifer if GC sample value is not within calibration
U=t< Min. Detect

Volume used to extract a portion of the aliquot sample (Col 26)
(determined gravimetrically and corrected for spec. gravity of hexane=0.66)

Portion of Aliquot extracted
(determined gravimetrically)

Col 23/Ratio where Ratio= (Col 25/Col 26)

Same as Col 24

For Each Reactor: $Col27_{T=x}/Col27_{T=0}$

For Each Reactor:
@T=0; 0

@ all other T=x sample collection times:
$(Col\ 27_{T=x-1}-Col\ 27_{T=x})$x Col 10

Running Total of Mass Oxidized (Col 30 from each reactor

100 x ($Col\ 30_{T=x}$/Initial Aqueous TCE)

Where Initial Aqueous= Values in Mass Balance Tables in Report
(computed differently for each type of experiment as described in report text)

100 x ($Col\ 30_{T=x}$/Total Initial TCE)

where Total Initial= Values in Mass Balance Tables in Report
(computed differently for each type of experiment as described in report text)

Running Total of Col 33

Col 27x Col 8
Note: Assumes that concentration of duplicate samples are identical (Variation of dupicates is computed in next columns)

%Diff of Duplicate Samples:
$(Col\ 27_a-Col\ 27_b)/Col\ 27_a$
Where a&b represent duplicate aliquot samples from a given reactor

Average Value of Col 27_a & Col 27_b

Standard deviation of Col 27_a & Col 27_b

Prepared by: S.R. Cline

Last Updated: 11/8/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R1 For additional comments, see Laboratory Notebook B000025 Pages: 61-65

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	100	NO	0.01 & 0.1

Experiment Start Date: 5/20/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
Step 9 not performed for this run since in only involves groundwater

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	3.21 liters	
Volume Sat. TCE added	0.3 mL	
	0.3 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	93 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
352	4AR1TBA	5/26/98 8:45	223		4.71	5.50	191
353	4AR1TBB	5/26/98 8:45	211		4.88	5.47	188

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R1	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Samplin	Ratio
1	5/26/98 13:45	0.0	4AR1T01A	**538.35**	GW Only	**0**	14	14	538.35	NA
1	5/26/98 14:25	0.7	4AR1T30MIN1	538.35	GW Only	0	7	21	524.35	NA
1	5/26/98 15:24	1.7	4AR1T1.5H1	538.35	GW Only	0	7	28	517.35	NA
1	5/26/98 16:55	3.2	4AR1T3H1	538.35	GW Only	0	7	35	510.35	NA
1	5/26/98 18:54	5.2	4AR1T5H1	538.35	GW Only	0	7	42	503.35	NA
1	5/27/98 8:45	19.0	4AR1T20H1	538.35	GW Only	0	7	49	496.35	NA
1	5/27/98 13:45	24.0	4AR1T24H1A	538.35	GW Only	0	14	63	489.35	NA
2	5/26/98 13:48	0.0	4AR1T02	**519.43**	GW Only	**0**	7	7	519.43	NA
2	5/26/98 14:27	0.7	4AR1T30MIN2A	519.43	GW Only	0	14	21	512.43	NA
2	5/26/98 15:25	1.6	4AR1T1.5H2	519.43	GW Only	0	7	28	498.43	NA
2	5/26/98 16:57	3.2	4AR1T3H2	519.43	GW Only	0	7	35	491.43	NA
2	5/26/98 18:59	5.2	4AR1T5H2	519.43	GW Only	0	7	42	484.43	NA
2	5/27/98 8:46	19.0	4AR1T20H2	519.43	GW Only	0	7	49	477.43	NA
2	5/27/98 13:47	24.0	4AR1T24H2	519.43	GW Only	0	7	56	470.43	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	4a-R1	For additional comments, see Laboratory Notebook B000025								
	MnO4- Calb. Slope:		0.019	STOCK SC	0.364	DF:	2500	CONC:	Conc (ppm):	
	Calibration Date: 4/8/98									
	[redacted]									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	0.003	1	NA	NA	NA	NA	NA	7.89
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.12
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.10
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.09
1	0	0	NT	NT	NA	NA	NA	NA	NA	8.09
1	0	0	NT	NT	NA	NA	NA	NA	NA	8.14
1	0	0	0.007	1	NA	NA	NA	NA	NA	8.15
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.001	1	NA	NA	NA	NA	NA	8.11
2	0	0	0.000	1	NA	NA	NA	NA	NA	8.10
2	0	0	0.001	1	NA	NA	NA	NA	NA	8.09
2	0	0	NT	NT	NA	NA	NA	NA	NA	8.15
2	0	0	NT	NT	NA	NA	NA	NA	NA	8.16
2	0	0	0.001	1	NA	NA	NA	NA	NA	8.18

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R I	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	354	196		2.88	3.33	169		NA	NA	NA	NA	NA	NA	0.00
1	361	212		2.71	3.44	167		NA	NA	NA	NA	NA	NA	0.00
1	368	214		2.92	3.70	169		NA	NA	NA	NA	NA	NA	0.00
1	375	184		2.73	3.02	167		NA	NA	NA	NA	NA	NA	0.00
1	382	170		2.88	3.10	158		NA	NA	NA	NA	NA	NA	0.00
1	389	142		3.31	2.78	170		NA	NA	NA	NA	NA	NA	0.00
1	396R	180		3.2	3.33	173		NA	NA	NA	NA	NA	NA	0.00
2	356	200		2.85	3.36	170		NA	NA	NA	NA	NA	NA	0.00
2	362	207		2.73	3.20	177		NA	NA	NA	NA	NA	NA	0.00
2	369	188		2.90	3.08	176		NA	NA	NA	NA	NA	NA	0.00
2	376	192		2.95	3.24	176		NA	NA	NA	NA	NA	NA	0.00
2	383	166		3.09	2.90	177		NA	NA	NA	NA	NA	NA	0.00
2	390	173		3.16	3.07	178		NA	NA	NA	NA	NA	NA	0.00
2	398R	171		2.97	3.24	156		NA	NA	NA	NA	NA	NA	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	4a-R1	For additional comments, see Laboratory Notebook B000025								
	MnO4- Calb. Slope:		0.019	STOCK SO	0.364	DF:	2500	CONC:	Conc (ppm):	
	Calibration Date: 4/8/98									
	MnO4 Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0.0	0.003	1	114.7	0	0	0.00	0	8.13
3	1.25	114.7	0.380	5	99.7	8	8	0.01	0.7	8.11
3	1.25	99.7	0.386	5	101.3	-1	7	0.01	1.4	8.12
3	1.25	101.3	0.366	5	96.0	3	10	0.02	0.7	8.10
3	1.25	96.0	0.371	5	97.3	-1	9	0.02	0.7	8.14
3	1.25	97.3	0.361	5	94.7	1	10	0.02	0.7	8.16
3	1.25	94.7	0.361	5	94.7	0	10	0.02	0.7	8.15
4	0	0.0	0.002	1	114.6	0	0	0.00	0	8.13
4	1.25	114.6	0.402	5	105.5	5	5	0.01	0.7	8.10
4	1.25	105.5	0.408	5	107.0	-1	4	0.01	0.7	8.10
4	1.25	107.0	0.394	5	103.4	2	6	0.01	1.4	8.11
4	1.25	103.4	0.393	5	103.1	0	6	0.01	0.7	8.09
4	1.25	103.1	0.391	5	102.6	0	6	0.01	0.7	8.14
4	1.25	102.6	0.388	5	101.8	0	7	0.01	0.7	8.13

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R1	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	357	217		2.86	3.56	174		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
3	364	35		2.81	3.01	33		0.19	0.1	0.1	80.1%	80.1%	80.1%	0.00
3	370	14		3.10	3.28	13			0	0.1	11.1%	11.1%	91.2%	0.00
3	377	0		1.58	3.28	1			0	0.1	6.7%	6.7%	97.9%	0.00
3	384	0		3.06	3.20	1		0.01	0.0	0.1	0.0%	0.0%	97.9%	0.00
3	391	0		3.20	3.21	1		0.01	0.0	0.1	0.0%	0.0%	97.9%	0.00
3	399	0		3.17	3.12	1		0.01	0.0	0.1	0.0%	0.0%	97.9%	0.00
4	358	216		2.85	3.40	181		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
4	365	28		2.81	2.92	27		0.15	0.1	0.1	83.9%	83.9%	83.9%	0.00
4	372	14		2.91	3.31	12		0.07	0.0	0.1	8.2%	8.2%	92.1%	0.00
4	378	0		3.04	3.06	1		0.01	0.0	0.1	5.9%	5.9%	98.1%	0.00
4	385	0		3.02	3.11	1		0.01	0.0	0.1	0.0%	0.0%	98.1%	0.00
4	392	0		3.20	3.08	1		0.01	0.0	0.1	0.0%	0.0%	98.1%	0.00
4	400	0		3.14	2.95	1		0.01	0.0	0.1	0.0%	0.0%	98.1%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R1	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Samplin	Ratio
5	5/26/98 13:53	0.0	4AR1T05	**541.98**	GW Only	**0**	7	7	541.98	NA
5	5/26/98 14:33	0.7	4AR1T30MIN5	541.98	GW Only	0	7	14	547.48	NA
5	5/26/98 15:32	1.6	4AR1T1.5H5	541.98	GW Only	0	7	21	540.48	NA
5	5/26/98 17:03	3.2	4AR1T3H5	541.98	GW Only	0	7	28	533.48	NA
5	5/26/98 19:06	5.2	4AR1T5H5A	541.98	GW Only	0	14	42	526.48	NA
5	5/27/98 8:49	18.9	4AR1T20H5	541.98	GW Only	0	7	49	512.48	NA
5	5/27/98 13:50	24.0	4AR1T24H5	541.98	GW Only	0	7	56	505.48	NA
6	5/26/98 13:54	0.0	4AR1T06	**530.82**	GW Only	**0**	7	7	530.82	NA
6	5/26/98 14:35	0.7	4AR1T30MIN6	530.82	GW Only	0	7	14	536.32	NA
6	5/26/98 15:34	1.7	4AR1T1.5H6	530.82	GW Only	0	7	21	529.32	NA
6	5/26/98 17:05	3.2	4AR1T3H6	530.82	GW Only	0	7	28	522.32	NA
6	5/26/98 19:12	5.3	4AR1T5H6	530.82	GW Only	0	7	35	515.32	NA
6	5/27/98 8:50	18.9	4AR1T20H6A	530.82	GW Only	0	14	49	508.32	NA
6	5/27/98 13:51	23.9	4AR1T24H6	530.82	GW Only	0	7	56	494.32	NA

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	4a-R1	For additional comments, see Laboratory Notebook B000025								
	MnO4- Calb. Slope:		0.019	STOCK SO	0.364	DF:	2500	CONC:	Conc (ppm):	
	Calibration Date: 4/8/98									
	MnO4 Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
5	0	0.0	0.010	1	1090.2	0	0	0.00	0	8.13
5	12.5	1090.2	0.398	50	1044.1	25	25	0.05	7.3	8.18
5	12.5	1044.1	0.406	50	1065.1	-11	14	0.03	7.5	8.19
5	12.5	1065.1	0.380	50	996.9	36	50	0.09	7.0	8.18
5	12.5	996.9	0.382	50	1002.2	-3	47	0.09	14.0	8.19
5	12.5	1002.2	0.423	50	1109.7	-55	-8	-0.01	7.8	8.23
5	12.5	1109.7	0.415	50	1088.7	11	3	0.01	7.6	8.22
6	0	0.0	0.009	1	1112.8	0	0	0.00	0	8.13
6	12.5	1112.8	0.415	50	1088.7	13	13	0.02	7.6	8.20
6	12.5	1088.7	0.398	50	1044.1	24	37	0.07	7.3	8.20
6	12.5	1044.1	0.420	50	1101.9	-30	6	0.01	7.7	8.20
6	12.5	1101.9	0.417	50	1094.0	4	10	0.02	7.7	
6	12.5	1094.0	0.417	50	1094.0	0	10	0.02	15.3	8.24
6	12.5	1094.0	0.424	50	1112.4	-9	1	0.00	7.8	8.21

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R1	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	359	202		2.72	3.01	182		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
5	366	0		2.83	3.56	1		0.01	0.1	0.1	100.5%	100.5%	100.5%	0.00
5	373	0		2.93	3.45	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
5	380	0		3.06	3.17	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
5	386	0		2.93	3.42	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
5	393	0		3.20	2.96	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
5	401	0		3.20	3.14	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
6	360	220		2.66	3.34	175		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
6	367	0		2.88	3.71	1		0.01	0.1	0.1	100.5%	100.5%	100.5%	0.00
6	374	0		2.84	3.13	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
6	381	0		3.04	3.21	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
6	388	0		3.17	3.15	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
6	394	0		3.21	3.13	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
6	402	0		3.18	3.01	1		0.01	0.0	0.1	0.0%	0.0%	100.5%	0.00
								0.00	0.0	0.1	0.0%	0.0%	100.5%	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4a-R1 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope: 0.019 STOCK SC 0.364 DF: 2500 CONC: Conc (ppm)

Calibration Date: 4/8/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data vol (mL) aqueous aliquot	Cum Aliquot Vol (mL	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (mL	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH Data pH	ORML GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples											DUPLICATE										DUPLICATES				
1	5/26/98 13:47	0.0	4AR1T01B	538.35	GW Only	0	7	NA	NA	NA	0	NA	0.002	1	NA	8.13	355	206		2.91	3.30	182		% Diff	AVG	STDEV
2	5/26/98 14:29	0.7	4AR1T30MIN2B	519.43	GW Only	0	7	NA	NA	NA	0	NA	0.004	1	NA	8.10	363	185		2.69	3.48	143		-0.07	175.66	8.84
3	5/26/98 15:28	1.6	4AR1T1.5H3B	526.26	GW Only	0	7	NA	NA	NA	1.25	NA	0.374	5	98.1	8.11	371	21		2.71	2.83	20		0.19	160.00	24.00
4	5/26/98 17:02	3.2	4AR1T3H4B	526.45	GW Only	0	7	NA	NA	NA	1.25	NA	0.367	5	96.3	8.10	379	0		3.08	3.13	1		-0.53	16.89	5.02
5	5/26/98 19:07	5.2	4AR1T5H5B	541.98	GW Only	0	7	NA	NA	NA	12.5	NA	0.393	50	1031.0	8.18	387	0		3.04	3.33	1		0.00	1.00	0.00
6	5/27/98 8:51	18.9	4AR1T20H6B	530.82	GW Only	0	7	NA	NA	NA	12.5	NA	0.413	50	1083.5	8.23	395	0		3.18	3.53	1		0.00	1.00	0.00
1	5/27/98 13:46	24.0	4AR1T24H1B	538.35	GW Only	0	7	NA	NA	NA	0	NA	0.002	1	NA	8.17	397R	188		3.13	3.36	175		0.00	1.00	0.00
																										1.43
	Extraction of the Remaining RXN Contents																					CHLOW (g)	TOE (mg)			
1																										
2																										
3	5/27/98 14:00		4AR1F3	526.26	GW Only	0					NA	NA	NA	NA	NA	NT	415	0		402.92	433.19	0.0E+00				
4	5/27/98 14:03		4AR1F4	526.45	GW Only	0					NA	NA	NA	NA	NA	NT	416	0		401.77	447.17	0.0E+00				
5	5/27/98 14:05		4AR1F5	541.98	GW Only	0					NA	NA	NA	NA	NA	NT	417	0		402.65	474.63	0.0E+00				
6	5/27/98 14:08		4AR1F6	530.82	GW Only	0					NA	NA	NA	NA	NA	NT	418	0		402.38	464.36	0.0E+00				
	Extraction of the Charcoal Beads																					CHLOW (g)	TOE (mg)			
1	5/27/98 14:08		4AR1CHAR1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	403	0		3.18	0.08	0.0E+00				
1	5/27/98 14:08		4AR1CHAR1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	404	0		3.25	0.04	0.0E+00				
2	5/27/98 14:09		4AR1CHAR2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	405	0		2.92	0.07	0.0E+00				
2	5/27/98 14:10		4AR1CHAR2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	406	0		2.98	0.05	0.0E+00				
3	5/27/98 14:11		4AR1CHAR3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	407	0		2.96	0.10	0.0E+00				
3	5/27/98 14:12		4AR1CHAR3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	408	0		2.98	0.04	0.0E+00				
4	5/27/98 14:13		4AR1CHAR4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	409	0		2.99	0.10	0.0E+00				
4	5/27/98 14:13		4AR1CHAR4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	410	0		2.99	0.04	0.0E+00				
5	5/27/98 14:14		4AR1CHAR5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	411	0		2.98	0.10	0.0E+00				
5	5/27/98 14:15		4AR1CHAR5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	412	0		2.98	0.04	0.0E+00				
6	5/27/98 14:16		4AR1CHAR6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	413	0		4.48	0.10	0.0E+00				
6	5/27/98 14:17		4AR1CHAR6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	414	0		2.95	0.04	0.0E+00				

Steven Robert Cline: ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	59.7	0.11	10.39	0.02	
4	59.7	0.11	6.68	0.01	0.02
5	596.8	1.09	0.78	0.00	
6	596.8	1.11	0.26	0.00	0.00

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R2 For additional comments, see Laboratory Notebook B000025 Pages: 66-69

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	1000	NO	0.01 & 0.1

Experiment Start Date: 5/28/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
Step 9 not performed for this run since in only involves groundwater
Sparged GW was cooled overnight @12C THEN spiked with SAT TCE SOLN and mixed 2 hrs prior to filling reactors

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	3.16 liters	
Volume Sat. TCE added	3 mL	
	3 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	950 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
487	4AR2TBA	5/28/98 11:15	1564		4.84	5.15	1469
488	4AR2TBB	5/28/98 11:15	1538		4.87	5.30	1415

Prepared by: S.R. Cline LastUpdated: 10/22/98

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Samplin	Actual L/S Ratio
1	5/28/98 11:20	0.0	4AR2T01A	**511.45**	GW Only	**0**	14	14	511.45	NA
1	5/28/98 12:00	0.7	4AR2T30MIN1	511.45	GW Only	0	7	21	497.45	NA
1	5/28/98 13:04	1.7	4AR2T1.5H1	511.45	GW Only	0	7	28	490.45	NA
1	5/28/98 14:37	3.3	4AR2T3H1	511.45	GW Only	0	7	35	483.45	NA
1	5/28/98 16:20	5.0	4AR2T5H1	511.45	GW Only	0	7	42	476.45	NA
1	5/29/98 8:40	21.3	4AR2T21H1	511.45	GW Only	0	7	49	469.45	NA
1	5/29/98 11:18	24.0	4AR2T24H1A	511.45	GW Only	0	14	63	462.45	NA
2	5/28/98 11:24	0.0	4AR2T02	**503.49**	GW Only	**0**	7	7	503.49	NA
2	5/28/98 12:01	0.6	4AR2T30MIN2A	503.49	GW Only	0	14	21	496.49	NA
2	5/28/98 13:04	1.7	4AR2T1.5H2	503.49	GW Only	0	7	28	482.49	NA
2	5/28/98 14:38	3.2	4AR2T3H2	503.49	GW Only	**0**	7	35	475.49	NA
2	5/28/98 16:20	4.9	4AR2T5H2	503.49	GW Only	0	7	42	468.49	NA
2	5/29/98 8:40	21.3	4AR2T21H2	503.49	GW Only	0	7	49	461.49	NA
2	5/29/98 11:20	23.9	4AR2T24H2	503.49	GW Only	0	7	56	454.49	NA

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.354	DF:	2500	Conc (ppm):	46435.73
	Calibration Date: 4/8/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	NT	NT	NA	NA	NA	NA	NA	8.43
1	0	0	NT	NT	NA	NA	NA	NA	NA	8.4
1	0	0	0.008	1	NA	NA	NA	NA	NA	8.39
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.36
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.34
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.23
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.18
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.38
2	0	0	NT	NT	NA	NA	NA	NA	NA	8.4
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.41
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.39
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.36
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.18
2	0	0	0.007	1	NA	NA	NA	NA	NA	8.16

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	489	1,435		2.95	2.96	1,432		NA	NA	NA	NA	NA	NA	0.02
1	496	1,474		2.97	3.14	1,394		NA	NA	NA	NA	NA	NA	0.01
1	503	1,536		2.98	3.17	1,440		NA	NA	NA	NA	NA	NA	0.01
1	510	1,436		2.95	3.15	1,344		NA	NA	NA	NA	NA	NA	0.01
1	517	1,421		2.64	2.84	1,325		NA	NA	NA	NA	NA	NA	0.01
1	524	1,339		2.94	3.05	1,292		NA	NA	NA	NA	NA	NA	0.01
1	531	1,372		2.90	3.07	1,296		NA	NA	NA	NA	NA	NA	0.02
2	491	1,497		2.96	3.28	1,351		NA	NA	NA	NA	NA	NA	0.01
2	497	1,516		2.99	3.21	1,412		NA	NA	NA	NA	NA	NA	0.02
2	504	1,388		3.00	2.93	1,421		NA	NA	NA	NA	NA	NA	0.01
2	511	1,394		2.98	3.05	1,362		NA	NA	NA	NA	NA	NA	0.01
2	518	1,379		3.01	3.10	1,341		NA	NA	NA	NA	NA	NA	0.01
2	525	1,368		3.00	3.13	1,309		NA	NA	NA	NA	NA	NA	0.01
2	533	1,451		2.94	3.23	1,323		NA	NA	NA	NA	NA	NA	0.01

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Samplin	Ratio
3	5/28/98 11:25	0.0	4AR2T03	**511.38**	GW Only	0	7	7	511.38	NA
3	5/28/98 12:03	0.6	4AR2T30MIN3	511.38	GW Only	0	7	14	505.63	NA
3	5/28/98 13:05	1.7	4AR2T1.5H3A	511.38	GW Only	0	14	28	498.63	NA
3	5/28/98 14:39	3.2	4AR2T3H3	511.38	GW Only	0	7	35	484.63	NA
3	5/28/98 16:21	4.9	4AR2T5H3	511.38	GW Only	0	7	42	477.63	NA
3	5/29/98 8:41	21.3	4AR2T21H3	511.38	GW Only	0	7	49	470.63	NA
3	5/29/98 11:21	23.9	4AR2T24H3	511.38	GW Only	0	7	56	463.63	NA
4	5/28/98 11:27	0.0	4AR2T04	**495.84**	GW Only	0	7	7	495.84	NA
4	5/28/98 12:05	0.6	4AR2T30MIN4	495.84	GW Only	0	7	14	490.09	NA
4	5/28/98 13:06	1.6	4AR2T1.5H4	495.84	GW Only	0	7	21	483.09	NA
4	5/28/98 14:40	3.2	4AR2T3H4A	495.84	GW Only	0	14	35	476.09	NA
4	5/28/98 16:22	4.9	4AR2T5H4	495.84	GW Only	0	7	42	462.09	NA
4	5/29/98 8:42	21.3	4AR2T21H4	495.84	GW Only	0	7	49	455.09	NA
4	5/29/98 11:22	23.9	4AR2T24H4	495.84	GW Only	0	7	56	448.09	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.354	DF:	2500	Conc (ppm):	46435.73
	Calibration Date: 4/8/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0.0	0.001	1	114.8	0	0	0.00	0	8.38
3	1.25	114.8	0.353	5	92.6	11	11	0.02	0.6	8.34
3	1.25	92.6	0.357	5	93.7	-1	11	0.02	1.3	8.35
3	1.25	93.7	0.354	5	92.9	0	11	0.02	0.7	8.33
3	1.25	92.9	0.340	5	89.2	2	13	0.03	0.6	8.32
3	1.25	89.2	0.204	5	53.5	17	30	0.06	0.4	8.21
3	1.25	53.5	0.304	5	79.8	-12	17	0.03	0.6	8.22
4	0	0.0	NT	NT	118.4	0	0	0.00	0	8.4
4	1.25	118.4	0.414	5	108.6	5	5	0.01	0.8	8.34
4	1.25	108.6	0.396	5	103.9	2	7	0.01	0.7	8.33
4	1.25	103.9	0.375	5	98.4	3	10	0.02	1.4	8.33
4	1.25	98.4	0.389	5	102.1	-2	8	0.02	0.7	8.33
4	1.25	102.1	0.369	5	96.8	2	10	0.02	0.7	8.22
4	1.25	96.8	0.308	5	80.8	7	18	0.04	0.6	8.23

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
3	492	1,444		2.95	3.11	1,366		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.01
3	499	312		2.98	3.27	284		0.21	0.5	0.5	78.3%	78.3%	78.3%	0.00
3	505	68		4.23	2.42	120		0.09	0.1	0.6	11.8%	11.8%	90.0%	0.00
3	512	16		2.98	3.07	16		0.01	0.1	0.7	7.2%	7.2%	97.3%	0.00
3	519	13		3.01	3.12	12		0.01	0.0	0.7	0.2%	0.2%	97.5%	0.00
3	526	14		3.01	2.96	14		0.01	0.0	0.7	-0.1%	-0.1%	97.4%	0.00
3	534	15		2.95	3.22	14		0.01	0.0	0.7	0.0%	0.0%	97.4%	0.00
4	493	1,414		2.94	3.04	1,369			0.0	0.0	0.0%	0.0%	0.0%	0.01
4	500	282		3.00	3.34	253			0.5	0.5	80.6%	80.6%	80.6%	0.00
4	507	61		2.95	3.06	59		0.04	0.1	0.6	13.8%	13.8%	94.4%	0.00
4	513	13		2.97	3.03	13		0.01	0.0	0.7	3.3%	3.3%	97.6%	0.00
4	520	0		3.00	3.07	1		0.00	0.0	0.7	0.8%	0.8%	98.4%	0.00
4	527	0		3.00	3.14	1		0.00	0.0	0.7	0.0%	0.0%	98.4%	0.00
4	535	0		2.90	3.05	1		0.00	0.0	0.7	0.0%	0.0%	98.4%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Samplin	Actual L/S Ratio
5	5/28/98 11:29	0.0	4AR2T05	**515.45**	GW Only	0	7	7	515.45	NA
5	5/28/98 12:05	0.6	4AR2T30MIN5	515.45	GW Only	0	7	14	520.95	NA
5	5/28/98 13:07	1.6	4AR2T1.5H5	515.45	GW Only	0	7	21	513.95	NA
5	5/28/98 14:41	3.2	4AR2T3H5	515.45	GW Only	0	7	28	506.95	NA
5	5/28/98 16:22	4.9	4AR2T5H5A	515.45	GW Only	0	14	42	499.95	NA
5	5/29/98 8:42	21.2	4AR2T21H5	515.45	GW Only	0	7	49	485.95	NA
5	5/29/98 11:23	23.9	4AR2T24H5	515.45	GW Only	0	7	56	478.95	NA
6	5/28/98 11:30	0.0	4AR2T06	**518.13**	GW Only	0	7	7	518.13	NA
6	5/28/98 12:06	0.6	4AR2T30MIN6	518.13	GW Only	0	7	14	523.63	NA
6	5/28/98 13:08	1.6	4AR2T1.5H6	518.13	GW Only	0	7	21	516.63	NA
6	5/28/98 14:42	3.2	4AR2T3H6	518.13	GW Only	0	7	28	509.63	NA
6	5/28/98 16:24	4.9	4AR2T5H6	518.13	GW Only	0	7	35	502.63	NA
6	5/29/98 8:43	21.2	4AR2T21H6A	518.13	GW Only	0	14	49	495.63	NA
6	5/29/98 11:24	23.9	4AR2T24H6	518.13	GW Only	0	7	56	481.63	NA

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.354	DF:	2500	Conc (ppm):	46435.73
	Calibration Date: 4/8/98									
	MnO4 Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
5	0	0.0	NT	NT	1114.2	0	0	0.00	0	8.41
5	12.5	1114.2	0.420	50	1101.9	6	6	0.01	7.7	8.38
5	12.5	1101.9	0.418	50	1096.6	3	9	0.02	7.7	8.39
5	12.5	1096.6	0.425	50	1115.0	-9	0	0.00	7.8	8.39
5	12.5	1115.0	0.411	50	1078.3	18	18	0.04	15.1	8.39
5	12.5	1078.3	0.428	50	1122.9	-22	-3	-0.01	7.9	8.34
5	12.5	1122.9	0.419	50	1099.2	11	8	0.02	7.7	8.34
6	0	0.0	NT	NT	1108.5	0	0	0.00	0	8.4
6	12.5	1108.5	0.422	50	1107.1	1	1	0.00	7.7	8.38
6	12.5	1107.1	0.417	50	1094.0	7	8	0.01	7.7	8.39
6	12.5	1094.0	0.437	50	1146.5	-27	-19	-0.04	8.0	8.39
6	12.5	1146.5	0.427	50	1120.2	13	-6	-0.01	7.8	8.37
6	12.5	1120.2	0.436	50	1143.8	-12	-18	-0.03	16.0	8.34
6	12.5	1143.8	0.416	50	1091.4	25	8	0.01	7.6	8.35

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LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R2	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	494	1,362		2.98	3.04	1,338		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.01
5	501	11		2.99	3.36	10		0.01	0.7	0.7	100.3%	100.3%	100.3%	0.00
5	508	0		3.07	3.10	1		0.00	0.0	0.7	0.7%	0.7%	101.0%	0.00
5	515	0		2.98	3.41	1			0.0	0.7	0.0%	0.0%	101.0%	0.00
5	521	0		3.00	3.13	1			0.0	0.7	0.0%	0.0%	101.0%	0.00
5	528	0		3.02	3.24	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
5	536	0		2.97	3.13	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
6	495	1,356		2.97	3.10	1,299		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.01
6	502	0		3.01	3.08	1		0.00	0.7	0.7	101.0%	101.0%	101.0%	0.00
6	509	0		3.08	3.05	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
6	516	0		3.02	3.18	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
6	523	0		3.02	2.91	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
6	529	0		2.99	3.10	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00
6	537	0		2.94	3.19	1		0.00	0.0	0.7	0.0%	0.0%	101.0%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R3 For additional comments, see Laboratory Notebook B000025 Pages: 70-73

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
C. Basalt	100	NO	0.01 & 0.1

Experiment Start Date: 6/1/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
NONE

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	3.10 liters	
Volume Sat. TCE added	0.31 mL	
	0.31 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	100 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
629	4a-r3-tb-a	6/2/98 13:15	201		4.90	5.30	186
630	4a-r3-tb-b	6/2/98 13:15	174		5.02	5.00	175

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	6/3/98 11:30	0.0	4a-r3-t0-1a	**500.49**	GW Only	**0.0**	14.37	14.37	500.5	NA
1	6/3/98 12:05	0.6	4a-r3-t30m-1	500.49	GW Only	0	7.22	21.59	486.1	NA
1	6/3/98 13:05	1.6	4a-r3-t1.5h-1	500.49	GW Only	0	7.51	29.1	478.9	NA
1	6/3/98 14:30	3.0	4a-r3-t3h-1	500.49	GW Only	0	6.58	35.68	471.4	NA
1	6/3/98 16:30	5.0	4a-r3-t5h-1	500.49	GW Only	0	7.13	42.81	464.8	NA
1	6/4/98 8:30	21.0	4a-r3-t20h-1	500.49	GW Only	0	7.52	50.33	457.7	NA
1	6/4/98 11:40	24.2	4a-r3-t24h-1	500.49	GW Only	0	7.22	57.55	450.2	NA
2	6/3/98 11:33	0.0	4a-r3-t0-2	**524.94**	GW Only	**0.0**	7.2	7.2	524.9	NA
2	6/3/98 12:07	0.6	4a-r3-t30m-2a	524.94	GW Only	0	14.54	21.74	517.7	NA
2	6/3/98 13:06	1.5	4a-r3-t1.5h-2	524.94	GW Only	0	7.44	29.18	503.2	NA
2	6/3/98 14:31	3.0	4a-r3-t3h-2	524.94	GW Only	0	7.33	36.51	495.8	NA
2	6/3/98 16:31	5.0	4a-r3-t5h-2	524.94	GW Only	0	7.16	43.67	488.4	NA
2	6/4/98 8:31	21.0	4a-r3-t20h-2	524.94	GW Only	0	7.26	50.93	481.3	NA
2	6/4/98 11:41	24.1	4a-r3-t24h-2	524.94	GW Only	0	7.36	58.29	474.0	NA

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	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.369	DF:	2500	Conc (ppm):	48403.35
	Calibration Date: 4/8/98									
	MnO4 Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.2
1	0	0	0.034	1	NA	NA	NA	NA	NA	8.15
1	0	0	0.008	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.009	1	NA	NA	NA	NA	NA	8.12
1	0	0	0.010	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.013	1	NA	NA	NA	NA	NA	8.15
1	0	0	0.012	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.007	1	NA	NA	NA	NA	NA	8.21
2	0	0	0.009	1	NA	NA	NA	NA	NA	8.16
2	0	0	0.007	1	NA	NA	NA	NA	NA	8.18
2	0	0	0.008	1	NA	NA	NA	NA	NA	8.18
2	0	0	0.010	1	NA	NA	NA	NA	NA	8.17
2	0	0	0.012	1	NA	NA	NA	NA	NA	8.16
2	0	0	0.012	1	NA	NA	NA	NA	NA	8.19

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LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	631	160		2.97	2.99	159		NA	NA	NA	NA	NA	NA	0.00
1	638	166		2.93	3.16	154		NA	NA	NA	NA	NA	NA	0.00
1	645	154		2.87	2.82	157		NA	NA	NA	NA	NA	NA	0.00
1	652	187		2.89	3.68	147		NA	NA	NA	NA	NA	NA	0.00
1	659	158		2.90	3.00	153		NA	NA	NA	NA	NA	NA	0.00
1	666	154		2.86	2.99	147		NA	NA	NA	NA	NA	NA	0.00
1	673	159		2.91	3.12	148		NA	NA	NA	NA	NA	NA	0.00
2	633	159		2.95	3.27	144		NA	NA	NA	NA	NA	NA	0.00
2	639	165		2.92	3.06	157		NA	NA	NA	NA	NA	NA	0.00
2	646	147		2.87	2.97	142		NA	NA	NA	NA	NA	NA	0.00
2	653	153		2.88	3.16	140		NA	NA	NA	NA	NA	NA	0.00
2	660	145		2.88	2.99	140		NA	NA	NA	NA	NA	NA	0.00
2	667	145		2.90	3.00	140		NA	NA	NA	NA	NA	NA	0.00
2	674	143		2.91	3.01	139		NA	NA	NA	NA	NA	NA	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	6/3/98 11:34	0.0	4a-r3-t0-3	**454.86**	C. Basalt	**100.1**	7.04	7.04	454.9	4.5
3	6/3/98 12:10	0.6	4a-r3-t30m-3	454.86	C. Basalt	100.1	6.94	13.98	449.1	4.5
3	6/3/98 13:07	1.5	4a-r3-t1.5h-3a	454.86	C. Basalt	100.1	13.99	27.97	442.1	4.4
3	6/3/98 14:32	3.0	4a-r3-t3h-3	454.86	C. Basalt	100.1	6.91	34.88	428.1	4.3
3	6/3/98 16:32	5.0	4a-r3-t5h-3	454.86	C. Basalt	100.1	6.79	41.67	421.2	4.2
3	6/4/98 8:32	21.0	4a-r3-t20h-3	454.86	C. Basalt	100.1	6.63	48.3	414.4	4.1
3	6/4/98 11:42	24.1	4a-r3-t24h-3a	454.86	C. Basalt	100.1	13.94	62.24	407.8	4.1
4	6/3/98 11:36	0.0	4a-r3-t0-4	**433.12**	C. Basalt	**100.3**	7	7	433.1	4.3
4	6/3/98 12:13	0.6	4a-r3-t30m-4	433.12	C. Basalt	100.27	6.85	13.85	427.4	4.3
4	6/3/98 13:09	1.6	4a-r3-t1.5h-4	433.12	C. Basalt	100.27	7.19	21.04	420.5	4.2
4	6/3/98 14:33	3.0	4a-r3-t3h-4a	433.12	C. Basalt	100.27	13.98	35.02	413.3	4.1
4	6/3/98 16:34	5.0	4a-r3-t5h-4	433.12	C. Basalt	100.27	6.85	41.87	399.4	4.0
4	6/4/98 8:32	20.9	4a-r3-t20h-4	433.12	C. Basalt	100.27	7.04	48.91	392.5	3.9
4	6/4/98 11:44	24.1	4a-r3-t24h-4	433.12	C. Basalt	100.27	7.02	55.93	385.5	3.8

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.369	DF:	2500	Conc (ppm):	48403.35
	Calibration Date: 4/8/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0.0	0.002	1	134.7	0.0	0.0	0.0	0.0	8.2
3	1.25	134.7	0.463	5	121.5	6.0	6.0	0.1	0.8	8.22
3	1.25	121.5	0.442	5	116.0	2.4	8.4	0.1	1.6	8.22
3	1.25	116.0	0.436	5	114.4	0.7	9.1	0.1	0.8	8.22
3	1.25	114.4	0.422	5	110.7	1.5	10.6	0.1	0.8	8.23
3	1.25	110.7	0.374	5	98.1	5.2	15.8	0.2	0.7	8.26
3	1.25	98.1	0.305	5	80.0	7.4	23.2	0.2	1.1	8.3
4	0	0.0	0.004	1	141.6	0.0	0.0	0.0	0.0	8.21
4	1.25	141.6	0.465	5	122.0	8.4	8.4	0.1	0.8	8.23
4	1.25	122.0	0.466	5	122.3	-0.1	8.3	0.1	0.9	8.23
4	1.25	122.3	0.466	5	122.3	0.0	8.3	0.1	1.7	8.23
4	1.25	122.3	0.459	5	120.4	0.7	9.0	0.1	0.8	8.24
4	1.25	120.4	0.380	5	99.7	8.1	17.1	0.2	0.7	8.25
4	1.25	99.7	0.447	5	117.3	-6.8	10.4	0.1	0.8	8.3

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	634	171		2.97	3.11	164		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
3	641	21		2.89	3.14	19		0.12	0.065	0.1	87.0%	94.4%	94.4%	0.00
3	647	6		2.85	3.01	6		0.04	0.006	0.1	8.0%	8.6%	103.0%	0.00
3	654	0		2.91	3.24	1			.002	0.1	2.8%	3.1%	106.1%	0.00
3	661	0		2.74	3.20	1			.000	0.1	0.0%	0.0%	106.1%	0.00
3	668	0		2.89	3.18	1		0.01	0.000	0.1	0.0%	0.0%	106.1%	0.00
3	675	0		2.88	3.14	1		0.01	0.000	0.1	0.0%	0.0%	106.1%	0.00
4	635	172		2.93	3.18	159		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
4	642	17		2.91	3.01	17		0.11	0.1	0.1	88.3%	92.9%	92.9%	0.00
4	649	0		2.87	3.01	1		0.01	0.0	0.1	9.6%	10.1%	103.1%	0.00
4	655	0		2.88	3.17	1		0.01	0.0	0.1	0.0%	0.0%	103.1%	0.00
4	662	0		2.92	2.98	1		0.01	0.0	0.1	0.0%	0.0%	103.1%	0.00
4	669	0		2.88	3.13	1		0.01	0.0	0.1	0.0%	0.0%	103.1%	0.00
4	677	0		2.84	3.10	1		0.01	0.0	0.1	0.0%	0.0%	103.1%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	6/3/98 11:37	0.0	4a-r3-t0-5	**451.03**	C. Basalt	**100.7**	7.11	7.11	451.0	4.5
5	6/3/98 12:14	0.6	4a-r3-t30m-5	451.03	C. Basalt	100.7	7	14.11	456.4	4.5
5	6/3/98 13:10	1.5	4a-r3-t1.5h-5	451.03	C. Basalt	100.7	7.17	21.28	449.4	4.5
5	6/3/98 14:35	3.0	4a-r3-t3h-5	451.03	C. Basalt	100.7	7.12	28.4	442.3	4.4
5	6/3/98 16:35	5.0	4a-r3-t5h-5a	451.03	C. Basalt	100.7	13.68	42.08	435.1	4.3
5	6/4/98 8:33	20.9	4a-r3-t20h-5	451.03	C. Basalt	100.7	6.91	48.99	421.5	4.2
5	6/4/98 11:45	24.1	4a-r3-t24h-5	451.03	C. Basalt	100.7	7.09	56.08	414.5	4.1
6	6/3/98 11:38	0.0	4a-r3-t0-6	**453.78**	C. Basalt	**100.6**	7.05	7.05	453.8	4.5
6	6/3/98 12:15	0.6	4a-r3-t30m-6	453.78	C. Basalt	100.61	7.08	14.13	459.2	4.6
6	6/3/98 13:11	1.5	4a-r3-t1.5h-6	453.78	C. Basalt	100.61	7.1	21.23	452.2	4.5
6	6/3/98 14:36	3.0	4a-r3-t3h-6	453.78	C. Basalt	100.61	7.04	28.27	445.1	4.4
6	6/3/98 16:37	5.0	4a-r3-t5h-6	453.78	C. Basalt	100.61	6.99	35.26	438.0	4.4
6	6/4/98 8:34	20.9	4a-r3-t20h-6a	453.78	C. Basalt	100.61	13.97	49.23	431.0	4.3
6	6/4/98 11:46	24.1	4a-r3-t24h-6	453.78	C. Basalt	100.61	6.95	56.18	417.1	4.1

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.019	STOCK SOLN ABS		0.369	DF:	2500	Conc (ppm):	48403.35
	Calibration Date: 4/8/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0.0	0.004	1	1325.6	0.0	0.0	0.0	0.0	8.22
5	12.5	1325.6	0.487	50	1277.6	21.9	21.9	0.2	8.9	8.29
5	12.5	1277.6	0.472	50	1238.3	17.7	39.6	0.4	8.9	8.27
5	12.5	1238.3	0.480	50	1259.3	-9.3	30.3	0.3	9.0	8.24
5	12.5	1259.3	0.466	50	1222.5	16.0	46.3	0.5	16.7	8.23
5	12.5	1222.5	0.464	50	1217.3	2.2	48.5	0.5	8.4	8.23
5	12.5	1217.3	0.454	50	1191.1	10.9	59.4	0.6	8.4	8.24
6	0	0.0	0.004	1	1317.5	0.0	0.0	0.0	0.0	8.2
6	12.5	1317.5	0.494	50	1296.0	9.9	9.9	0.1	9.2	8.27
6	12.5	1296.0	0.462	50	1212.1	38.0	47.8	0.5	8.6	8.25
6	12.5	1212.1	0.486	50	1275.0	-28.0	19.8	0.2	9.0	8.23
6	12.5	1275.0	0.477	50	1251.4	10.3	30.2	0.3	8.7	8.21
6	12.5	1251.4	0.457	50	1198.9	22.6	52.8	0.5	16.7	8.2
6	12.5	1198.9	0.477	50	1251.4	-21.9	30.9	0.3	8.7	8.23

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R3	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	636	168		2.94	3.21	154		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
5	643	0		2.88	3.10	1		[illegible]	0.1	0.1	100.5%	102.3%	102.3%	0.00
5	650	0		2.88	2.96	1		[illegible]	0.0	0.1	0.0%	0.0%	102.3%	0.00
5	657	0		2.89	2.99	1		[illegible]	0.0	0.1	0.0%	0.0%	102.3%	0.00
5	663	0		2.89	3.16	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
5	670	0		3.13	3.00	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
5	678	0		2.90	3.01	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
6	637	154		2.95	2.96	154		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.00
6	644	0		2.89	3.03	1		0.01	0.1	0.1	100.5%	102.3%	102.3%	0.00
6	651	0		2.90	3.13	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
6	658	0		2.88	3.13	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
6	665	0		2.91	2.99	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
6	671	0		2.91	3.02	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00
6	679	0		2.88	3.38	1		0.01	0.0	0.1	0.0%	0.0%	102.3%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp: 4a-R3 — For additional comments, see Laboratory Notebook B0000025

MnO4- Calib. Slope: 0.019 — STOCK SOLN ABS: 0.369 — DF: 2500 — Conc (ppm): 48403.35 — For additional comments, see Laboratory N

Calibration Date: 4/8/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Curn Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	MnO4 Data: Volume Stock Mn Added (mL)	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples											DUPLICATES										DUPLICATES				
1	6/3/98 11:31	0.0	4a-r3-t0-1b	500.49	GW Only	0	7.24	NA	NA	NA	0	NA	0.006	1	NA	8.21	632	157		2.90	3.15	145		8.6%	151.85	9.62
2	6/3/98 12:09	0.6	4a-r3-t30m-2b	524.94	GW Only	0	7.42	NA	NA	NA	0	NA	0.007	1	NA	8.18	640	147		2.92	2.99	143		9.0%	150.32	10.01
3	6/3/98 13:08	1.6	4a-r3-t1.5h-3b	454.86	C. Basalt	100.1	7.15	NA	NA	NA	1.25	NA	0.451	5	118.3	8.21	648	7		2.90	3.07	7		-15.5%	6.42	0.65
4	6/3/98 14:34	3.0	4a-r3-t3h-4b	433.12	C. Basalt	100.27	7.03	NA	NA	NA	1.25	NA	0.467	5	122.5	8.24	656	0		2.88	3.08	1		0.0%	1.00	0.00
5	6/3/98 16:36	5.0	4a-r3-t5h-5b	451.03	C. Basalt	100.7	6.85	NA	NA	NA	12.5	NA	0.482	50	1264.5	8.23	664	0		2.90	3.03	1		0.0%	1.00	0.00
6	6/4/98 8:35	21.0	4a-r3-t20h-6b	453.78	C. Basalt	100.61	6.98	NA	NA	NA	12.5	NA	0.470	50	1233.0	8.21	672	0		2.89	3.21	1		0.0%	1.00	0.00
7	6/4/98 11:43	24.1	4a-r3-t24h-3b	454.86	C. Basalt	100.1	7	NA	NA	NA	1.25	NA	0.358	5	93.9	8.31	676	0		2.90	3.11	1		0.0%	1.00	0.00
	Extraction of the Remaining Reactor Contents																					Mass TCE (mg)				
1																										
2																										
3	6/4/98 11:50	24.3	4a-r3-f3	454.86	C. Basalt	100.1					NA	NA	NA	NA	NA	NT	692	0		400.42	447.27	0.0E+00				
4	6/4/98 11:54	24.3	4a-r3-f4	433.12	C. Basalt	100.27					NA	NA	NA	NA	NA	NT	693	0		400.52	441.11	0.0E+00				
5	6/4/98 11:57	24.3	4a-r3-f5	451.03	C. Basalt	100.7					NA	NA	NA	NA	NA	NT	694	0		400.59	470.61	0.0E+00				
6	6/4/98 12:00	24.4	4a-r3-f6	453.78	C. Basalt	100.61					NA	NA	NA	NA	NA	NT	695	0		400.17	475.83	0.0E+00				
	Extraction of the Charcoal Beds																				Mass carbon	Mass TCE (mg)				
1	6/4/98 12:05		4a-r3-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	680	0		2.88	0.08	0.0E+00				
1	6/4/98 12:05		4a-r3-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	681	0		2.91	0.05	0.0E+00				
2	6/4/98 12:07		4a-r3-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	682	0		2.92	0.08	0.0E+00				
2	6/4/98 12:07		4a-r3-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	683	0		2.90	0.03	0.0E+00				
3	6/4/98 12:09		4a-r3-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	684	0		2.90	0.09	0.0E+00				
3	6/4/98 12:09		4a-r3-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	685	0		2.89	0.04	0.0E+00				
4	6/4/98 12:11		4a-r3-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	686	0		2.88	0.07	0.0E+00				
4	6/4/98 12:11		4a-r3-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	687	0		2.90	0.04	0.0E+00				
5	6/4/98 12:13		4a-r3-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	688	0		2.90	0.09	0.0E+00				
5	6/4/98 12:13		4a-r3-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	689	0		2.88	0.04	0.0E+00				
6	6/4/98 12:14		4a-r3-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	690	0		2.88	0.09	0.0E+00				
6	6/4/98 12:14		4a-r3-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	691	0		2.97	0.02	0.0E+00				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @ t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	60.5	0.11	24.57	0.04	
4	60.5	0.11	10.39	0.02	0.03
5	605.0	1.09	61.42	0.11	
6	605.0	1.08	30.36	0.05	0.08

Steven Robert Cline:
F.O. BUT DIVIDED AS 1 PTB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

Last Updated: 11/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R4 For additional comments, see Laboratory Notebook B000025 Pages: 91-94

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
A. Basalt	100	NO	0.01 & 0.1

Experiment Start Date: 7/14/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
NONE

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.97 liters	
Volume Sat. TCE added	0.3 mL	
	0.3 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	101 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1246	4a-r4-tba	7/14/98 14:46	192		4.95	5.11	185
1247	4a-r4-tbb	7/14/98 14:46	157		4.82	5.27	143

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	7/15/98 10:48	0.0	4a-r4-t0-1a	**500.964**	GW Only	**0.0**	14.63	14.63	501.0	NA
1	7/15/98 11:20	0.5	4a-r4-t30min-1	500.964	GW Only	0	7.42	22.05	486.3	NA
1	7/15/98 12:20	1.5	4a-r4-t1.5h-1	500.964	GW Only	0	7.37	29.42	478.9	NA
1	7/15/98 13:56	3.1	4a-r4-t3h-1	500.964	GW Only	0	7.35	36.77	471.5	NA
1	7/15/98 15:50	5.0	4a-r4-t5h-1	500.964	GW Only	0	7.44	44.21	464.2	NA
1	7/16/98 8:01	21.2	4a-r4-t20h-1	500.964	GW Only	0	7.35	51.56	456.8	NA
1	7/16/98 10:42	23.9	4a-r4-t24h-1	500.964	GW Only	0	7.35	58.91	449.4	NA
2	7/15/98 10:49	0.0	4a-r4-t0-2	**496.24**	GW Only	**0.0**	7.49	7.49	496.2	NA
2	7/15/98 11:21	0.5	4a-r4-t30min-2a	496.24	GW Only	0	14.74	22.23	488.8	NA
2	7/15/98 12:21	1.5	4a-r4-t1.5h-2	496.24	GW Only	0	7.45	29.68	474.0	NA
2	7/15/98 13:57	3.1	4a-r4-t3h-2	496.24	GW Only	0	7.44	37.12	466.6	NA
2	7/15/98 15:51	5.0	4a-r4-t5h-2	496.24	GW Only	0	7.38	44.5	459.1	NA
2	7/16/98 8:02	21.2	4a-r4-t20h-2	496.24	GW Only	0	7.34	51.84	451.7	NA
2	7/16/98 10:43	23.9	4a-r4-t24h-2	496.24	GW Only	0	7.27	59.11	444.4	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.517	DF:	1667	Conc (ppm):	38607.91
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.08
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.08
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.1
1	0	0	0.008	1	NA	NA	NA	NA	NA	8.09
1	0	0	0.008	1	NA	NA	NA	NA	NA	8.07
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.07
1	0	0	0.008	1	NA	NA	NA	NA	NA	8.08
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.02
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.05
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.06

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1248	160		3.00	3.42	141		NA	NA	NA	NA	NA	NA	0.00
1	1255	154		2.89	3.19	140		NA	NA	NA	NA	NA	NA	0.00
1	1262	141		2.88	3.03	134		NA	NA	NA	NA	NA	NA	0.00
1	1269	144		2.87	3.05	136		NA	NA	NA	NA	NA	NA	0.00
1	1276	140		2.87	3.05	131		NA	NA	NA	NA	NA	NA	0.00
1	1283	142		2.86	3.04	134		NA	NA	NA	NA	NA	NA	0.00
1	1290	146		2.87	3.21	131		NA	NA	NA	NA	NA	NA	0.00
2	1250	139		2.95	2.92	140		NA	NA	NA	NA	NA	NA	0.00
2	1256	161		2.87	3.28	141		NA	NA	NA	NA	NA	NA	0.00
2	1263	142		2.89	2.97	138		NA	NA	NA	NA	NA	NA	0.00
2	1270	149		2.87	3.09	139		NA	NA	NA	NA	NA	NA	0.00
2	1277	151		2.89	3.17	137		NA	NA	NA	NA	NA	NA	0.00
2	1284	155		2.84	3.23	137		NA	NA	NA	NA	NA	NA	0.00
2	1291	162		2.99	3.39	143		NA	NA	NA	NA	NA	NA	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	7/15/98 10:50	0.0	4a-r4-t0-3	**405.81**	A. Basalt	**100.1**	7.05	7.05	405.8	4.1
3	7/15/98 11:23	0.6	4a-r4-t30min-3	405.81	A. Basalt	100.054	6.83	13.88	400.0	4.0
3	7/15/98 12:22	1.5	4a-r4-t1.5h-3a	405.81	A. Basalt	100.054	14.19	28.07	393.2	3.9
3	7/15/98 13:58	3.1	4a-r4-t3h-3	405.81	A. Basalt	100.054	6.96	35.03	379.0	3.8
3	7/15/98 15:52	5.0	4a-r4-t5h-3	405.81	A. Basalt	100.054	6.9	41.93	372.0	3.7
3	7/16/98 8:03	21.2	4a-r4-t20h-3	405.81	A. Basalt	100.054	6.89	48.82	365.1	3.6
3	7/16/98 10:44	23.9	4a-r4-t24h-3	405.81	A. Basalt	100.054	6.65	55.47	358.2	3.6
4	7/15/98 10:50	0.0	4a-r4-t0-4	**409.143**	A. Basalt	**100.0**	7.14	7.14	409.1	4.1
4	7/15/98 11:24	0.6	4a-r4-t30min-4	409.143	A. Basalt	100.023	7.32	14.46	403.3	4.0
4	7/15/98 12:24	1.6	4a-r4-t1.5h-4	409.143	A. Basalt	100.023	7.11	21.57	395.9	4.0
4	7/15/98 13:58	3.1	4a-r4-t3h-4a	409.143	A. Basalt	100.023	14.58	36.15	388.8	3.9
4	7/15/98 15:53	5.1	4a-r4-t5h-4	409.143	A. Basalt	100.023	7.23	43.38	374.2	3.7
4	7/16/98 8:03	21.2	4a-r4-t20h-4	409.143	A. Basalt	100.023	7.27	50.65	367.0	3.7
4	7/16/98 10:44	23.9	4a-r4-t24h-4	409.143	A. Basalt	100.023	7.32	57.97	359.7	3.6

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.517	DF:	1667	Conc (ppm):	38607.91
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0.0	0.004	1	120.6	0.0	0.0	0.0	0.0	8.01
3	1.25	120.6	0.506	5	113.4	2.9	2.9	0.0	0.8	8.03
3	1.25	113.4	0.498	5	111.6	0.7	3.6	0.0	1.6	8.02
3	1.25	111.6	0.506	5	113.4	-0.7	2.9	0.0	0.8	8.02
3	1.25	113.4	0.498	5	111.6	0.7	3.6	0.0	0.8	8.03
3	1.25	111.6	0.447	5	100.1	4.2	7.8	0.1	0.7	8.3
3	1.25	100.1	0.481	5	107.8	-2.7	5.1	0.1	0.7	8.31
4	0	0.0	0.003	1	119.7	0.0	0.0	0.0	0.0	8.02
4	1.25	119.7	0.513	5	114.9	1.9	1.9	0.0	0.8	8.03
4	1.25	114.9	0.518	5	116.0	-0.4	1.5	0.0	0.8	8.02
4	1.25	116.0	0.512	5	114.7	0.5	2.0	0.0	1.7	8.02
4	1.25	114.7	0.507	5	113.6	0.4	2.4	0.0	0.8	8.03
4	1.25	113.6	0.503	5	112.7	0.3	2.7	0.0	0.8	8.23
4	1.25	112.7	0.492	5	110.2	0.9	3.6	0.0	0.8	8.25

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1251	145		2.91	3.06	138		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
3	1258	13		2.86	3.13	12		0.08	0.050	0.1	90.3%	88.6%	88.6%	0.00
3	1264	0		2.90	3.19	1		0.01	0.004	0.1	7.4%	7.3%	95.9%	0.00
3	1271	0		2.89	3.28	1		0.01	0.000	0.1	0.0%	0.0%	95.9%	0.00
3	1278	0		2.87	3.06	1		0.01	0.000	0.1	0.0%	0.0%	95.9%	0.00
3	1285	0		2.87	3.09	1		0.01	0.000	0.1	0.0%	0.0%	95.9%	0.00
3	1292	0		2.90	2.87	1		0.01	0.000	0.1	0.0%	0.0%	95.9%	0.00
4	1252	152		2.90	3.28	134		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
4	1259	15		2.87	3.12	14		0.10	0.049	0.0	88.6%	84.7%	84.7%	0.00
4	1266	0		2.86	3.24	1		0.01	0.005	0.1	9.1%	8.7%	93.4%	0.00
4	1272	0		2.88	3.19	1		0.01	0.000	0.1	0.0%	0.0%	93.4%	0.00
4	1279	0		2.87	3.15	1		0.01	0.000	0.1	0.0%	0.0%	93.4%	0.00
4	1286	0		2.87	2.98	1		0.01	0.000	0.1	0.0%	0.0%	93.4%	0.00
4	1293	0		2.88	3.04	1		0.01	0.000	0.1	0.0%	0.0%	93.4%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.517	DF:	1667	Conc (ppm):	38607.91
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0.0	0.003	1	1186.4	0.0	0.0	0.0	0.0	8.02
5	12.5	1186.4	0.493	50	1104.5	33.3	33.3	0.3	8.2	8.14
5	12.5	1104.5	0.488	50	1093.3	4.5	37.8	0.4	7.9	8.12
5	12.5	1093.3	0.493	50	1104.5	-4.4	33.4	0.3	8.2	8.12
5	12.5	1104.5	0.497	50	1113.4	-3.4	30.0	0.3	16.4	8.13
5	12.5	1113.4	0.500	50	1120.2	-2.5	27.5	0.3	8.2	8.28
5	12.5	1120.2	0.497	50	1113.4	2.4	29.9	0.3	8.1	8.28
6	0	0.0	0.001	1	1186.1	0.0	0.0	0.0	0.0	8.01
6	12.5	1186.1	0.533	50	1194.1	-3.2	-3.2	0.0	8.8	8.15
6	12.5	1194.1	0.535	50	1198.6	-1.8	-5.0	-0.1	8.6	8.13
6	12.5	1198.6	0.529	50	1185.1	5.3	0.2	0.0	8.7	8.13
6	12.5	1185.1	0.532	50	1191.8	-2.6	-2.3	0.0	8.6	8.14
6	12.5	1191.8	0.533	50	1194.1	-0.8	-3.2	0.0	16.9	8.31
6	12.5	1194.1	0.522	50	1169.4	9.0	5.8	0.1	17.1	8.32

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1253	135		2.88	3.02	128		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
5	1260	0		2.87	3.18	1		0.01	0.052	0.1	100.5%	92.0%	92.0%	0.00
5	1267	0		2.84	3.25	1			.000	0.1	0.0%	0.0%	92.0%	0.00
5	1274	0		2.87	3.22	1			.000	0.1	0.0%	0.0%	92.0%	0.00
5	1280	0		2.87	3.03	1		0.01	0.000	0.1	0.0%	0.0%	92.0%	0.00
5	1287	0		2.87	3.33	1		0.01	0.000	0.1	0.0%	0.0%	92.0%	0.00
5	1294	0		2.87	3.17	1		0.01	0.000	0.1	0.0%	0.0%	92.0%	0.00
6	1254	159		2.89	3.20	144		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
6	1261	0		2.89	3.25	1		0.01	0.058	0.1	100.6%	103.2%	103.2%	0.00
6	1268	0		2.87	3.12	1		0.01	0.000	0.1	0.0%	0.0%	103.2%	0.00
6	1275	0		2.87	3.10	1		0.01	0.000	0.1	0.0%	0.0%	103.2%	0.00
6	1282	0		2.84	3.13	1		0.01	0.000	0.1	0.0%	0.0%	103.2%	0.00
6	1288	0		2.88	3.02	1		0.01	0.000	0.1	0.0%	0.0%	103.2%	0.00
6	1295	0		2.84	3.22	1		0.01	0.000	0.1	0.0%	0.0%	103.2%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R4	For additional comments, see Laboratory Notebook B000025																					For additional comments, see Laboratory N			
											MnO4- Calib. Slope:		0.022	STOCK SOLN ABS		0.517	DF:		1667	Conc (ppm):	38607.91						
											Calibration Date: 6/10/98																
						Sample Data					[redacted]					pH Data											
Reactor	Sample	RXN Time	Sample	Volume GW Used	Media	Solid Mass	vol (mL) aqueous	Corr Aliquot	Actual Vol at	Actual L/S	Volume Stock Mn	Initial MnO4-	Final MnO4-	Final Spec	Final MnO4-	pH	ORNL GC #	Extract Conc.	Flag	Hexane Volume	Aqueous Volume	Aqueous Conc	Flag	% Diff	AVG (ppb)	STDEV (ppb)
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio	Added (m	(mg/L)	ABS	DF	(mg/L)			(ppb)		(mL)	(mL)	(ppb)				
	Duplicate VOC Samples											[redacted]	DUPLICATES										DUPLICATES				
1	7/15/98 10:48	0.0	4a-r4-i0-1b	500.964	GW Only	0	7.36	NA	NA	NA	0	NA	0.002	1	NA	8.02	1249	152		2.98	3.15	143		-1.9%	142.08	1.92
2	7/15/98 11:22	0.6	4a-r4-i30min-2b	496.24	GW Only	0	7.44	NA	NA	NA	0	NA	0.003	1	NA	8.05	1257	150		2.86	3.07	140		0.6%	140.57	0.60
3	7/15/98 12:23	1.5	4a-r4-i1.5h-3b	405.81	A. Basalt	100.054	7.30	NA	NA	NA	1.25	NA	0.543	5	121.6	8.03	1265	0		2.86	3.20	1		0.0%	1.00	0.00
4	7/15/98 13:59	3.1	4a-r4-i3h-4b	409.143	A. Basalt	100.0	7.29	NA	NA	NA	1.25	NA	0.514	5	115.2	8.03	1273	0		2.88	3.06	1		0.0%	1.00	0.00
5	7/15/98 15:55	5.1	4a-r4-i5h-5b	401.463	A. Basalt	100.0	7.30	NA	NA	NA	1.25	NA	0.529	5	118.5	8.13	1281	0		2.87	3.08	1		0.0%	1.00	0.00
6	7/16/98 8:05	21.2	4a-r4-i20h-6b	401.58	A. Basalt	100.1	6.92	NA	NA	NA	12.5	NA	0.535	50	1198.6	8.31	1289	0		2.92	3.48	1		0.0%	1.00	0.00
6	7/16/98 10:47	23.9	4a-r4-i24h-6b	401.58	A. Basalt	100.1	7.32	NA	NA	NA	12.5	NA	0.525	50	1176.2	8.33	1296	0		2.87	3.18	1		0.0%	1.00	0.00
	Extraction of the Remaining Reactor Contents																					soldgw TCE (mg)					
1																											
2																											
3	7/16/98 10:58	24.1	4a-r4-I3	405.81	A. Basalt	100.054					NA	NA	NA	NA	NA	NT	1309	0		400.24	419.47	0.0E+00					
4	7/16/98 10:59	24.1	4a-r4-I4	409.143	A. Basalt	100.023					NA	NA	NA	NA	NA	NT	1310	0		400.82	423.78	0.0E+00					
5	7/16/98 11:02	24.2	4a-r4-I5	401.463	A. Basalt	99.997					NA	NA	NA	NA	NA	NT	1311	0		400.3	426.52	0.0E+00					
6	7/16/98 11:04	24.2	4a-r4-I6	401.58	A. Basalt	100.058					NA	NA	NA	NA	NA	NT	1312	0		400	417.48	0.0E+00					
																					Mass carbon	Mass TCE (mg)					
	Extraction of the Charcoal Beds																										
1	7/16/98 10:50		4a-r4-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1297	0		2.82	0.08	0.0E+00					
1	7/16/98 10:50		4a-r4-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1298	0		2.82	0.04	0.0E+00					
2	7/16/98 10:51		4a-r4-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1299	0		2.84	0.09	0.0E+00					
2	7/16/98 10:51		4a-r4-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1300	0		2.85	0.04	0.0E+00					
3	7/16/98 10:52		4a-r4-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1301	0		2.85	0.09	0.0E+00					
3	7/16/98 10:52		4a-r4-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1302	0		2.85	0.05	0.0E+00					
4	7/16/98 10:53		4a-r4-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1303	0		2.85	0.02	0.0E+00					
4	7/16/98 10:53		4a-r4-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1304	0		2.84	0.04	0.0E+00					
5	7/16/98 10:54		4a-r4-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1305	0		2.85	0.09	0.0E+00					
5	7/16/98 10:54		4a-r4-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1306	0		2.83	0.03	0.0E+00					
6	7/16/98 10:55		4a-r4-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1307	0		2.88	0.10	0.0E+00					
6	7/16/98 10:55		4a-r4-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1308	0		2.84	0.04	0.0E+00					

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	no	0.000	NA	NA	NA
2	no	0.000	NA	NA	NA
3	48.3	0.10	5.16	0.01	
4	48.3	0.10	3.81	0.01	0.01
5	482.6	0.95	29.67	0.06	
6	482.6	0.95	6.79	0.01	0.04

Steven Robert Cline:
ND, BUT ENTERED AS 1 FOR PLOTTING LOG SCALE

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R5 For additional comments, see Laboratory Notebook B000025 Pages: **78-81**

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
C. Basalt	1000	NO	0.01 & 0.1

Experiment Start Date: 6/15/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
NONE NOTE: Small Amt of TCE in Blank solution!!!!!! (8-12 ppb) (See 061998b data set)
This hexane was likely used in the preparation of the GC extracts/dilutions

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.99 liters	
Volume Sat. TCE added	3 mL	
	3 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	1003 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
763	4a-r5-tba	6/17/98 15:10	1344		4.93	4.92	1347
764	4a-r5-tbb	6/17/98 15:10	1443		4.98	5.30	1354

Prepared by: S.R. Cline LastUpdated: 10/22/98

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	6/18/98 11:00	0.0	4a-r5--t0-1a	**495.18**	GW Only	**0.0**	14.30	14.3	495.18	NA
1	6/18/98 11:33	0.5	4a-r5-t30m-1	495.18	GW Only	0	7.61	21.91	480.88	NA
1	6/18/98 13:00	2.0	4a-r5-t1.5h-1	495.18	GW Only	0	7.39	29.3	473.27	NA
1	6/18/98 14:10	3.2	4a-r5-t3h-1	495.18	GW Only	0	7.33	36.63	465.88	NA
1	6/18/98 16:05	5.1	4a-r5-t5h-1	495.18	GW Only	0	6.95	43.58	458.55	NA
1	6/19/98 8:30	21.5	4a-r5-t20h-1	495.18	GW Only	0	7.48	51.06	451.6	NA
1	6/19/98 11:00	24.0	4a-r5-t24h-1	495.18	GW Only	0	7.35	58.41	444.12	NA
2	6/18/98 11:01	0.0	4a-r5-t0-2	**502.82**	GW Only	**0.0**	6.99	6.99	502.82	NA
2	6/18/98 11:33	0.5	4a-r5-t30m-2a	502.82	GW Only	0	14.83	21.82	495.83	NA
2	6/18/98 13:01	2.0	4a-r5-t1.5h-2	502.82	GW Only	0	7.27	29.09	481	NA
2	6/18/98 14:10	3.2	4a-r5-t3h-2	502.82	GW Only	0	7.22	36.31	473.73	NA
2	6/18/98 16:06	5.1	4a-r5-t5h-2	502.82	GW Only	0	7.18	43.49	466.51	NA
2	6/19/98 8:30	21.5	4a-r5-t20h-2	502.82	GW Only	0	7.22	50.71	459.33	NA
2	6/19/98 11:00	24.0	4a-r5-t24h-2	502.82	GW Only	0	7.22	57.93	452.11	NA

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.511	DF:	1667	Conc (ppm):	38160
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.17
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.15
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.007	1	NA	NA	NA	NA	NA	8.14
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.002	1	NA	NA	NA	NA	NA	8
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.17
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.15
2	0	0	0.000	1	NA	NA	NA	NA	NA	8.14
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.15
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.14

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	765	1,403		2.98	3.17	1,319		NA	NA	NA	NA	NA	NA	0.02
1	772	1,385		2.95	3.13	1,307		NA	NA	NA	NA	NA	NA	0.01
1	779	1,326		2.93	3.07	1,264		NA	NA	NA	NA	NA	NA	0.01
1	786	1,310		2.85	2.95	1,264		NA	NA	NA	NA	NA	NA	0.01
1	793	1,331		2.87	3.13	1,222		NA	NA	NA	NA	NA	NA	0.01
1	800	1,316		2.87	2.89	1,310		NA	NA	NA	NA	NA	NA	0.01
1	807	1,349		2.83	3.00	1,270		NA	NA	NA	NA	NA	NA	0.01
2	767	1,376		2.96	3.19	1,276		NA	NA	NA	NA	NA	NA	0.01
2	773	1,389		2.96	3.12	1,318		NA	NA	NA	NA	NA	NA	0.02
2	780	1,452		2.87	3.15	1,320		NA	NA	NA	NA	NA	NA	0.01
2	787	1,294		2.90	2.87	1,310		NA	NA	NA	NA	NA	NA	0.01
2	794	1,383		2.87	3.08	1,290		NA	NA	NA	NA	NA	NA	0.01
2	801	1,443		2.87	3.11	1,329		NA	NA	NA	NA	NA	NA	0.01
2	808	1,302		2.86	3.04	1,224		NA	NA	NA	NA	NA	NA	0.01

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	6/18/98 11:02	0.0	4a-r5-t0-3	**405.93**	C. Basalt	**100.0**	7.25	7.25	405.93	4.1
3	6/18/98 11:35	0.6	4a-r5-t30m-3	405.93	C. Basalt	100	7.18	14.43	399.93	4.0
3	6/18/98 13:01	2.0	4a-r5-t1.5h-3a	405.93	C. Basalt	100	14.06	28.49	392.75	3.9
3	6/18/98 14:11	3.1	4a-r5-t3h-3	405.93	C. Basalt	100	6.78	35.27	378.69	3.8
3	6/18/98 16:07	5.1	4a-r5-t5h-3	405.93	C. Basalt	100	6.86	42.13	371.91	3.7
3	6/19/98 8:31	21.5	4a-r5-t20h-3	405.93	C. Basalt	100	6.99	49.12	365.05	3.7
3	6/19/98 11:01	24.0	4a-r5-t24h-3	405.93	C. Basalt	100	6.78	55.9	358.06	3.6
4	6/18/98 11:03	0.0	4a-r5-t0-4	**420.04**	C. Basalt	**100.0**	6.88	6.88	420.04	4.2
4	6/18/98 11:36	0.5	4a-r5-t30m-4	420.04	C. Basalt	100.02	7.22	14.1	414.41	4.1
4	6/18/98 13:02	2.0	4a-r5-t1.5h-4	420.04	C. Basalt	100.02	7.01	21.11	407.19	4.1
4	6/18/98 14:12	3.1	4a-r5-t3h-4a	420.04	C. Basalt	100.02	13.42	34.53	400.18	4.0
4	6/18/98 16:08	5.1	4a-r5-t5h-4	420.04	C. Basalt	100.02	6.79	41.32	386.76	3.9
4	6/19/98 8:31	21.5	4a-r5-t20h-4	420.04	C. Basalt	100.02	6.95	48.27	379.97	3.8
4	6/19/98 11:01	24.0	4a-r5-t24h-4a	420.04	C. Basalt	100.02	13.73	62	373.02	3.7

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.511	DF:	1667	Conc (ppm):	38160
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0.0	0.002	1	119.3	0.0	0.0	0.0	0.0	8.17
3	1.25	119.3	0.472	5	105.7	5.4	5.4	0.1	0.8	8.1
3	1.25	105.7	0.452	5	101.3	1.8	7.2	0.1	1.4	8.11
3	1.25	101.3	0.438	5	98.1	1.2	8.4	0.1	0.7	8.11
3	1.25	98.1	0.439	5	98.3	-0.1	8.3	0.1	0.7	8.12
3	1.25	98.3	0.401	5	89.8	3.1	11.4	0.1	0.6	8.24
3	1.25	89.8	0.408	5	91.4	-0.6	10.8	0.1	0.6	8.26
4	0	0.0	0.003	1	115.1	0.0	0.0	0.0	0.0	8.17
4	1.25	115.1	0.459	5	102.8	5.1	5.1	0.1	0.7	8.09
4	1.25	102.8	0.444	5	99.5	1.4	6.5	0.1	0.7	8.09
4	1.25	99.5	0.432	5	96.8	1.1	7.5	0.1	1.3	8.1
4	1.25	96.8	0.417	5	93.4	1.3	8.8	0.1	0.6	8.11
4	1.25	93.4	0.399	5	89.4	1.5	10.4	0.1	0.6	8.21
4	1.25	89.4	0.406	5	91.0	-0.6	9.8	0.1	1.2	8.22

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	768	1,317		2.96	3.08	1,263		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
3	775	162		2.95	3.13	153		0.12	0.444	0.4	86.6%	84.3%	84.3%	0.00
3	781	23		2.98	3.03	22		0.02	0.051	0.5	10.0%	9.7%	94.0%	0.00
3	788	15		2.90	3.22	13		0.01	0.003	0.5	0.7%	0.6%	94.7%	0.00
3	795	8		2.85	3.08	7		0.01	0.002	0.5	0.5%	0.5%	95.1%	0.00
3	802	14		2.87	3.18	12		0.01	-0.002	0.5	-0.4%	-0.4%	94.8%	0.00
3	809	26		2.86	3.12	24		0.02	-0.004	0.5	-0.8%	-0.8%	93.9%	0.00
4	769	1,338		2.95	3.11	1,269		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
4	776	157		2.94	3.02	153		0.12	0.463	0.5	86.8%	84.9%	84.9%	0.00
4	783	31		2.93	3.02	30		0.02	0.050	0.5	9.4%	9.2%	94.1%	0.00
4	789	15		2.91	3.04	14		0.01	0.006	0.5	1.2%	1.2%	95.3%	0.00
4	796	18		2.09	3.67	10		0.01	0.002	0.5	0.3%	0.3%	95.6%	0.00
4	803	19		2.85	3.11	17		0.01	-0.003	0.5	-0.5%	-0.5%	95.1%	0.00
4	810	19		2.82	2.83	19		0.02	-0.001	0.5	-0.2%	-0.1%	94.9%	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	6/18/98 11:03	0.0	4a-r5-t0-5	**384.79**	C. Basalt	**100.0**	7.11	7.11	384.79	3.8
5	6/18/98 11:36	0.5	4a-r5-t30m-5	384.79	C. Basalt	100	7.05	14.16	390.18	3.9
5	6/18/98 13:03	2.0	4a-r5-t1.5h-5	384.79	C. Basalt	100	7.12	21.28	383.13	3.8
5	6/18/98 14:15	3.2	4a-r5-t3h-5	384.79	C. Basalt	100	7.1	28.38	376.01	3.8
5	6/18/98 16:08	5.1	4a-r5-t5h-5a	384.79	C. Basalt	100	14.15	42.53	368.91	3.7
5	6/19/98 8:32	21.5	4a-r5-t20h-5	384.79	C. Basalt	100	7.1	49.63	354.76	3.5
5	6/19/98 11:03	24.0	4a-r5-t24h-5	384.79	C. Basalt	100	6.9	56.53	347.66	3.5
6	6/18/98 11:04	0.0	4a-r5-t0-6	**406.26**	C. Basalt	**100.1**	7.12	7.12	406.26	4.1
6	6/18/98 11:37	0.6	4a-r5-t30m-6	406.26	C. Basalt	100.07	6.89	14.01	411.64	4.1
6	6/18/98 13:03	2.0	4a-r5-t1.5h-6	406.26	C. Basalt	100.07	6.84	20.85	404.75	4.0
6	6/18/98 14:15	3.2	4a-r5-t3h-6	406.26	C. Basalt	100.07	7.01	27.86	397.91	4.0
6	6/18/98 16:09	5.1	4a-r5-t5h-6	406.26	C. Basalt	100.07	6.71	34.57	390.9	3.9
6	6/19/98 8:33	21.5	4a-r5-t20h-6a	406.26	C. Basalt	100.07	13.68	48.25	384.19	3.8
6	6/19/98 11:04	24.0	4a-r5-t24h-6	406.26	C. Basalt	100.07	6.73	54.98	370.51	3.7
						100.07				

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.511	DF:	1667	Conc (ppm):	38160
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0.0	0.002	1	1222.5	0.0	0.0	0.0	0.0	8.15
5	12.5	1222.5	0.547	50	1225.5	-1.1	-1.1	0.0	8.6	8.11
5	12.5	1225.5	0.540	50	1209.8	6.0	4.9	0.0	8.6	8.1
5	12.5	1209.8	0.546	50	1223.2	-5.1	-0.2	0.0	8.7	8.1
5	12.5	1223.2	0.545	50	1221.0	0.8	0.6	0.0	17.3	8.1
5	12.5	1221.0	0.539	50	1207.5	4.8	5.4	0.1	8.6	8.24
5	12.5	1207.5	0.536	50	1200.8	2.3	7.7	0.1	8.3	8.25
6	0	0.0	0.002	1	1158.8	0.0	0.0	0.0	0.0	8.14
6	12.5	1158.8	0.531	50	1189.6	-12.7	-12.7	-0.1	8.2	8.09
6	12.5	1189.6	0.522	50	1169.4	8.2	-4.5	0.0	8.0	8.07
6	12.5	1169.4	0.522	50	1169.4	0.0	-4.5	0.0	8.2	8.07
6	12.5	1169.4	0.522	50	1169.4	0.0	-4.5	0.0	7.8	8.07
6	12.5	1169.4	0.528	50	1182.9	-5.2	-9.7	-0.1	16.2	8.14
6	12.5	1182.9	0.522	50	1169.4	5.0	-4.7	0.0	7.9	8.15

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R5	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	770	1,267		2.96	2.98	1,259		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
5	777	0		2.92	3.06	1		0.00	0.491	0.5	101.3%	98.3%	98.3%	0.00
5	784	0		2.91	2.92	1		0.00	0.000	0.5	0.0%	0.0%	98.3%	0.00
5	791	16		2.89	2.91	16		0.01	-0.006	0.5	-1.2%	-1.1%	97.2%	0.00
5	797	0		2.40	3.00	1		0.00	0.005	0.5	1.1%	1.1%	98.3%	0.00
5	804	0		2.87	2.93	1		0.00	0.000	0.5	0.0%	0.0%	98.3%	0.00
5	812	0		2.85	3.19	1		0.00	0.000	0.5	0.0%	0.0%	98.3%	0.00
6	771	1,554		2.92	3.45	1,317		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
6	778	13		2.95	2.87	13		0.01	0.537	0.5	100.3%	101.8%	101.8%	0.00
6	785	16		2.91	3.06	16		0.01	-0.001	0.5	-0.2%	-0.2%	101.6%	0.00
6	792	16		2.88	2.94	16		0.01	0.000	0.5	0.0%	0.0%	101.6%	0.00
6	799	17		2.88	2.20	22		0.02	-0.003	0.5	-0.5%	-0.5%	101.1%	0.00
6	805	18		2.85	3.11	16		0.01	0.002	0.5	0.4%	0.4%	101.6%	0.00
6	813	17		2.85	3.20	15		0.01	0.000	0.5	0.1%	0.1%	101.7%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4a-R5 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope: 0.022 STOCK SOLN ABS 0.515 DF: 1667 Conc (ppm) 38160

Calibration Date: 6/10/98

For additional comments, see Laboratory N

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	MnO4- Stock Mr Volume Added (mL)	MnO4- Initial (mg/L)	MnO4- Final ABS	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	%Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																					DUPLICATES				
1	6/18/98 11:01	0.0	4a-r5-t0-1b	495.18	GW Only	0	7.21	NA	NA	NA	0	NA	0.003	1	NA	8.14	766	1,395		3.00	3.12	1,339		-1.6%	1328.92	14.70
2	6/18/98 11:34	0.6	4a-r5-t30m-2b	502.82	GW Only	0	7.44	NA	NA	NA	0	NA	0.003	1	NA	8.15	774	1,296		2.95	2.89	1,324		-0.4%	1320.88	3.87
3	6/18/98 13:02	2.0	4a-r5-t1.5h-3b	405.93	C. Basalt	100	7.06	NA	NA	NA	1.25	NA	0.456	5	102.2	8.1	782	23		2.79	2.93	22		2.1%	22.03	0.33
4	6/18/98 14:13	3.2	4a-r5-t3h-4b	420.04	C. Basalt	100.02	6.67	NA	NA	NA	1.25	NA	0.438	5	98.1	8.09	790	14		2.89	3.13	13		9.8%	13.39	0.98
5	6/18/98 16:09	5.1	4a-r5-t5h-5b	384.79	C. Basalt	100	7.05	NA	NA	NA	12.5	NA	0.533	50	1194.1	8.1	798	12		2.87	2.98	12		-1069.9%	6.35	7.57
6	6/19/98 8:34	21.5	4a-r5-t20h-6b	406.26	C. Basalt	100.07	6.87	NA	NA	NA	12.5	NA	0.522	50	1169.4	8.13	806	19		2.87	3.19	17		-6.2%	16.86	0.72
4	6/19/98 11:02	24.0	4a-r5-t24h-4b	420.04	C. Basalt	100.02	6.86	NA	NA	NA	1.25	NA	0.409	5	91.6	8.22	811	19		2.84	3.215	17		13.4%	17.97	1.82
	Extraction of the Remaining Reactor Contents																									
1																										
2																										
3	6/19/98 11:30	24.5	4a-r5-f3	405.93	C. Basalt	100					NA	NA	NA	NA	NA	NT	826	17		400.88	412.99	6.8E-03				
4	6/19/98 11:31	24.5	4a-r5-f4	420.04	C. Basalt	100.02					NA	NA	NA	NA	NA	NT	827	0		402.21	423.29	0.0E+00				
5	6/19/98 11:32	24.5	4a-r5-f5	384.79	C. Basalt	100					NA	NA	NA	NA	NA	NT	828	0		401.89	357.59	0.0E+00				
6	6/19/98 11:33	24.5	4a-r5-f6	406.26	C. Basalt	100.07					NA	NA	NA	NA	NA	NT	829	21		403.15	429.28	8.5E-03				
	Extraction of the Charcoal Beds																				Mass carbon	Mass TCE (mg)				
1	6/19/98 11:49		4a-r5-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	814	0		2.85	0.08	0.0E+00				
1	6/19/98 11:49		4a-r5-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	815	14		2.85	0.04	4.1E-05				
2	6/19/98 11:47		4a-r5-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	816	13		2.82	0.08	3.8E-05				
2	6/19/98 11:47		4a-r5-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	817	0		2.87	0.03	0.0E+00				
3	6/19/98 11:45		4a-r5-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	818	14		2.85	0.05	3.9E-05				
3	6/19/98 11:45		4a-r5-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	819	0		2.87	0.03	0.0E+00				
4	6/19/98 11:40		4a-r5-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	820	14		1.97	0.69	2.7E-05				
4	6/19/98 11:40		4a-r5-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	821	0		2.86	0.03	0.0E+00				
5	6/19/98 0:00		4a-r5-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	822	NOSAMPLE		2.85	lost/broken					
5	6/19/98 0:00		4a-r5-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	823	NO SAMPLE		3.42	lost/broken					
6	6/19/98 11:36		4a-r5-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	824	13		2.86	0.09	3.6E-05				
6	6/19/98 11:36		4a-r5-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	825	0		2.87	0.04	0.0E+00				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @ t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	47.7	0.10	11.14	0.02	
4	47.7	0.09	10.01	0.02	0.02
5	477.0	0.97	8.47	0.02	
6	477.0	0.93	-4.39	-0.01	0.00

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R6 For additional comments, see Laboratory Notebook B000025 Pages: 106-109,114

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
A. Basalt	1000	NO	0.01 & 0.1

Experiment Start Date: 8/17/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
Spike solution only incubated at 12C for 3 hours instead of overnite.
Leak in Tedlar Bag, flasks5 and 6 only received 200 mL of spike directly from the Tedlar, the remaing vol for each was recovered from the tray.

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.81 liters	
Volume Sat. TCE added	2.8 mL	
	2.8 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	998 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1727R	4a-r6-tba	8/18/98 13:44	2706		4.92	5.25	2535
1728R	4a-r6-tbb	8/18/98 13:45	2362		4.87	4.92	2337

Prepared by: S.R. Cline LastUpdated: 10/22/98

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	8/19/98 11:00	0.0	4a-r6-t0-1a	**510.17**	GW Only	**0.0**	14.95	15.0	510.2	NA
1	8/19/98 11:30	0.5	4a-r6-t30min-1	510.17	GW Only	0.0	7.34	22.3	495.2	NA
1	8/19/98 12:36	1.6	4a-r6-t1.5h-1	510.17	GW Only	0.0	7.41	29.7	487.9	NA
1	8/19/98 14:05	3.1	4a-r6-t3h-1	510.17	GW Only	0.0	7.62	37.3	480.5	NA
1	8/19/98 16:04	5.1	4a-r6-t5h-1	510.17	GW Only	0.0	7.43	44.8	472.9	NA
1	8/20/98 8:10	21.2	4a-r6-t20h-1	510.17	GW Only	0.0	7.66	52.4	465.4	NA
1	8/20/98 11:00	24.0	4a-r6-t24h-1	510.17	GW Only	0.0	7.6	60.0	457.8	NA
2	8/19/98 11:02	0.0	4a-r6-t0-2	**472.81**	GW Only	**0.0**	8.2	8.2	472.8	NA
2	8/19/98 11:31	0.5	4a-r6-t30min-2a	472.81	GW Only	0.0	14.38	22.6	464.6	NA
2	8/19/98 12:37	1.6	4a-r6-t1.5h-2	472.81	GW Only	0.0	7.33	29.9	450.2	NA
2	8/19/98 14:06	3.1	4a-r6-t3h-2	472.81	GW Only	0.0	7.48	37.4	442.9	NA
2	8/19/98 16:05	5.1	4a-r6-t5h-2	472.81	GW Only	0.0	7.26	44.7	435.4	NA
2	8/20/98 8:11	21.1	4a-r6-t20h-2	472.81	GW Only	0.0	7.34	52.0	428.2	NA
2	8/20/98 11:01	24.0	4a-r6-t24h-2	472.81	GW Only	0.0	7.35	59.3	420.8	NA

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.539	DF:	1667	Conc (ppm):	40250.8
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4- per gram	mg MnO4- in Aliquot	pH
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.4
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.37
1	0	0	0.006	1	NA	NA	NA	NA	NA	8.42
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.38
1	0	0	0.006	1	NA	NA	NA	NA	NA	8.38
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.28
1	0	0	0.009	1	NA	NA	NA	NA	NA	8.26
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.41
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.41
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.41
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.38
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.38
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.24
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.24

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1729R	2,779		2.86	3.23	2,459		NA	NA	NA	NA	NA	NA	0.04
1	1736R	2,607		2.85	3.05	2,437		NA	NA	NA	NA	NA	NA	0.02
1	1743R	2,709		2.86	3.18	2,441		NA	NA	NA	NA	NA	NA	0.02
1	1750R	2,614		2.87	3.05	2,465		NA	NA	NA	NA	NA	NA	0.02
1	1757R	2,574		2.91	3.08	2,431		NA	NA	NA	NA	NA	NA	0.02
1	1764R	2,626		2.83	3.06	2,428		NA	NA	NA	NA	NA	NA	0.02
1	1771R	2,590		2.85	3.03	2,436		NA	NA	NA	NA	NA	NA	0.02
2	1731R	2,710		2.87	3.03	2,574		NA	NA	NA	NA	NA	NA	0.02
2	1737R	2,756		2.86	3.18	2,473		NA	NA	NA	NA	NA	NA	0.04
2	1744R	2,771		2.85	3.21	2,468		NA	NA	NA	NA	NA	NA	0.02
2	1751R	2,649		2.83	3.11	2,416		NA	NA	NA	NA	NA	NA	0.02
2	1758R	2,782		2.87	3.28	2,432		NA	NA	NA	NA	NA	NA	0.02
2	1765R	2,643		2.87	3.06	2,476		NA	NA	NA	NA	NA	NA	0.02
2	1772R	2,817		2.86	3.24	2,488		NA	NA	NA	NA	NA	NA	0.02

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	8/19/98 11:03	0.0	4a-r6-t0-3	**388.15**	A. Basalt	**100.1**	8.37	8.4	388.2	3.9
3	8/19/98 11:33	0.5	4a-r6-t30min-3	388.15	A. Basalt	100.1	6.88	15.3	381.0	3.8
3	8/19/98 12:38	1.6	4a-r6-t1.5h-3a	388.15	A. Basalt	100.1	13.94	29.2	374.2	3.7
3	8/19/98 14:07	3.1	4a-r6-t3h-3	388.15	A. Basalt	100.1	6.98	36.2	360.2	3.6
3	8/19/98 16:06	5.0	4a-r6-t5h-3	388.15	A. Basalt	100.1	7.22	43.4	353.2	3.5
3	8/20/98 8:12	21.1	4a-r6-t20h-3	388.15	A. Basalt	100.1	7.1	50.5	346.0	3.5
3	8/20/98 11:02	24.0	4a-r6-t24h-3a	388.15	A. Basalt	100.1	14.32	64.8	338.9	3.4
4	8/19/98 11:04	0.0	4a-r6-t0-4	**406.41**	A. Basalt	**100.3**	7.32	7.3	406.4	4.1
4	8/19/98 11:34	0.5	4a-r6-t30min-4	406.41	A. Basalt	100.3	7	14.3	400.3	4.0
4	8/19/98 12:40	1.6	4a-r6-t1.5h-4	406.41	A. Basalt	100.3	7.4	21.7	393.3	3.9
4	8/19/98 14:08	3.1	4a-r6-t3h-4a	406.41	A. Basalt	100.3	14.27	36.0	385.9	3.8
4	8/19/98 16:07	5.1	4a-r6-t5h-4	406.41	A. Basalt	100.3	7.19	43.2	371.7	3.7
4	8/20/98 8:13	21.2	4a-r6-t20h-4	406.41	A. Basalt	100.3	7.32	50.5	364.5	3.6
4	8/20/98 11:04	24.0	4a-r6-t24h-4	406.41	A. Basalt	100.3	7.26	57.8	357.2	3.6

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.539	DF:	1667	Conc (ppm):	40250.8
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4- Consumed in Interval	Cum. mg MnO4- Consumed	Cum mg MnO4- per gram	mg MnO4- in Aliquot	pH
3	0	0.0	0.009	1	132.0	0.0	0.0	0.0	0.0	8.38
3	1.25	132.0	0.508	5	113.8	6.9	6.9	0.1	0.8	8.27
3	1.25	113.8	0.472	5	105.7	3.0	10.0	0.1	1.5	8.25
3	1.25	105.7	0.495	5	110.9	-1.9	8.1	0.1	0.8	8.24
3	1.25	110.9	0.494	5	110.7	0.1	8.2	0.1	0.8	8.24
3	1.25	110.7	0.480	5	107.5	1.1	9.3	0.1	0.8	8.19
3	1.25	107.5	0.483	5	108.2	-0.2	9.0	0.1	1.5	8.22
4	0	0.0	0.003	1	125.7	0.0	0.0	0.0	0.0	8.37
4	1.25	125.7	0.494	5	110.7	6.0	6.0	0.1	0.8	8.27
4	1.25	110.7	0.483	5	108.2	1.0	7.0	0.1	0.8	8.22
4	1.25	108.2	0.491	5	110.0	-0.7	6.3	0.1	1.6	8.23
4	1.25	110.0	0.487	5	109.1	0.3	6.6	0.1	0.8	8.23
4	1.25	109.1	0.476	5	106.6	0.9	7.5	0.1	0.8	8.18
4	1.25	106.6	0.552	5	123.7	-6.1	1.4	0.0	0.9	8.21

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1732R	2,578		2.86	3.20	2,304		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.02
3	1739	267		2.83	3.11	243		0.11	0.785	0.8	87.8%	80.4%	80.4%	0.00
3	1745	57		2.93	3.15	53		0.02	0.071	0.9	7.9%	7.3%	87.7%	0.00
3	1752	17		2.82	2.99	16		0.01	0.013	0.9	1.5%	1.4%	89.0%	0.00
3	1759	10		2.86	3.33	8		0.00	0.003	0.9	0.3%	0.3%	89.3%	0.00
3	1766	7		2.83	2.97	6		0.00	0.001	0.9	0.1%	0.1%	89.4%	0.00
3	1773	21		2.88	3.08	20		0.01	-0.005	0.9	-0.5%	-0.5%	88.9%	0.00
4	1733R	2,493		2.91	3.12	2,324		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.02
4	1740	272		2.84	3.04	253		0.11	0.829	0.8	87.8%	81.1%	81.1%	0.00
4	1747	54		2.85	3.10	50		0.02	0.080	0.9	8.5%	7.8%	88.9%	0.00
4	1753	6	U	2.82	3.02	5	U	0.00	0.017	0.9	1.8%	1.7%	90.6%	0.00
4	1760	0		2.87	3.09	1		[illegible]	.002	0.9	0.2%	0.2%	90.7%	0.00
4	1767	0		2.87	3.21	1		0.00	0.000	0.9	0.0%	0.0%	90.7%	0.00
4	1775	0		2.85	3.08	1		0.00	0.000	0.9	0.0%	0.0%	90.7%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	8/19/98 11:05	0.0	4a-r6-t0-5	**417.52**	A. Basalt	**100.4**	7.23	7.2	417.5	4.2
5	8/19/98 11:35	0.5	4a-r6-t30min-5	417.52	A. Basalt	100.4	7.18	14.4	422.8	4.2
5	8/19/98 12:41	1.6	4a-r6-t1.5h-5	417.52	A. Basalt	100.4	7.43	21.8	415.6	4.1
5	8/19/98 14:10	3.1	4a-r6-t3h-5	417.52	A. Basalt	100.4	7.56	29.4	408.2	4.1
5	8/19/98 16:08	5.1	4a-r6-t5h-5a	417.52	A. Basalt	100.4	14.72	44.1	400.6	4.0
5	8/20/98 8:14	21.1	4a-r6-t20h-5	417.52	A. Basalt	100.4	7.32	51.4	385.9	3.8
5	8/20/98 11:05	24.0	4a-r6-t24h-5	417.52	A. Basalt	100.4	7.26	58.7	378.6	3.8
6	8/19/98 11:06	0.0	4a-r6-t0-6	**381.89**	A. Basalt	**100.1**	6.85	6.9	381.9	3.8
6	8/19/98 11:36	0.5	4a-r6-t30min-6	381.89	A. Basalt	100.1	7.19	14.0	387.5	3.9
6	8/19/98 12:42	1.6	4a-r6-t1.5h-6	381.89	A. Basalt	100.1	7.47	21.5	380.4	3.8
6	8/19/98 14:11	3.1	4a-r6-t3h-6	381.89	A. Basalt	100.1	7.22	28.7	372.9	3.7
6	8/19/98 16:10	5.1	4a-r6-t5h-6	381.89	A. Basalt	100.1	7.17	35.9	365.7	3.7
6	8/20/98 8:15	21.1	4a-r6-t20h-6a	381.89	A. Basalt	100.1	14.46	50.4	358.5	3.6
6	8/20/98 11:06	24.0	4a-r6-t24h-6	381.89	A. Basalt	100.1	7.32	57.7	344.0	3.4

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.539	DF:	1667	Conc (ppm):	40250.8
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4-	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4-	mg MnO4-	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0.0	0.002	1	1190.0	0.0	0.0	0.0	0.0	8.35
5	12.5	1190.0	0.491	50	1100.0	38.1	38.1	0.4	7.9	8.39
5	12.5	1100.0	0.480	50	1075.4	10.2	48.3	0.5	8.0	8.37
5	12.5	1075.4	0.492	50	1102.2	-11.0	37.3	0.4	8.3	8.36
5	12.5	1102.2	0.490	50	1097.8	1.8	39.1	0.4	16.2	8.36
5	12.5	1097.8	0.497	50	1113.4	-6.1	33.1	0.3	8.2	8.29
5	12.5	1113.4	0.507	50	1135.8	-8.5	24.6	0.2	8.2	8.3
6	0	0.0	0.001	1	1298.3	0.0	0.0	0.0	0.0	8.34
6	12.5	1298.3	0.579	50	1297.1	0.4	0.4	0.0	9.3	8.39
6	12.5	1297.1	0.555	50	1243.4	20.5	20.9	0.2	9.3	8.37
6	12.5	1243.4	0.554	50	1241.1	0.8	21.7	0.2	9.0	8.35
6	12.5	1241.1	0.565	50	1265.8	-9.0	12.7	0.1	9.1	8.36
6	12.5	1265.8	0.571	50	1279.2	-4.8	7.9	0.1	18.5	8.29
6	12.5	1279.2	0.564	50	1263.5	5.4	13.3	0.1	9.2	8.3

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R6	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1734	718		2.90	3.22	647		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
5	1741	5	U	2.86	3.16	5	U	0.01	0.271	0.3	100.6%	25.8%	25.8%	0.00
5	1748	0		2.87	3.05	1		[illegible]	.001	0.3	0.5%	0.1%	26.0%	0.00
5	1755	0		2.87	3.06	1		[illegible]	.000	0.3	0.0%	0.0%	26.0%	0.00
5	1761	0		2.82	3.37	1		0.00	0.000	0.3	0.0%	0.0%	26.0%	0.00
5	1768	0		2.87	3.16	1		0.00	0.000	0.3	0.0%	0.0%	26.0%	0.00
5	1776	0		2.82	3.13	1		0.00	0.000	0.3	0.0%	0.0%	26.0%	0.00
6	1735	666		2.84	3.03	624		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
6	1742	0		2.86	3.11	1		0.00	0.241	0.2	101.3%	25.1%	25.1%	0.00
6	1749	0		2.88	3.05	1		0.00	0.000	0.2	0.0%	0.0%	25.1%	0.00
6	1756	0		2.87	3.25	1		0.00	0.000	0.2	0.0%	0.0%	25.1%	0.00
6	1763	0		2.84	3.14	1		0.00	0.000	0.2	0.0%	0.0%	25.1%	0.00
6	1769	0		2.88	3.16	1		0.00	0.000	0.2	0.0%	0.0%	25.1%	0.00
6	1777	0		2.84	3.23	1		0.00	0.000	0.2	0.0%	0.0%	25.1%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp 4a-R6 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope 0.022 STOCK SOLN ABS 0.539 DF 1667 Conc (ppm) 402508

Calibration Date: 6/10/98

For additional comments, see Laboratory N

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (mL)	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	8/19/98 11:01	0.0	4a-r6-t0-1b	510.17	GW Only	0.0	7.54	NA	NA	NA	0	NA	0.004	1	NA	8.41	1730R	2,809		2.86	3.16	2,542		-3.4%	2500.28	58.52
2	8/19/98 11:32	0.5	4a-r6-t30min-2b	472.81	GW Only	0.0	7.18	NA	NA	NA	0	NA	0.000	1	NA	8.43	1738R	2,673		2.87	3.18	2,407		2.7%	2440.36	46.57
3	8/19/98 12:39	1.6	4a-r6-t1.5h-3b	388.15	A. Basalt	100.1	6.99	NA	NA	NA	1.25	NA	0.498	5	111.6	8.23	1746	52		2.86	3.32	45		15.8%	49.19	5.97
4	8/19/98 14:09	3.1	4a-r6-t3h-4b	406.41	A. Basalt	100.3	6.96	NA	NA	NA	1.25	NA	0.49	5	109.8	8.22	1754	5	U	2.94	3.24	4	U	20.5%	4.66	0.75
5	8/19/98 16:09	5.1	4a-r6-t5h-5b	417.52	A. Basalt	100.4	7.43	NA	NA	NA	12.5	NA	0.525	50	1176.2	8.36	1762	0		2.87	3.11	1		0.0%	1.00	0.00
6	8/20/98 8:16	21.2	4a-r6-t20h-6b	381.89	A. Basalt	100.1	7.08	NA	NA	NA	12.5	NA	0.581	50	1301.6	8.29	1770	0		2.86	3.32	1		0.0%	1.00	0.00
3	8/20/98 11:03	24.0	4a-r6-t24h-3b	388.15	A. Basalt	100.1	7.34	NA	NA	NA	1.25	NA	0.500	5	112.0	8.21	1774	0		2.85	3.11	1		95.0%	10.54	13.49
	Extraction of the Remaining Reactor Contents																					**soil/gw TCE (mg)**				
1																										
2																										
3	8/20/98 11:24	24.3	4a-r6-f3	388.15	A. Basalt	100.1					NA	NA	NA	NA	NA	NT	1790	0		403.03	389.44	0.0E+00				
4	8/20/98 11:26	24.4	4a-r6-f4	406.41	A. Basalt	100.3					NA	NA	NA	NA	NA	NT	1791	0		403.09	420.21	0.0E+00				
5	8/20/98 11:28	24.4	4a-r6-f5	417.52	A. Basalt	100.4					NA	NA	NA	NA	NA	NT	1792	0		404.55	441.06	0.0E+00				
6	8/20/98 11:30	24.4	4a-r6-f6	381.89	A. Basalt	100.1					NA	NA	NA	NA	NA	NT	1793	0		403.33	403.29	0.0E+00				
																					Mass	Mass				
	Extraction of the Charcoal Beds																					**carbon (TCE (mg)**				
1	8/20/98 11:17		4a-r6-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1778	0		2.83	0.08	0.0E+00				
1	8/20/98 11:17		4a-r6-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1779	0		2.86	0.03	0.0E+00				
2	8/20/98 11:18		4a-r6-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1780	0		2.85	0.10	0.0E+00				
2	8/20/98 11:18		4a-r6-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1781	0		2.90	0.03	0.0E+00				
3	8/20/98 11:19		4a-r6-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1782	0		2.76	0.08	0.0E+00				
3	8/20/98 11:19		4a-r6-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1783	0		2.85	0.04	0.0E+00				
4	8/20/98 11:20		4a-r6-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1784	0		2.87	0.08	0.0E+00				
4	8/20/98 11:20		4a-r6-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1785	0		2.87	0.04	0.0E+00				
5	8/20/98 11:21		4a-r6-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1786	0		2.79	0.09	0.0E+00				
5	8/20/98 11:21		4a-r6-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1787	0		2.82	0.04	0.0E+00				
6	8/20/98 11:22		4a-r6-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1788	0		2.84	0.09	0.0E+00				
6	8/20/98 11:22		4a-r6-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1789	0		2.98	0.03	0.0E+00				

pH Data

MnO4 Data

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @ t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	50.3	0.10	9.08	0.02	
4	50.3	0.10	0.81	0.00	0.01
5	503.1	0.96	22.91	0.04	
6	503.1	1.03	13.46	0.03	0.04

Steven Robert Cline:

Prepared by: S.R. Cline

Last Updated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R7 For additional comments, see Laboratory Notebook B000025 Pages: 87-90

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sed (1st)	100	NO	0.01 & 0.1

Experiment Start Date: 7/7/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
Also extracted un-used orbo charcoal tubes to determine if Peak at 5.03 minutes is related to TCE spiking

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.62 liters	
Volume Sat. TCE added	0.3 mL	
	0.3 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	114 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1029	4a-r7-tb-a	7/8/98 15:50	293		4.96	5.23	278
1030	4a-r7-tb-b	7/8/98 15:50	285		5.02	5.31	270

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	7/9/98 11:37	0.0	4a-r7-t0-1a	**489.295**	GW Only	**0.0**	13.68	13.68	489.3	NA
1	7/9/98 12:30	0.9	4a-r7-t30min-1	489.295	GW Only	0	6.98	20.66	475.6	NA
1	7/9/98 13:32	1.9	4a-r7-t1.5h-1	489.295	GW Only	0	6.91	27.57	468.6	NA
1	7/9/98 14:59	3.4	4a-r7-t3h-1	489.295	GW Only	0	6.93	34.5	461.7	NA
1	7/9/98 16:55	5.3	4a-r7-t5h-1	489.295	GW Only	0	6.82	41.32	454.8	NA
1	7/10/98 8:35	21.0	4a-r7-t20h-1	489.295	GW Only	0	7.31	48.63	448.0	NA
1	7/10/98 12:06	24.5	4a-r7-t24h-1	489.295	GW Only	0	7.32	55.95	440.7	NA
2	7/9/98 11:38	0.0	4a-r7-t0-2	**478.168**	GW Only	**0.0**	7.08	7.08	478.2	NA
2	7/9/98 12:31	0.9	4a-r7-t30min-2a	478.168	GW Only	0	14.74	21.82	471.1	NA
2	7/9/98 13:33	1.9	4a-r7-t1.5h-2	478.168	GW Only	0	7.37	29.19	456.3	NA
2	7/9/98 15:00	3.4	4a-r7-t3h-2	478.168	GW Only	0	7.01	36.2	449.0	NA
2	7/9/98 16:56	5.3	4a-r7-t5h-2	478.168	GW Only	0	7.11	43.31	442.0	NA
2	7/10/98 8:36	21.0	4a-r7-t20h-2	478.168	GW Only	0	7.34	50.65	434.9	NA
2	7/10/98 12:07	24.5	4a-r7-t24h-2	478.168	GW Only	0	7.5	58.15	427.5	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.54	DF:	1667	Conc (ppm):	40325.47
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.07
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.1
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.1
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.1
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.1
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.13
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.12
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.1
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.001	1	NA	NA	NA	NA	NA	8.12
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.13
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.12
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.12
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.14

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1031	269		2.91	3.11	252		NA	NA	NA	NA	NA	NA	0.00
1	1038	284		2.95	3.54	236		NA	NA	NA	NA	NA	NA	0.00
1	1045	264		2.97	3.29	238		NA	NA	NA	NA	NA	NA	0.00
1	1052	259		2.95	3.25	236		NA	NA	NA	NA	NA	NA	0.00
1	1059	270		2.92	3.31	238		NA	NA	NA	NA	NA	NA	0.00
1	1066	261		2.93	3.21	238		NA	NA	NA	NA	NA	NA	0.00
1	1073	266		2.95	3.39	232		NA	NA	NA	NA	NA	NA	0.00
2	1032	289		2.93	3.32	255		NA	NA	NA	NA	NA	NA	0.00
2	1039	281		2.95	3.34	249		NA	NA	NA	NA	NA	NA	0.00
2	1046	270		2.97	3.23	248		NA	NA	NA	NA	NA	NA	0.00
2	1053	278		2.94	3.34	244		NA	NA	NA	NA	NA	NA	0.00
2	1060	273		2.93	3.31	242		NA	NA	NA	NA	NA	NA	0.00
2	1067	275		2.93	3.28	245		NA	NA	NA	NA	NA	NA	0.00
2	1074	257		2.93	3.10	244		NA	NA	NA	NA	NA	NA	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	7/9/98 11:39	0.0	4a-r7-t0-3	**415.232**	Sed (1st)	**97.1**	6.41	6.41	415.2	4.3
3	7/9/98 12:32	0.9	4a-r7-t30min-3	415.232	Sed (1st)	97.107	6.8	13.21	410.1	4.2
3	7/9/98 13:34	1.9	4a-r7-t1.5h-3a	415.232	Sed (1st)	97.107	13.85	27.06	403.3	4.2
3	7/9/98 15:01	3.4	4a-r7-t3h-3	415.232	Sed (1st)	97.107	6.71	33.77	389.4	4.0
3	7/9/98 16:57	5.3	4a-r7-t5h-3	415.232	Sed (1st)	97.107	7.27	41.04	382.7	3.9
3	7/10/98 8:37	21.0	4a-r7-t20h-3	415.232	Sed (1st)	97.107	6.76	47.8	375.4	3.9
3	7/10/98 12:08	24.5	4a-r7-t24h-3	415.232	Sed (1st)	97.107	5.33	53.13	368.7	3.8
4	7/9/98 11:40	0.0	4a-r7-t0-4	**389.721**	Sed (1st)	**97.0**	6.56	6.56	389.7	4.0
4	7/9/98 12:33	0.9	4a-r7-t30min-4	389.721	Sed (1st)	96.963	6.76	13.32	384.4	4.0
4	7/9/98 13:36	1.9	4a-r7-t1.5h-4	389.721	Sed (1st)	96.963	6.52	19.84	377.7	3.9
4	7/9/98 15:02	3.4	4a-r7-t3h-4a	389.721	Sed (1st)	96.963	12.95	32.79	371.1	3.8
4	7/9/98 16:57	5.3	4a-r7-t5h-4	389.721	Sed (1st)	96.963	6.74	39.53	358.2	3.7
4	7/10/98 8:38	21.0	4a-r7-t20h-4	389.721	Sed (1st)	96.963	6.85	46.38	351.4	3.6
4	7/10/98 12:09	24.5	4a-r7-t24h-4	389.721	Sed (1st)	96.963	6.41	52.79	344.6	3.6

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.54	DF:	1667	Conc (ppm):	40325.47
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (ml	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0.0	0.001	1	122.9	0.0	0.0	0.0	0.0	7.89
3	1.25	122.9	0.48	5	107.5	6.3	6.3	0.1	0.7	7.91
3	1.25	107.5	0.451	5	101.0	2.6	8.9	0.1	1.4	7.94
3	1.25	101.0	0.468	5	104.8	-1.5	7.4	0.1	0.7	7.88
3	1.25	104.8	0.429	5	96.1	3.3	10.8	0.1	0.7	7.95
3	1.25	96.1	0.433	5	97.0	-0.3	10.5	0.1	0.7	7.98
3	1.25	97.0	0.44	5	98.6	-0.6	9.9	0.1	0.5	7.9
4	0	0.0	0.003	1	131.1	0.0	0.0	0.0	0.0	7.9
4	1.25	131.1	0.529	5	118.5	4.8	4.8	0.1	0.8	7.89
4	1.25	118.5	0.53	5	118.7	-0.1	4.8	0.0	0.8	7.86
4	1.25	118.7	0.51	5	114.3	1.7	6.4	0.1	1.5	7.88
4	1.25	114.3	0.503	5	112.7	0.6	7.0	0.1	0.8	7.92
4	1.25	112.7	0.471	5	105.5	2.5	9.5	0.1	0.7	7.99
4	1.25	105.5	0.524	5	117.4	-4.1	5.4	0.1	0.8	7.97

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1033	255		2.99	3.22	237		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
3	1041	28		2.96	3.32	25		0.10	0.087	0.1	88.4%	82.6%	82.6%	0.00
3	1047	6	U	2.97	3.43	5	U	[illegible]	[illegible].008	0.1	8.2%	7.6%	90.2%	0.00
3	1054	0		2.94	3.21	1		[illegible]	[illegible].002	0.1	1.6%	1.4%	91.6%	0.00
3	1061	0		2.93	3.38	1		[illegible]	[illegible].000	0.1	0.0%	0.0%	91.6%	0.00
3	1068	0		2.95	2.98	1		0.00	0.000	0.1	0.0%	0.0%	91.6%	0.00
3	1075	0		2.93	2.87	1		0.00	0.000	0.1	0.0%	0.0%	91.6%	0.00
4	1034	241		2.98	3.09	233		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
4	1042	19		2.97	3.22	18		0.08	0.083	0.1	91.0%	83.7%	83.7%	0.00
4	1049	5	U	2.93	3.37	4	U	0.02	0.005	0.1	5.7%	5.2%	88.9%	0.00
4	1055	0		2.95	3.47	1		0.00	0.001	0.1	1.4%	1.3%	90.1%	0.00
4	1062	0		2.94	3.23	1		0.00	0.000	0.1	0.0%	0.0%	90.1%	0.00
4	1069	0		2.94	3.08	1		0.00	0.000	0.1	0.0%	0.0%	90.1%	0.00
4	1076	0		2.92	2.96	1		0.00	0.000	0.1	0.0%	0.0%	90.1%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	7/9/98 11:41	0.0	4a-r7-t0-5	**405.574**	Sed (1st)	**97.0**	6.49	6.49	405.6	4.2
5	7/9/98 12:34	0.9	4a-r7-t30min-5	405.574	Sed (1st)	97.023	6.78	13.27	411.6	4.2
5	7/9/98 13:37	1.9	4a-r7-t1.5h-5	405.574	Sed (1st)	97.023	6.78	20.05	404.8	4.2
5	7/9/98 15:04	3.4	4a-r7-t3h-5	405.574	Sed (1st)	97.023	6.75	26.8	398.0	4.1
5	7/9/98 16:58	5.3	4a-r7-t5h-5a	405.574	Sed (1st)	97.023	13.52	40.32	391.3	4.0
5	7/10/98 8:39	21.0	4a-r7-t20h-5	405.574	Sed (1st)	97.023	6.61	46.93	377.8	3.9
5	7/10/98 12:10	24.5	4a-r7-t24h-5a	405.574	Sed (1st)	97.023	13.75	60.68	371.1	3.8
6	7/9/98 11:42	0.0	4a-r7-t0-6	**367.946**	Sed (1st)	**91.6**	6.5	6.5	367.9	4.0
6	7/9/98 12:35	0.9	4a-r7-t30min-6	367.946	Sed (1st)	91.59	6.65	13.15	373.9	4.1
6	7/9/98 13:38	1.9	4a-r7-t1.5h-6	367.946	Sed (1st)	91.59	6.95	20.1	367.3	4.0
6	7/9/98 15:05	3.4	4a-r7-t3h-6	367.946	Sed (1st)	91.59	6.74	26.84	360.3	3.9
6	7/9/98 17:00	5.3	4a-r7-t5h-6	367.946	Sed (1st)	91.59	6.91	33.75	353.6	3.9
6	7/10/98 8:39	21.0	4a-r7-t20h-6a	367.946	Sed (1st)	91.59	13.92	47.67	346.7	3.8
6	7/10/98 12:12	24.5	4a-r7-t24h-6	367.946	Sed (1st)	91.59	6.77	54.44	332.8	3.6

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.54	DF:	1667	Conc (ppm):	40325.47
	Calibration Date: 6/10/98									
	MnO4 Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0.0	0.004	1	1224.7	0.0	0.0	0.0	0.0	7.91
5	12.5	1224.7	0.529	50	1185.1	16.3	16.3	0.2	8.0	7.79
5	12.5	1185.1	0.512	50	1147.0	15.4	31.7	0.3	7.8	7.72
5	12.5	1147.0	0.517	50	1158.2	-4.5	27.2	0.3	7.8	7.72
5	12.5	1158.2	0.497	50	1113.4	17.5	44.8	0.5	15.1	7.74
5	12.5	1113.4	0.494	50	1106.7	2.5	47.3	0.5	7.3	7.78
5	12.5	1106.7	0.516	50	1156.0	-18.3	29.0	0.3	15.9	7.81
6	0	0.0	0.002	1	1348.0	0.0	0.0	0.0	0.0	7.91
6	12.5	1348.0	0.563	50	1261.3	32.4	32.4	0.4	8.4	7.78
6	12.5	1261.3	0.566	50	1268.0	-2.5	29.9	0.3	8.8	7.72
6	12.5	1268.0	0.572	50	1281.5	-4.8	25.1	0.3	8.6	7.72
6	12.5	1281.5	0.555	50	1243.4	13.5	38.6	0.4	8.6	7.74
6	12.5	1243.4	0.553	50	1238.9	1.6	40.1	0.4	17.2	7.78
6	12.5	1238.9	0.557	50	1247.9	-3.0	37.1	0.4	8.4	7.81

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R7	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1035	257		2.95	3.21	236		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
5	1043	0		2.95	3.35	1		[illegible]	0.097	0.1	101.1%	94.1%	94.1%	0.00
5	1050	0		2.95	3.39	1		[illegible]	0.000	0.1	0.0%	0.0%	94.1%	0.00
5	1057	0		2.93	3.44	1		0.00	0.000	0.1	0.0%	0.0%	94.1%	0.00
5	1063	0		2.94	3.09	1		0.00	0.000	0.1	0.0%	0.0%	94.1%	0.00
5	1070	0		2.95	3.29	1		0.00	0.000	0.1	0.0%	0.0%	94.1%	0.00
5	1077	0		2.92	3.16	1		0.00	0.000	0.1	0.0%	0.0%	94.1%	0.00
6	1036	232		2.98	3.36	206		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.00
6	1044	0		2.98	3.61	1		0.00	0.077	0.1	101.1%	82.4%	82.4%	0.00
6	1051	0		2.96	3.15	1		0.00	0.000	0.1	0.0%	0.0%	82.4%	0.00
6	1058	0		2.92	3.51	1		0.00	0.000	0.1	0.0%	0.0%	82.4%	0.00
6	1065	0		2.91	3.37	1		0.00	0.000	0.1	0.0%	0.0%	82.4%	0.00
6	1071	0		2.95	3.20	1		0.00	0.000	0.1	0.0%	0.0%	82.4%	0.00
6	1079	0		2.94	3.29	1		0.00	0.000	0.1	0.0%	0.0%	82.4%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4a-R7 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope: 0.022 STOCK SOLN ABS 0.54 DF: 1667 Conc (ppm): 40325.47 For additional comments, see Laboratory N

Calibration Date: 6/10/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	MnO4- Data: Volume Stock Mn Added (m	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	ORNL GC #	Extract Conc (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
Duplicate VOC Samples												DUPLICATES										DUPLICATES				
1	7/9/98 11:42	0.1	4a-r7-10-1b	489.295	GW Only	0	6.71	NA	NA	NA	0	NA	0.003	1	NA	8.06	1037	288		2.98	3.46	248		1.6%	249.71	2.76
2	7/9/98 12:31	0.9	4a-r7-130min-2b	478.168	GW Only	0	7.50	NA	NA	NA	0	NA	0.003	1	NA	8.13	1040	287		2.95	3.39	250		-0.5%	249.26	0.87
3	7/9/98 13:35	1.9	4a-r7-11.5h-3b	415.232	Sed (1st)	97.107	6.71	NA	NA	NA	1.25	NA	0.49	5	109.8	7.86	1048	6	U	2.95	3.33	5	U	-1.0%	4.94	0.04
4	7/9/98 15:03	3.4	4a-r7-13h-4b	389.721	Sed (1st)	96.963	6.50	NA	NA	NA	1.25	NA	0.516	5	115.6	7.87	1056	0		2.92	3.57	1		0.0%	1.00	0.00
5	7/9/98 16:59	5.3	4a-r7-15h-5b	405.574	Sed (1st)	97.023	6.66	NA	NA	NA	12.5	NA	0.519	50	1162.7	7.74	1064	0		2.95	3.34	1		0.0%	1.00	0.00
6	7/10/98 8:40	21.0	4a-r7-120h-6b	367.946	Sed (1st)	91.59	6.94	NA	NA	NA	12.5	NA	0.553	50	1238.9	7.79	1072	0		2.96	3.23	1		0.0%	1.00	0.00
5	7/10/98 12:11	24.5	4a-r7-124h-5b	405.574	Sed (1st)	97.023	6.85	NA	NA	NA	12.5	NA	0.514	50	0.0	7.81	1078	0		2.92	2.84	1		0.0%	1.00	0.00
Extraction of the Remaining Reactor Contents																						soil/gw TCE (mg)				
1																										
2																										
3	7/10/98 12:40	25.0	4a-r7-f3	415.232	Sed (1st)	97.107					NA	NA	NA	NA	NA	NT	1092	0		400.33	416.54	0.0E+00				
4	7/10/98 12:43	25.1	4a-r7-f4	389.721	Sed (1st)	96.963					NA	NA	NA	NA	NA	NT	1093	0		399.55	394.01	0.0E+00				
5	7/10/98 12:47	25.1	4a-r7-f5	405.574	Sed (1st)	97.023					NA	NA	NA	NA	NA	NT	1094	0		399.06	410.54	0.0E+00				
6	7/10/98 12:50	25.1	4a-r7-f6	367.946	Sed (1st)	91.59					NA	NA	NA	NA	NA	NT	1095	0		399.00	380.75	0.0E+00				
Extraction of the Charcoal Beds																						carbon (TCE (mg)				
1	7/10/98 12:25		4a-r7-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1080	0		2.93	0.10	0.0E+00				
1	7/10/98 12:25		4a-r7-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1081	0		2.92	0.04	0.0E+00				
2	7/10/98 12:26		4a-r7-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1082	0		2.92	0.10	0.0E+00				
2	7/10/98 12:26		4a-r7-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1083	0		2.91	0.05	0.0E+00				
3	7/10/98 12:27		4a-r7-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1084	0		2.92	0.10	0.0E+00				
3	7/10/98 12:27		4a-r7-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1085	0		2.94	0.05	0.0E+00				
4	7/10/98 12:28		4a-r7-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1086	0		2.95	0.10	0.0E+00				
4	7/10/98 12:28		4a-r7-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1087	0		2.92	0.05	0.0E+00				
5	7/10/98 12:29		4a-r7-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1088	0		2.92	0.10	0.0E+00				
5	7/10/98 12:29		4a-r7-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1089	0		2.93	0.05	0.0E+00				
6	7/10/98 12:30		4a-r7-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1090	0		2.93	0.08	0.0E+00				
6	7/10/98 12:30		4a-r7-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1091	0		2.93	0.04	0.0E+00				
*	35984.48958		Clean char-b		Charcoal	NA					NA	NA	NA	NA	NA	NA	1096	0		2.93	0.05	0.0E+00				
*	35984.48958		Clean char-a		Charcoal	NA					NA	NA	NA	NA	NA	NA	1097	0		2.93	0.10	0.0E+00				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or	Consumed mg 6*1+24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	50.4	0.10	9.98	0.02	
4	50.4	0.10	5.28	0.01	0.02
5	504.1	0.99	28.28	0.06	
6	504.1	1.08	37.44	0.08	0.07

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4a-R8 For additional comments, see Laboratory Notebook B000025 Pages: **110-113**

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sed (2nd)	1000	NO	0.01 & 0.1

Experiment Start Date: 8/24/98

Comments:
See general procedure on pages 57-60 in the laboratory Notebook.
Deviations from general procedure:
This is a different "sediment fill material" than was used in Run 4a-r8

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.70 liters	
Volume Sat. TCE added	2.7 mL	
	2.7 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	1000 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1794	4a-r8-tb-a	8/24/98 16:20	1912		4.90	5.08	1843
1795	4a-r8-tb-b	8/24/98 16:20	1989		4.89	5.01	1941

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	8/25/98 10:30	0.0	4a-r8-t0-1a	**494.19**	GW Only	**0.0**	14.53	14.53	494.2	NA
1	8/25/98 11:00	0.5	4a-r8-t30min-1	494.19	GW Only	0	7.22	21.75	479.7	NA
1	8/25/98 12:40	2.2	4a-r8-t1.5h-1	494.19	GW Only	0	7.27	29.02	472.4	NA
1	8/25/98 14:00	3.5	4a-r8-t3h-1	494.19	GW Only	0	7.4	36.42	465.2	NA
1	8/25/98 16:00	5.5	4a-r8-t5h-1	494.19	GW Only	0	7.41	43.83	457.8	NA
1	8/26/98 8:40	22.2	4a-r8-t20h-1	494.19	GW Only	0	7.31	51.14	450.4	NA
1	8/26/98 10:45	24.2	4a-r8-t24h-1	494.19	GW Only	0	7.2	58.34	443.1	NA
2	8/25/98 10:32	0.0	4a-r8-t0-2	**498.91**	GW Only	**0.0**	7.11	7.11	498.9	NA
2	8/25/98 11:01	0.5	4a-r8-t30min-2a	498.91	GW Only	0	14.18	21.29	491.8	NA
2	8/25/98 12:41	2.2	4a-r8-t1.5h-2	498.91	GW Only	0	7.42	28.71	477.6	NA
2	8/25/98 14:01	3.5	4a-r8-t3h-2	498.91	GW Only	0	7.36	36.07	470.2	NA
2	8/25/98 16:01	5.5	4a-r8-t5h-2	498.91	GW Only	0	7.31	43.38	462.8	NA
2	8/26/98 8:41	22.2	4a-r8-t20h-2	498.91	GW Only	0	7.08	50.46	455.5	NA
2	8/26/98 10:46	24.2	4a-r8-t24h-2	498.91	GW Only	0	7.29	57.75	448.5	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.508	DF:	1667	Conc (ppm):	37935.82
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.12
1	0	0	0.020	1	NA	NA	NA	NA	NA	8.12
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.11
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.12
1	0	0	0.006	1	NA	NA	NA	NA	NA	8.08
1	0	0	0.004	1	NA	NA	NA	NA	NA	8
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.09
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.04
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.05
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.06
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.08
2	0	0	0.003	1	NA	NA	NA	NA	NA	7.98
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.04

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	1796	2,226		2.87	3.23	1,974		NA	NA	NA	NA	NA	NA	0.03
1	1803	2,051		2.82	3.17	1,826		NA	NA	NA	NA	NA	NA	0.01
1	1810	1,935		2.86	3.12	1,779		NA	NA	NA	NA	NA	NA	0.01
1	1817	1,757		2.82	2.85	1,740		NA	NA	NA	NA	NA	NA	0.01
1	1824	1,962		2.87	3.26	1,728		NA	NA	NA	NA	NA	NA	0.01
1	1831	1,951		2.85	3.29	1,687		NA	NA	NA	NA	NA	NA	0.01
1	1838	1,933		2.88	3.24	1,717		NA	NA	NA	NA	NA	NA	0.01
2	1798	2,174		2.89	3.25	1,935		NA	NA	NA	NA	NA	NA	0.01
2	1804	2,147		2.81	3.20	1,881		NA	NA	NA	NA	NA	NA	0.03
2	1811	2,034		2.84	3.19	1,814		NA	NA	NA	NA	NA	NA	0.01
2	1818	2,123		2.83	3.28	1,830		NA	NA	NA	NA	NA	NA	0.01
2	1825	2,104		2.86	3.38	1,779		NA	NA	NA	NA	NA	NA	0.01
2	1832	2,083		2.87	3.28	1,825		NA	NA	NA	NA	NA	NA	0.01
2	1839	1,995		2.82	3.27	1,721		NA	NA	NA	NA	NA	NA	0.01

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	8/25/98 10:33	0.0	4a-r8-t0-3	**379.71**	Sed (2nd)	**102.1**	7.02	7.02	379.7	3.7
3	8/25/98 11:03	0.5	4a-r8-t30min-3	379.71	Sed (2nd)	102.06	6.53	13.55	373.9	3.7
3	8/25/98 12:42	2.2	4a-r8-t1.5h-3a	379.71	Sed (2nd)	102.06	14.21	27.76	367.4	3.6
3	8/25/98 14:02	3.5	4a-r8-t3h-3	379.71	Sed (2nd)	102.06	6.88	34.64	353.2	3.5
3	8/25/98 16:02	5.5	4a-r8-t5h-3	379.71	Sed (2nd)	102.06	6.79	41.43	346.3	3.4
3	8/26/98 8:42	22.2	4a-r8-t20h-3	379.71	Sed (2nd)	102.06	6.78	48.21	339.5	3.3
3	8/26/98 10:47	24.2	4a-r8-t24h-3	379.71	Sed (2nd)	102.06	6.45	54.66	332.8	3.3
4	8/25/98 10:34	0.0	4a-r8-t0-4	**384.05**	Sed (2nd)	**100.1**	6.76	6.76	384.1	3.8
4	8/25/98 11:04	0.5	4a-r8-t30min-4	384.05	Sed (2nd)	100.09	6.89	13.65	378.5	3.8
4	8/25/98 12:44	2.2	4a-r8-t1.5h-4	384.05	Sed (2nd)	100.09	7	20.65	371.7	3.7
4	8/25/98 14:03	3.5	4a-r8-t3h-4a	384.05	Sed (2nd)	100.09	13.97	34.62	364.7	3.6
4	8/25/98 16:03	5.5	4a-r8-t5h-4	384.05	Sed (2nd)	100.09	6.27	40.89	350.7	3.5
4	8/26/98 8:43	22.1	4a-r8-t20h-4	384.05	Sed (2nd)	100.09	6.78	47.67	344.4	3.4
4	8/26/98 10:48	24.2	4a-r8-t24h-4a	384.05	Sed (2nd)	100.09	13.55	61.22	337.6	3.4

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.508	DF:	1667	Conc (ppm):	37935.82
	Calibration Date: 6/10/98									
	MnO4 Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
3	0	0.0	0.002	1	126.8	0.0	0.0	0.0	0.0	8.06
3	1.25	126.8	0.469	5	105.1	8.1	8.1	0.1	0.7	8
3	1.25	105.1	0.416	5	93.2	4.4	12.5	0.1	1.3	8
3	1.25	93.2	0.417	5	93.4	-0.1	12.4	0.1	0.6	8
3	1.25	93.4	0.41	5	91.9	0.5	13.0	0.1	0.6	8.01
3	1.25	91.9	0.373	5	83.6	2.8	15.8	0.2	0.6	8
3	1.25	83.6	0.383	5	85.8	-0.7	15.0	0.1	0.6	8.01
4	0	0.0	0.004	1	125.3	0.0	0.0	0.0	0.0	8.03
4	1.25	125.3	0.518	5	116.0	3.5	3.5	0.0	0.8	7.92
4	1.25	116.0	0.443	5	99.2	6.2	9.7	0.1	0.7	7.94
4	1.25	99.2	0.433	5	97.0	0.8	10.6	0.1	1.4	7.98
4	1.25	97.0	0.425	5	95.2	0.6	11.2	0.1	0.6	7.97
4	1.25	95.2	0.396	5	88.7	2.2	13.4	0.1	0.6	7.96
4	1.25	88.7	0.4	5	89.6	-0.3	13.1	0.1	1.2	7.98

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1799	2,059		2.83	3.38	1,725		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
3	1806	201		2.85	3.45	166		0.10	0.583	0.6	89.0%	78.6%	78.6%	0.00
3	1812	34		2.84	3.13	31		0.02	0.050	0.6	7.6%	6.7%	85.3%	0.00
3	1819	16		2.85	3.19	14		0.01	0.006	0.6	0.9%	0.8%	86.0%	0.00
3	1826	12		3.02	3.18	12		0.01	0.001	0.6	0.1%	0.1%	86.2%	0.00
3	1833	6		2.88	3.14	6		0.00	0.002	0.6	0.3%	0.3%	86.4%	0.00
3	1840	0		2.83	2.92	1			.001	0.6	0.2%	0.2%	86.6%	0.00
4	1800	1,938		2.87	3.12	1,781		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
4	1807	217		2.87	3.17	197		0.11	0.600	0.6	87.7%	79.9%	79.9%	0.00
4	1814	26		2.86	3.00	25		0.01	0.064	0.7	9.4%	8.5%	88.4%	0.00
4	1820	9		2.86	3.19	8		0.00	0.006	0.7	0.9%	0.8%	89.2%	0.00
4	1827	0		2.84	3.30	1		0.00	0.003	0.7	0.4%	0.3%	89.5%	0.00
4	1834	0		2.89	3.17	1		0.00	0.000	0.7	0.0%	0.0%	89.5%	0.00
4	1841	0		2.84	3.16	1		0.00	0.000	0.7	0.0%	0.0%	89.5%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	8/25/98 10:35	0.0	4a-r8-t0-5	**394.8**	Sed (2nd)	**100.0**	7.25	7.25	394.8	3.9
5	8/25/98 11:05	0.5	4a-r8-t30min-5	394.8	Sed (2nd)	99.95	7	14.25	400.1	4.0
5	8/25/98 12:45	2.2	4a-r8-t1.5h-5	394.8	Sed (2nd)	99.95	7.36	21.61	393.1	3.9
5	8/25/98 14:05	3.5	4a-r8-t3h-5	394.8	Sed (2nd)	99.95	7.32	28.93	385.7	3.9
5	8/25/98 16:04	5.5	4a-r8-t5h-5a	394.8	Sed (2nd)	99.95	14.14	43.07	378.4	3.8
5	8/26/98 8:44	22.2	4a-r8-t20h-5	394.8	Sed (2nd)	99.95	6.86	49.93	364.2	3.6
5	8/26/98 10:50	24.3	4a-r8-t24h-5	394.8	Sed (2nd)	99.95	6.78	56.71	357.4	3.6
6	8/25/98 10:36	0.0	4a-r8-t0-6	**405.09**	Sed (2nd)	**104.5**	6.85	6.85	405.1	3.9
6	8/25/98 11:06	0.5	4a-r8-t30min-6	405.09	Sed (2nd)	104.53	7.03	13.88	410.7	3.9
6	8/25/98 12:46	2.2	4a-r8-t1.5h-6	405.09	Sed (2nd)	104.53	7.15	21.03	403.7	3.9
6	8/25/98 14:06	3.5	4a-r8-t3h-6	405.09	Sed (2nd)	104.53	6.83	27.86	396.6	3.8
6	8/25/98 16:06	5.5	4a-r8-t5h-6	405.09	Sed (2nd)	104.53	7.28	35.14	389.7	3.7
6	8/26/98 8:45	22.2	4a-r8-t20h-6a	405.09	Sed (2nd)	104.53	14.15	49.29	382.5	3.7
6	8/26/98 10:51	24.2	4a-r8-t24h-6	405.09	Sed (2nd)	104.53	7.34	56.63	368.3	3.5

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.508	DF:	1667	Conc (ppm):	37935.82
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0.0	0.004	1	1185.3	0.0	0.0	0.0	0.0	8
5	12.5	1185.3	0.549	50	1229.9	-17.8	-17.8	-0.2	8.6	7.75
5	12.5	1229.9	0.522	50	1169.4	23.8	5.9	0.1	8.6	7.74
5	12.5	1169.4	0.517	50	1158.2	4.3	10.3	0.1	8.5	7.75
5	12.5	1158.2	0.52	50	1165.0	-2.5	7.7	0.1	16.5	7.74
5	12.5	1165.0	0.539	50	1207.5	-15.5	-7.8	-0.1	8.3	7.75
5	12.5	1207.5	0.53	50	1187.4	7.2	-0.6	0.0	8.1	7.76
6	0	0.0	0.003	1	1154.5	0.0	0.0	0.0	0.0	8
6	12.5	1154.5	0.573	50	1283.7	-53.1	-53.1	-0.5	9.0	7.83
6	12.5	1283.7	0.538	50	1205.3	31.7	-21.4	-0.2	8.6	7.73
6	12.5	1205.3	0.544	50	1218.7	-5.3	-26.7	-0.3	8.3	7.75
6	12.5	1218.7	0.556	50	1245.6	-10.5	-37.2	-0.4	9.1	7.73
6	12.5	1245.6	0.531	50	1189.6	21.4	-15.8	-0.2	16.8	7.74
6	12.5	1189.6	0.529	50	1185.1	1.7	-14.2	-0.1	8.7	7.76

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1801	1,986		2.99	3.31	1,796		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
5	1808	0		2.86	3.17	1		[illegible]	.718	0.7	101.3%	93.1%	93.1%	0.00
5	1815	0		2.81	3.01	1		[illegible]	.000	0.7	0.0%	0.0%	93.1%	0.00
5	1822	0		2.98	3.15	1		0.00	0.000	0.7	0.0%	0.0%	93.1%	0.00
5	1828	0		2.80	3.11	1		0.00	0.000	0.7	0.0%	0.0%	93.1%	0.00
5	1835	0		2.87	3.24	1		0.00	0.000	0.7	0.0%	0.0%	93.1%	0.00
5	1843	0		2.87	3.34	1		0.00	0.000	0.7	0.0%	0.0%	93.1%	0.00
6	1802	1,877		2.88	3.27	1,653		1.00	0.000	0.0	0.0%	0.0%	0.0%	0.01
6	1809	0		2.87	3.30	1		0.00	0.679	0.7	101.3%	85.7%	85.7%	0.00
6	1816	0		2.81	3.03	1		0.00	0.000	0.7	0.0%	0.0%	85.7%	0.00
6	1823	0		2.85	3.31	1		0.00	0.000	0.7	0.0%	0.0%	85.7%	0.00
6	1830	0		2.85	3.17	1		0.00	0.000	0.7	0.0%	0.0%	85.7%	0.00
6	1836	0		2.88	3.46	1		0.00	0.000	0.7	0.0%	0.0%	85.7%	0.00
6	1844	0		2.86	3.30	1		0.00	0.000	0.7	0.0%	0.0%	85.7%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4a-R8	For additional comments, see Laboratory Notebook B0000025																						For additional comments, see Laboratory N			
											MnO4- Calib. Slope:		0.022	STOCK SOLN ABS		0.508	DF:		1667	Conc (ppm)	37935.82							
											Calibration Date: 8/10/98																	
							Sample Data				MnO4 Data													pH Data				
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Corr Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Added (m	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																											
1	8/25/98 10:31	0.0	4a-r8-t0-1b	494.19	GW Only	0	7.25	NA	NA	NA	0	NA	0.003	1	NA	8.05	1797	2,155		2.89	3.23	1,930		2.3%	1952.01	31.44
2	8/25/98 11:02	0.5	4a-r8-t30min-2b	498.91	GW Only	0	7.09	NA	NA	NA	0	NA	0.004	1	NA	8.04	1805	2,110		2.81	3.13	1,894		-0.7%	1887.55	8.69
3	8/25/98 12:43	2.2	4a-r8-t1.5h-3b	379.71	Sed (2nd)	102.06	7.17	NA	NA	NA	1.25	NA	0.425	5	95.2	7.96	1813	21		2.83	3.24	19		38.7%	24.61	8.36
4	8/25/98 14:04	3.5	4a-r8-t3h-4b	384.05	Sed (2nd)	100.09	6.71	NA	NA	NA	1.25	NA	0.442	5	99.0	7.97	1821	11		2.86	2.98	11		-27.2%	9.48	1.60
5	8/25/98 16:05	5.5	4a-r8-t5h-5b	394.8	Sed (2nd)	99.95	7.30	NA	NA	NA	12.5	NA	0.555	50	1243.4	7.73	1829	0		1.29	3.08	1		0.0%	1.00	0.00
6	8/26/98 8:46	22.2	4a-r8-t20h-6b	405.09	Sed (2nd)	104.53	7.33	NA	NA	NA	12.5	NA	0.533	50	1194.1	7.74	1837	0		2.88	3.24	1		0.0%	1.00	0.00
4	8/26/98 10:49	24.2	4a-r8-t24h-4b	384.05	Sed (2nd)	100.1	6.73	NA	NA	NA	1.25	NA	0.401	5	89.8	7.98	1842	0		2.82	3.07	1		0.0%	1.00	0.00
	Extraction of the Remaining Reactor Contents																											
1																												
2																												
3	8/26/98 11:11	24.6	4a-r8-f3	379.71	Sed (2nd)	102.06					NA	NA	NA	NA	NA	NT	1857	0		402.64	391.18	0.0E+00				
4	8/26/98 11:12	24.6	4a-r8-f4	384.05	Sed (2nd)	100.09					NA	NA	NA	NA	NA	NT	1858	0		401.98	385.79	0.0E+00				
5	8/26/98 11:13	24.6	4a-r8-f5	394.8	Sed (2nd)	99.95					NA	NA	NA	NA	NA	NT	1859	0		402.77	416.11	0.0E+00				
6	8/26/98 11:14	24.6	4a-r8-f6	405.09	Sed (2nd)	104.53					NA	NA	NA	NA	NA	NT	1860	0		403.08	430.28	0.0E+00				
	Extraction of the Charcoal Beds																											
1	8/26/98 11:02		4a-r8-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1845	0		2.90	0.07	0.0E+00				
1	8/26/98 11:02		4a-r8-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1846	0		2.89	0.03	0.0E+00				
2	8/26/98 11:04		4a-r8-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1847	0		2.86	0.08	0.0E+00				
2	8/26/98 11:04		4a-r8-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1848	0		2.87	0.03	0.0E+00				
3	8/26/98 11:05		4a-r8-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1849	0		2.86	0.08	0.0E+00				
3	8/26/98 11:06		4a-r8-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1850	0		2.88	0.03	0.0E+00				
4	8/26/98 11:07		4a-r8-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1851	0		4.89	0.08	0.0E+00				
4	8/26/98 11:07		4a-r8-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1852	0		2.84	0.02	0.0E+00				
5	8/26/98 11:08		4a-r8-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1853	0		2.80	0.08	0.0E+00				
5	8/26/98 11:08		4a-r8-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1854	0		2.84	0.03	0.0E+00				
6	8/26/98 11:10		4a-r8-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1855	0		2.90	0.06	0.0E+00				
6	8/26/98 11:10		4a-r8-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1856	0		2.87	0.02	0.0E+00				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load (mgmn/ or	Consumed mg @t=24 hrs	Consumed (mgmn/ mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	47.4	0.10	15.33	0.03	
4	47.4	0.10	13.50	0.03	0.03
5	474.2	0.95	-0.81	0.00	
6	474.2	0.92	-12.58	-0.02	-0.01

DUPLICATES

Soil/gw TCE (mg)

Carbon (TCE (mg)

Steven Robert Cline:
7.0, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S R Cline

Last Updated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R1 For additional comments, see Laboratory Notebook B000025 Pages: 98-101

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	10,000	NO	0.01 & 0.1

Experiment Start Date: 8/10/98

Comments:
See general procedure on pages 95-97 in the laboratory Notebook.
Deviations from general procedure:
NOTE: Small Amt of TCE in Blank solution!!!!!!
T=0 and controls ran at DF=20 Hexane not found in the blank for the repeat runs, therefore at least the repeat DILUTIONS are TCE free

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	3.05 liters	
Volume Sat. TCE added	31 mL	
	31 mg	(Assuming 1000 ppm Saturated Conc.)
Predicted Spike Conc:	10056 ppb	

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1461	4b-r1-tb-a	8/11/98 10:58	16303		4.84	5.22	15112
1462	4b-r1-tb-b	8/11/98 10:58	17007		4.88	5.19	15978

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	8/11/98 11:20	0.0	4b-r1-t0-1a	**483.45**	GW Only	**0.0**	14.68	14.68	483.5	NA
1	8/11/98 12:00	0.7	4b-r1-t30min-1	483.45	GW Only	0	7.43	22.11	468.8	NA
1	8/11/98 13:05	1.8	4b-r1-t1.5h-1	483.45	GW Only	0	7.74	29.85	461.3	NA
1	8/11/98 14:30	3.2	4b-r1-t3h-1	483.45	GW Only	0	7.3	37.15	453.6	NA
1	8/11/98 16:22	5.0	4b-r1-t5h-1	483.45	GW Only	0	7.56	44.71	446.3	NA
1	8/12/98 8:19	21.0	4b-r1-t20h-1	483.45	GW Only	0	7.46	52.17	438.7	NA
1	8/12/98 11:34	24.2	4b-r1-t24h-1a	483.45	GW Only	0	15	66.93	431.3	NA
2	8/11/98 11:21	0.0	4b-r1-t0-2	**497.71**	GW Only	**0.0**	7.5	7.5	497.7	NA
2	8/11/98 12:01	0.7	4b-r1-t30min-2a	497.71	GW Only	0	14.82	22.32	490.2	NA
2	8/11/98 13:05	1.7	4b-r1-t1.5h-2	497.71	GW Only	0	7.38	29.7	475.4	NA
2	8/11/98 14:31	3.2	4b-r1-t3h-2	497.71	GW Only	0	7.37	37.07	468.0	NA
2	8/11/98 16:23	5.0	4b-r1-t5h-2	497.71	GW Only	0	7.45	44.52	460.6	NA
2	8/12/98 8:20	21.0	4b-r1-t20h-2	497.71	GW Only	0	7.4	51.92	453.2	NA
2	8/12/98 11:35	24.2	4b-r1-t24h-2	497.71	GW Only	0	7.31	59.23	445.8	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.274	DF:	3333	Conc (ppm):	40922.89
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
1	0	0	0.000	1	NA	NA	NA	NA	NA	8.62
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.61
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.61
1	0	0	0.002	1	NA	NA	NA	NA	NA	8.6
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.61
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.59
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.6
2	0	0	0.001	1	NA	NA	NA	NA	NA	8.62
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.63
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.61
2	0	0	0.002	1	NA	NA	NA	NA	NA	8.63
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.6
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.6
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.62

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1463	14,997		2.95	3.35	13,177		NA	NA	NA	NA	NA	NA	0.19
1	1470	15,290		2.95	3.17	14,223		NA	NA	NA	NA	NA	NA	0.11
1	1477	14,077		2.92	2.89	14,209		NA	NA	NA	NA	NA	NA	0.11
1	1484	15,883		2.90	3.20	14,390		NA	NA	NA	NA	NA	NA	0.11
1	1491	14,006		2.88	3.19	12,673		NA	NA	NA	NA	NA	NA	0.10
1	1498	12,957		2.89	2.86	13,081		NA	NA	NA	NA	NA	NA	0.10
1	1505	14,930		2.89	3.25	13,303		NA	NA	NA	NA	NA	NA	0.20
2	1465	15,783		2.95	3.25	14,300		NA	NA	NA	NA	NA	NA	0.11
2	1471	15,358		2.96	3.15	14,419		NA	NA	NA	NA	NA	NA	0.21
2	1478	15,505		2.91	3.25	13,861		NA	NA	NA	NA	NA	NA	0.10
2	1485	14,923		2.91	3.13	13,873		NA	NA	NA	NA	NA	NA	0.10
2	1492	14,768		2.92	3.15	13,698		NA	NA	NA	NA	NA	NA	0.10
2	1499	15,112		2.87	3.37	12,861		NA	NA	NA	NA	NA	NA	0.10
2	1506	15,655		2.84	3.30	13,479		NA	NA	NA	NA	NA	NA	0.10

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	8/11/98 11:22	0.0	4b-r1-t0-3	**498.33**	GW Only	**0.0**	7.47	7.47	498.3	NA
3	8/11/98 12:03	0.7	4b-r1-t30min-3	498.33	GW Only	0	6.89	14.36	492.1	NA
3	8/11/98 13:06	1.7	4b-r1-t1.5h-3a	498.33	GW Only	0	14.16	28.52	485.2	NA
3	8/11/98 14:32	3.2	4b-r1-t3h-3	498.33	GW Only	0	6.95	35.47	471.1	NA
3	8/11/98 16:24	5.0	4b-r1-t5h-3	498.33	GW Only	0	7.24	42.71	464.1	NA
3	8/12/98 8:21	21.0	4b-r1-t20h-3	498.33	GW Only	0	6.66	49.37	456.9	NA
3	8/12/98 11:36	24.2	4b-r1-t24h-3	498.33	GW Only	0	6.96	56.33	450.2	NA
4	8/11/98 11:23	0.0	4b-r1-t0-4	**512.83**	GW Only	**0.0**	6.94	6.94	512.8	NA
4	8/11/98 12:04	0.7	4b-r1-t30min-4	512.83	GW Only	0	7.23	14.17	507.1	NA
4	8/11/98 13:08	1.7	4b-r1-t1.5h-4	512.83	GW Only	0	7.09	21.26	499.9	NA
4	8/11/98 14:33	3.2	4b-r1-t3h-4a	512.83	GW Only	0	14.87	36.13	492.8	NA
4	8/11/98 16:25	5.0	4b-r1-t5h-4	512.83	GW Only	0	7.38	43.51	478.0	NA
4	8/12/98 8:22	21.0	4b-r1-t20h-4	512.83	GW Only	0	6.74	50.25	470.6	NA
4	8/12/98 11:38	24.2	4b-r1-t24h-4	512.83	GW Only	0	7.5	57.75	463.8	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.274	DF:	3333	Conc (ppm):	40922.89
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
3	0	0.0	0.002	1	103.9	0	0	0.00	0	8.62
3	1.25	103.9	0.174	5	39.0	32	32	0.06	0.3	8.24
3	1.25	39.0	0.169	5	37.9	1	33	0.07	0.5	8.05
3	1.25	37.9	0.15	5	33.6	2	35	0.07	0.2	7.89
3	1.25	33.6	0.168	5	37.6	-2	33	0.07	0.3	7.89
3	1.25	37.6	0.162	5	36.3	1	33	0.07	0.2	7.85
3	1.25	36.3	0.125	5	28.0	4	37	0.07	0.2	7.8
4	0	0.0	0.001	1	100.9	0	0	0.00	0	8.63
4	1.25	100.9	0.172	5	38.5	32	32	0.06	0.3	8.22
4	1.25	38.5	0.163	5	36.5	1	33	0.06	0.3	7.93
4	1.25	36.5	0.149	5	33.4	2	34	0.07	0.5	7.8
4	1.25	33.4	0.154	5	34.5	-1	34	0.07	0.3	7.76
4	1.25	34.5	0.136	5	30.5	2	36	0.07	0.2	7.7
4	1.25	30.5	0.119	5	26.7	2	37	0.07	0.2	7.72

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
3	1466	15,198		2.96	3.13	14,362		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.11
3	1473R	*2,853*		2.94	3.21	2,609		0.18	5.8	5.8	80.8%	80.8%	80.8%	0.02
3	1479R	*1,749*		2.91	3.15	1,614		0.11	0.5	6.3	6.7%	6.7%	87.6%	0.02
3	1486R	*1,129*		2.90	3.00	1,091		0.08	0.2	6.5	3.4%	3.4%	91.0%	0.01
3	1493	626		2.89	3.12	582		0.04	0.2	6.7	3.3%	3.3%	94.3%	0.00
3	1500	278		2.90	3.25	249		0.02	0.2	6.9	2.1%	2.1%	96.4%	0.00
3	1508	339		2.82	3.14	304		0.02	0.0	6.9	-0.4%	-0.4%	96.1%	0.00
4	1467	16,081		2.94	3.22	14,687		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.10
4	1474R	*3,171*		2.93	3.25	2,858		0.19	6.0	6.0	79.6%	79.6%	79.6%	0.02
4	1481R	*1,974*		2.90	3.17	1,810		0.12	0.5	6.5	7.0%	7.0%	86.6%	0.01
4	1487R	*1,225*		2.91	2.99	1,193		0.08	0.3	6.8	4.0%	4.0%	90.6%	0.02
4	1494	631		2.90	3.12	586		0.04	0.3	7.1	3.9%	3.9%	94.5%	0.00
4	1501	240		2.88	3.21	216		0.01	0.2	7.3	2.3%	2.3%	96.8%	0.00
4	1509	266		2.85	3.05	250		0.02	0.0	7.3	-0.2%	-0.2%	96.6%	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	8/11/98 11:23	0.0	4b-r1-t0-5	**498.97**	GW Only	**0.0**	7.32	7.32	499.0	NA
5	8/11/98 12:05	0.7	4b-r1-t30min-5	498.97	GW Only	0	7.29	14.61	504.2	NA
5	8/11/98 13:09	1.8	4b-r1-t1.5h-5	498.97	GW Only	0	7.2	21.81	496.9	NA
5	8/11/98 14:35	3.2	4b-r1-t3h-5	498.97	GW Only	0	7.55	29.36	489.7	NA
5	8/11/98 16:26	5.0	4b-r1-t5h-5a	498.97	GW Only	0	14.96	44.32	482.1	NA
5	8/12/98 8:23	21.0	4b-r1-t20h-5	498.97	GW Only	0	7.25	51.57	467.2	NA
5	8/12/98 11:39	24.3	4b-r1-t24h-5	498.97	GW Only	0	7	59.06	459.9	NA
6	8/11/98 11:24	0.0	4b-r1-t0-6	**506.14**	GW Only	**0.0**	7.36	7.36	506.1	NA
6	8/11/98 12:06	0.7	4b-r1-t30min-6	506.14	GW Only	0	7.32	14.68	511.3	NA
6	8/11/98 13:10	1.8	4b-r1-t1.5h-6	506.14	GW Only	0	7.22	21.9	504.0	NA
6	8/11/98 14:36	3.2	4b-r1-t3h-6	506.14	GW Only	0	7.39	29.29	496.7	NA
6	8/11/98 16:28	5.1	4b-r1-t5h-6	506.14	GW Only	0	7.42	36.71	489.4	NA
6	8/12/98 8:24	21.0	4b-r1-t20h-6a	506.14	GW Only	0	14.65	51.36	481.9	NA
6	8/12/98 11:40	24.3	4b-r1-t24h-6	506.14	GW Only	0	7.46	58.82	467.3	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS		0.274	DF:	3333	Conc (ppm):	40922.89
	Calibration Date: 6/10/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock Mn Added (ml	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
5	0	0.0	0.002	1	1014.7	0	0	0.00	0	8.63
5	12.5	1014.7	0.189	50	423.4	298	298	0.60	3.1	7.81
5	12.5	423.4	0.191	50	427.9	-2	296	0.59	3.1	7.73
5	12.5	427.9	0.19	50	425.7	1	297	0.60	3.2	7.71
5	12.5	425.7	0.194	50	434.6	-4	293	0.59	6.5	7.7
5	12.5	434.6	0.194	50	434.6	0	293	0.59	3.2	7.67
5	12.5	434.6	0.184	50	412.2	10	303	0.61	3.1	7.72
6	0	0.0	0.001	1	1000.5	0	0	0.00	0	8.63
6	12.5	1000.5	0.202	50	452.5	280	280	0.55	3.3	7.73
6	12.5	452.5	0.204	50	457.0	-2	278	0.55	3.3	7.7
6	12.5	457.0	0.209	50	468.2	-6	272	0.54	3.5	7.71
6	12.5	468.2	0.204	50	457.0	5	278	0.55	3.4	7.68
6	12.5	457.0	0.203	50	454.8	1	279	0.55	6.7	7.67
6	12.5	454.8	0.190	50	425.7	14	293	0.58	3.2	7.69

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R1	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1468	14,758		2.93	3.11	13,902		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.10
5	1475	260		2.92	3.05	248		0.02	6.9	6.9	99.2%	99.2%	99.2%	0.00
5	1482	231		2.86	3.08	214		0.02	0.0	6.9	0.2%	0.2%	99.5%	0.00
5	1489	229		2.91	3.17	211		0.02	0.0	6.9	0.0%	0.0%	99.5%	0.00
5	1495	227		2.90	3.14	210		0.02	0.0	6.9	0.0%	0.0%	99.5%	0.00
5	1502	224		2.88	3.29	196		0.01	0.0	6.9	0.1%	0.1%	99.6%	0.00
5	1510	223		2.78	3.13	197		0.01	0.0	6.9	0.0%	0.0%	99.6%	0.00
6	1469	14,081		2.97	3.07	13,653		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.10
6	1476	237		2.95	3.12	224		0.02	6.9	6.9	99.4%	99.4%	99.4%	0.00
6	1483	228		2.93	3.11	215		0.02	0.0	6.9	0.1%	0.1%	99.4%	0.00
6	1490	226		2.90	3.09	212		0.02	0.0	6.9	0.0%	0.0%	99.4%	0.00
6	1497	223		2.87	3.08	208		0.02	0.0	6.9	0.0%	0.0%	99.5%	0.00
6	1503	214		2.86	2.95	208		0.02	0.0	6.9	0.0%	0.0%	99.5%	0.00
6	1511	222		2.86	3.02	210		0.02	0.0	6.9	0.0%	0.0%	99.5%	0.00

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R1 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope: 0.022 STOCK SOLN ABS 0.274 DF: 3333 Conc (ppm): 40922.89

Calibration Date: 8/10/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (m	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	For additional comments, see Laboratory N																									
	Duplicate VOC Samples																									
1	8/11/98 11:20	0.0	4b-r1-t0-1b	483.45	GW Only	0	7.39	NA	NA	NA	0	NA	0.001	1	NA	8.63	1464	16,394		2.97	3.37	14,483		-9.9%	13830.13	923.18
2	8/11/98 12:02	0.7	4b-r1-t30min-2b	497.71	GW Only	0	7.43	NA	NA	NA	0	NA	0.003	1	NA	8.84	1472	14,814		2.94	3.04	14,324		0.7%	14371.51	67.77
3	8/11/98 13:07	1.7	4b-r1-t1.5h-3b	498.33	GW Only	0	7.29	NA	NA	NA	1.25	NA	0.164	5	36.7	7.96	1480R	1,869		2.90	3.00	1,805		-11.8%	1709.57	135.20
4	8/11/98 14:34	3.2	4b-r1-t3h-4b	512.83	GW Only	0	7.4	NA	NA	NA	1.25	NA	0.148	5	33.2	7.8	1488R	1,216		2.91	2.88	1,229		-3.0%	1210.89	24.93
5	8/11/98 16:27	5.1	4b-r1-t5h-5b	498.97	GW Only	0	7.49	NA	NA	NA	12.5	NA	0.206	50	461.5	7.68	1496	224		2.92	2.98	219		-4.5%	214.54	6.70
6	8/12/98 8:25	21.0	4b-r1-t20h-6b	506.14	GW Only	0	7.28	NA	NA	NA	12.5	NA	0.203	50	454.8	7.67	1504	219		2.87	3.10	203		2.3%	205.22	3.36
1	8/12/98 11:35	24.2	4b-r1-t24h-1b	483.45	GW Only	0	7	NA	NA	NA	0	NA	0.008	1	NA	8.61	1507	15,100		2.84	3.14	13,670		-2.8%	13486.46	259.98
	Extraction of the Remainder Reactor Contents																									
1	NOT EXTRACTED																									
2	NOT EXTRACTED																									
3	NOT EXTRACTED																									
4	NOT EXTRACTED																									
5	NOT EXTRACTED																									
6	NOT EXTRACTED																									
	Extraction of the Charcoal Beds																									
1	8/12/98 11:46		4b-r1-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1512	45		2.91	0.09	1.3E-04				
1	8/12/98 11:47		4b-r1-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1513	80		2.89	0.05	2.3E-04				
2	8/12/98 11:49		4b-r1-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1514	48		2.80	0.10	1.3E-04				
2	8/12/98 11:48		4b-r1-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1515	75		2.84	0.05	2.1E-04				
3	8/12/98 11:49		4b-r1-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1516	44		2.85	0.11	1.3E-04				
3	8/12/98 11:50		4b-r1-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1517	84		2.84	0.05	2.4E-04				
4	8/12/98 11:51		4b-r1-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1518	49		2.88	0.08	1.4E-04				
4	8/12/98 11:52		4b-r1-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1519	81		2.85	0.05	2.3E-04				
5	8/12/98 11:55		4b-r1-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1520	46		2.75	0.09	1.3E-04				
5	8/12/98 11:54		4b-r1-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1521	77		2.73	0.10	2.1E-04				
6	8/12/98 11:45		4b-r1-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1522	43		2.82	0.12	1.2E-04				
6	8/12/98 11:45		4b-r1-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1523	89		2.86	0.06	2.5E-04				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or	Consumed mg 6/1=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	51.2	0.10	37.37	0.08	
4	51.2	0.10	37.63	0.07	0.08
5	511.5	1.01	303.72	0.60	
6	511.5	1.00	293.90	0.57	0.59

Prepared by: S R. Cline

Last Updated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	8/13/98 11:30	0.0	4b-R2-t0-1a	**514.07**	GW Only	**0.0**	14.61	14.61	514.1	NA
1	8/13/98 12:10	0.7	4b-R2-t30min-1	514.07	GW Only	0	7.3	21.91	499.5	NA
1	8/13/98 13:20	1.8	4b-R2-t1.5h-1	514.07	GW Only	0	7.36	29.27	492.2	NA
1	8/13/98 14:45	3.3	4b-R2-t3h-1	514.07	GW Only	0	7.33	36.6	484.8	NA
1	8/13/98 16:50	5.3	4b-R2-t5h-1	514.07	GW Only	0	7.6	44.2	477.5	NA
1	8/14/98 8:11	20.7	4b-R2-t20h-1	514.07	GW Only	0	7.17	51.37	469.9	NA
1	8/14/98 11:30	24.0	4b-R2-t24h-1	514.07	GW Only	0	6.26	57.63	462.7	NA
2	8/13/98 11:32	0.0	4b-R2-t0-2	**498.894**	GW Only	**0.0**	7.22	7.22	498.9	NA
2	8/13/98 12:11	0.7	4b-R2-t30min-2a	498.894	GW Only	0	14.47	21.69	491.7	NA
2	8/13/98 13:21	1.8	4b-R2-t1.5h-2	498.894	GW Only	0	7.45	29.14	477.2	NA
2	8/13/98 14:46	3.2	4b-R2-t3h-2	498.894	GW Only	0	7.25	36.39	469.8	NA
2	8/13/98 16:51	5.3	4b-R2-t5h-2	498.894	GW Only	0	7.4	43.79	462.5	NA
2	8/14/98 8:12	20.7	4b-R2-t20h-2	498.894	GW Only	0	7.07	50.86	455.1	NA
2	8/14/98 11:31	24.0	4b-R2-t24h-2	498.894	GW Only	0	7.2	58.06	448.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	MnO4- Data									pH Dat
	KMnO4	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.58
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.56
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.54
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.53
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.53
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.66
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.66
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.57
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.57
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.55
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.53
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.53
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.67
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.69

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1662	13,597		2.95	3.289	12,196		NA	NA	NA	NA	NA	NA	0.18
1	1669	10,325		2.957576	3.149	9,697		NA	NA	NA	NA	NA	NA	0.07
1	1676	11,716		2.937879	3.266	10,539		NA	NA	NA	NA	NA	NA	0.08
1	1683	9,789		2.925758	3.018	9,490		NA	NA	NA	NA	NA	NA	0.07
1	1690	9,557		2.933333	3.044	9,209		NA	NA	NA	NA	NA	NA	0.07
1	1697	11,435		2.924242	3.207	10,427		NA	NA	NA	NA	NA	NA	0.07
1	1704	13,960		2.906061	4.059	9,994		NA	NA	NA	NA	NA	NA	0.06
2	1664	12,968		2.977273	3.223	11,979		NA	NA	NA	NA	NA	NA	0.09
2	1670	11,042		2.956061	3.087	10,573		NA	NA	NA	NA	NA	NA	0.15
2	1677	12,292		2.937879	3.108	11,619		NA	NA	NA	NA	NA	NA	0.09
2	1684	11,101		2.913636	3.032	10,668		NA	NA	NA	NA	NA	NA	0.08
2	1691	12,396		2.921212	3.08	11,757		NA	NA	NA	NA	NA	NA	0.09
2	1698	13,100		2.921212	3.429	11,160		NA	NA	NA	NA	NA	NA	0.08
2	1705	12,111		2.898485	3.196	10,983		NA	NA	NA	NA	NA	NA	0.08

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	8/13/98 11:33	0.0	4b-R2-t0-3	**497.305**	GW Only	**0.0**	7.12	7.12	497.3	NA
3	8/13/98 12:13	0.7	4b-R2-t30min-3	497.305	GW Only	0	7.31	14.43	490.2	NA
3	8/13/98 13:22	1.8	4b-R2-t1.5h-3a	497.305	GW Only	0	14.14	28.57	482.9	NA
3	8/13/98 14:47	3.2	4b-R2-t3h-3	497.305	GW Only	0	6.91	35.48	468.7	NA
3	8/13/98 16:52	5.3	4b-R2-t5h-3	497.305	GW Only	0	6.99	42.47	461.8	NA
3	8/14/98 8:13	20.7	4b-R2-t20h-3	497.305	GW Only	0	6.88	49.35	454.8	NA
3	8/14/98 11:32	24.0	4b-R2-t24h-3	497.305	GW Only	0	6.96	56.31	448.0	NA
4	8/13/98 11:34	0.0	4b-R2-t0-4	**499.476**	GW Only	**0.0**	7.23	7.23	499.5	NA
4	8/13/98 12:14	0.7	4b-R2-t30min-4	499.476	GW Only	0	7.12	14.35	492.2	NA
4	8/13/98 13:24	1.8	4b-R2-t1.5h-4	499.476	GW Only	0	7.37	21.72	485.1	NA
4	8/13/98 14:48	3.2	4b-R2-t3h-4a	499.476	GW Only	0	14.82	36.54	477.8	NA
4	8/13/98 16:53	5.3	4b-R2-t5h-4	499.476	GW Only	0	7.17	43.71	462.9	NA
4	8/14/98 8:14	20.7	4b-R2-t20h-4	499.476	GW Only	0	7.21	50.92	455.8	NA
4	8/14/98 11:33	24.0	4b-R2-t24h-4	499.476	GW Only	0	7.3	58.22	448.6	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	MnO4- Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
3	0	0	NA	NA	10149.9	0	0	0.00	0	8.57
3	**6605.9**	10150	0.606	250	6788	1648	1648	3.31	49.6	8.39
3	6605.9	6788	0.815	250	9129	-1130	517	1.04	129.1	8.43
3	6605.9	9129	0.189	1000	8468	310	827	1.66	58.5	8.44
3	6605.9	8468	0.409	500	9163	-321	506	1.02	64.0	8.45
3	6605.9	9163	0.436	500	9768	-275	231	0.47	67.2	8.57
3	6605.9	9768	0.475	500	10641	-391	-160	-0.32	74.1	8.57
4	0	0	NA	NA	10090	0	0	0.00	0	8.58
4	**6594.4**	10090	0.462	250	5175	2419	2419	4.84	36.8	8.25
4	6594.4	5175	0.847	250	9488	-2092	327	0.65	69.9	8.4
4	6594.4	9488	0.199	1000	8916	273	600	1.20	132.1	8.39
4	6594.4	8916	0.406	500	9096	-83	517	1.04	65.2	8.41
4	6594.4	9096	0.391	500	8760	153	670	1.34	63.2	8.52
4	6594.4	8760	0.424	500	9499	-332	339	0.68	69.3	8.52

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025												
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1665	10,703		2.983333	3.252	9,818		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.07
3	1672	16		2.954545	3.26	15		0.00	4.8	4.8	98.4%	98.4%	98.4%	0.00
3	1678	14		2.930303	3.309	13		0.00	0.0	4.8	0.0%	0.0%	98.4%	0.00
3	1685	14		2.927273	3.253	13		0.00	0.0	4.8	0.0%	0.0%	98.4%	0.00
3	1692	13		2.887879	3.082	12		0.00	0.0	4.8	0.0%	0.0%	98.4%	0.00
3	1699	13		2.910606	3.285	12		0.00	0.0	4.8	0.0%	0.0%	98.5%	0.00
3	1706	0		2.919697	3.204	1		0.00	0.0	4.8	0.1%	0.1%	98.5%	0.00
4	1666	11,947		2.966667	3.119	11,363		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.08
4	1673	9		2.945455	3.075	9		0.00	5.6	5.6	98.5%	98.5%	98.5%	0.00
4	1680	0		2.943939	3.131	1		0.00	0.0	5.6	0.1%	0.1%	98.5%	0.00
4	1686	0		2.936364	3.185	1		0.00	0.0	5.6	0.0%	0.0%	98.5%	0.00
4	1693	0		2.918182	3.286	1		0.00	0.0	5.6	0.0%	0.0%	98.5%	0.00
4	1700	0		2.907576	3.438	1		0.00	0.0	5.6	0.0%	0.0%	98.5%	0.00
4	1707	0		2.907576	3.222	1		0.00	0.0	5.6	0.0%	0.0%	98.5%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	8/13/98 11:35	0.0	4b-R2-t0-5	**499.149**	GW Only	**0.0**	7.17	7.17	499.1	NA
5	8/13/98 12:15	0.7	4b-R2-t30min-5	499.149	GW Only	0	7.23	14.4	492.0	NA
5	8/13/98 13:25	1.8	4b-R2-t1.5h-5	499.149	GW Only	0	7.39	21.79	484.7	NA
5	8/13/98 14:50	3.2	4b-R2-t3h-5	499.149	GW Only	0	7.48	29.27	477.4	NA
5	8/13/98 16:54	5.3	4b-R2-t5h-5a	499.149	GW Only	0	14.81	44.08	469.9	NA
5	8/14/98 8:15	20.7	4b-R2-t20h-5	499.149	GW Only	0	7.65	51.73	455.1	NA
5	8/14/98 11:34	24.0	4b-R2-t24h-5	499.149	GW Only	0	7.22	58.95	447.4	NA
6	8/13/98 11:36	0.0	4b-R2-t0-6	**504.17**	GW Only	**0.0**	7.11	7.11	504.2	NA
6	8/13/98 12:16	0.7	4b-R2-t30min-6	504.17	GW Only	0	7.35	14.46	497.1	NA
6	8/13/98 13:26	1.8	4b-R2-t1.5h-6	504.17	GW Only	0	7.56	22.02	489.7	NA
6	8/13/98 14:51	3.3	4b-R2-t3h-6	504.17	GW Only	0	7.51	29.53	482.2	NA
6	8/13/98 16:56	5.3	4b-R2-t5h-6	504.17	GW Only	0	7.51	37.04	474.6	NA
6	8/14/98 8:16	20.7	4b-R2-t20h-6a	504.17	GW Only	0	14.64	51.68	467.1	NA
6	8/14/98 11:35	24.0	4b-R2-t24h-6a	504.17	GW Only	0	14.57	66.25	452.5	NA
						0				

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	MnO4 Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	30621	0	0	0.00	0	8.58
5	**20001.8**	30621	0.322	500	7214	11516	11516	23.07	52.2	8.7
5	20001.8	7214	1.185	500	26548	-9372	2144	4.29	196.2	8.8
5	20001.8	26548	0.582	1000	26077	225	2368	4.74	195.1	8.81
5	20001.8	26077	0.598	1000	26794	-337	2031	4.07	396.8	8.82
5	20001.8	26794	0.611	1000	27377	-265	1766	3.54	209.4	8.93
5	20001.8	27377	0.605	1000	27108	120	1886	3.78	195.7	8.91
6	0	0	NA	NA	30328	0	0	0.00	0	8.57
6	**20015.3**	30328	0.408	500	9140	10531	10531	20.89	67.2	8.75
6	20015.3	9140	1.232	500	27601	-9040	1491	2.96	208.7	8.83
6	20015.3	27601	0.599	1000	26839	367	1859	3.69	201.6	8.84
6	20015.3	26839	0.540	1000	24195	1255	3113	6.18	181.7	8.86
6	20015.3	24195	0.642	1000	28766	-2135	978	1.94	421.1	8.97
6	20015.3	28766	0.629	1000	28183	264	1242	2.46	410.6	8.96

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R2	For additional comments, see Laboratory Notebook B000025											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1667	9,436		2.97	3.16	8,885		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.06
5	1674	0		2.94	3.21	1		0.00	4.4	4.4	98.6%	98.6%	98.6%	0.00
5	1681	0		2.93	3.24	1		0.00	0.0	4.4	0.0%	0.0%	98.6%	0.00
5	1688	0		2.93	3.19	1		0.00	0.0	4.4	0.0%	0.0%	98.6%	0.00
5	1694	0		2.67	3.38	1		0.00	0.0	4.4	0.0%	0.0%	98.6%	0.00
5	1701	0		2.90	3.14	1		0.00	0.0	4.4	0.0%	0.0%	98.6%	0.00
5	1708	0		2.88	3.51	1		0.00	0.0	4.4	0.0%	0.0%	98.6%	0.00
6	1668	11,809		2.94	3.13	11,095		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.08
6	1675	0		2.94	3.14	1		0.00	5.5	5.5	98.6%	98.6%	98.6%	0.00
6	1682	0		2.95	3.08	1		0.00	0.0	5.5	0.0%	0.0%	98.6%	0.00
6	1689	0		2.94	3.23	1		0.00	0.0	5.5	0.0%	0.0%	98.6%	0.00
6	1696	0		2.94	3.13	1		0.00	0.0	5.5	0.0%	0.0%	98.6%	0.00
6	1702	0		2.93	3.35	1		0.00	0.0	5.5	0.0%	0.0%	98.6%	0.00
6	1709	0		2.87	3.37	1		0.00	0.0	5.5	0.0%	0.0%	98.6%	0.00

Steven Robert Cline: ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Steven Robert Cline: ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R2 For additional comments, see Laboratory Notebook B000025

MnO4- Calib. Slope: 0.022 STOCK SOLN ABS: NA DF: NA Conc (ppm)

Calibration Date: 6/10/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	%Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	8/13/98 11:31	0.0	4b-R2-t0-1b	514.07	GW Only	0	7.2	NA	NA	NA	0	NA	NA	NA	NA	8.57	1663	11,201		2.96	3.31	10,041		17.7%	11118.47	1523.59
2	8/13/98 12:12	0.7	4b-R2-t30min-2b	498.894	GW Only	0	7.06	NA	NA	NA	0	NA	NA	NA	NA	8.58	1671	12,852		2.95	3.18	11,929		-12.8%	11251.15	958.51
3	8/13/98 13:23	1.8	4b-R2-t1.5h-3b	497.305	GW Only	0	7.29	NA	NA	NA	6606	NA	0.864	250	9678	8.43	1679	0		2.94	3.04	1		92.0%	6.77	8.16
4	8/13/98 14:49	3.2	4b-R2-t3h-4b	499.476	GW Only	0	7.46	NA	NA	NA	6594	NA	0.202	1000	9051	8.39	1687	0		2.94	3.13	1		0.0%	1.00	0.00
5	8/13/98 16:55	5.3	4b-R2-t5h-5b	499.149	GW Only	0	7.43	NA	NA	NA	20002	NA	0.604	1000	27063	8.86	1695	0		2.93	3.16	1		0.0%	1.00	0.00
6	8/14/98 8:17	20.7	4b-R2-t20h-6b	504.17	GW Only	0	7.12	NA	NA	NA	20015	NA	0.656	1000	29393	8.98	1703	0		2.92	3.66	1		0.0%	1.00	0.00
6	8/14/98 11:36	24.1	4b-R2-t24h-6b	504.17	GW Only	0	7.18	NA	NA	NA	20015	NA	0.635	1000	28452	8.97	1710	0		2.89	3.31	1		0.0%	1.00	0.00
	Extraction of the Remaining Reactor Contents																									
1	NOT EXTRACTED																									
2	NOT EXTRACTED																									
3	NOT EXTRACTED																									
4	NOT EXTRACTED																									
5	NOT EXTRACTED																									
6	NOT EXTRACTED																									
	Extraction of the Charcoal Beads																				Mass Carbon (g)	Mass TCE (mg)				
1	8/14/98 11:46		4B-R2-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1711	0		2.90	0.09	0.0000				
1	8/14/98 11:45		4B-R2-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1712	0		2.87	0.03	0.0000				
2	8/14/98 11:47		4B-R2-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1713	0		2.91	0.08	0.0000				
2	8/14/98 11:48		4B-R2-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1714	0		2.89	0.03	0.0000				
3	8/14/98 11:50		4B-R2-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1715	0		2.89	0.09	0.0000				
3	8/14/98 11:49		4B-R2-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1716	0		2.87	0.04	0.0000				
4	8/14/98 11:52		4B-R2-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1717	0		2.91	0.09	0.0000				
4	8/14/98 11:51		4B-R2-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1718	0		2.92	0.04	0.0000				
5	8/14/98 11:54		4B-R2-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1719	0		2.92	0.10	0.0000				
5	8/14/98 11:53		4B-R2-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1720	0		2.89	0.04	0.0000				
6	8/14/98 11:56		4B-R2-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1721	0		2.91	0.08	0.0000				
6	8/14/98 11:55		4B-R2-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1722	0		2.87	0.04	0.0000				
7	8/14/98 11:58		ORBO-hood-a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1723	0		2.85	0.094	0.0000				
7	8/14/98 11:57		ORBO-hood-b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1724	0		2.865	0.047	0.0000				
8	8/14/98 12:00		ORBO-incub-a		Charcoal	NA					NA	NA	NA	NA	NA	NT	1725	0		2.861	0.083	0.0000				
8	8/14/98 11:59		ORBO-incub-b		Charcoal	NA					NA	NA	NA	NA	NA	NT	1726	0		2.853	0.026	0.0000				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load or mg/g	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	4975	10.1	-241	-0.5	
4	4967	10.1	291	0.6	0.05
5	15065	30.6	1728	3.5	
6	15075	30.3	1066	2.1	2.83

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R3 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	100,000	NO	.01&.1

Experiment Start Date: 7/29/98

Comments:
NOTE: use of Neat TCE to make spiking solution instead of an aqueous saturated TCE solution.
Extracted the entire reactor contents after the end of the test. Was not really necessary.

SPIKE SOLUTION PREPARATION
Prepared a 100 ppm TCE spiking solution in Tedlar bag using 2500gm of sparged groundwater and 280uL of pure phase TCE. Placed bag in incubator set at 12 C.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1313	4B-R3-TB-A	7/30/98 8:20	148,124		5.05	5.02	149,113
1314	4B-R3-TB-B	7/30/98 8:20	145,203		5.08	4.99	147,669

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	7/30/98 9:00	0.0	4B-R3-T0-1A	401	GW Only	0.0	20	20	401.0	NA
1	7/30/98 9:30	0.5	4B-R3-T30MIN-1	401	GW Only	0	10	30	381.0	NA
1	7/30/98 11:00	2.0	4B-R3-T2HR-1	401	GW Only	0	10	40	371.0	NA
1	7/30/98 13:00	4.0	4B-R3-T4HR-1	401	GW Only	0	10	50	361.0	NA
1	7/30/98 15:00	6.0	4B-R3-T6HR-1	401	GW Only	0	10	60	351.0	NA
1	7/31/98 6:55	21.9	4B-R3-T20HR-1	401	GW Only	0	10	70	341.0	NA
1	7/31/98 9:00	24.0	4B-R3-T24HR-1A	401	GW Only	0	20	90	331.0	NA
1	8/3/98 9:00	96.0	4B-R3-T96HR-1	401	GW Only	0	10	100	311.0	NA
2	7/30/98 9:00	0.0	4B-R3-T0-2	401	GW Only	0.0	10	10	401.0	NA
2	7/30/98 9:30	0.5	4B-R3-T30MIN-2A	401	GW Only	0	20	30	391.0	NA
2	7/30/98 11:00	2.0	4B-R3-T2HR-2	401	GW Only	0	10	40	371.0	NA
2	7/30/98 13:00	4.0	4B-R3-T4HR-2	401	GW Only	0	10	50	361.0	NA
2	7/30/98 15:00	6.0	4B-R3-T6HR-2	401	GW Only	0	10	60	351.0	NA
2	7/31/98 6:55	21.9	4B-R3-T20HR-2	401	GW Only	0	10	70	341.0	NA
2	7/31/98 9:00	24.0	4B-R3-T24HR-2	401	GW Only	0	10	80	331.0	NA
2	8/3/98 9:00	96.0	4B-R3-T96HR-2a	401	GW Only	0	20	100	321.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm)	39600
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquo	pH
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.04
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.09
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.93
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.77
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.17
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.09
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.26
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.11
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.99
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.83

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1317	113,576		3.05	3.21	107,847		NA	NA	NA	NA	NA	NA	2.16
1	1331	93,690		3.12	2.89	101,228		NA	NA	NA	NA	NA	NA	1.01
1	1345	99,569		3.13	3.08	101,277		NA	NA	NA	NA	NA	NA	1.01
1	1359	117,379		2.99	3.45	101,664		NA	NA	NA	NA	NA	NA	1.02
1	1373	101,637		3.03	2.90	106,387		NA	NA	NA	NA	NA	NA	1.06
1	1387R	110,164		3.08	3.66	92,665		NA	NA	NA	NA	NA	NA	0.93
1	1401	116,840		2.98	2.73	127,665		NA	NA	NA	NA	NA	NA	2.55
1	1415	128,397		3.06	3.048	128,992		NA	NA	NA	NA	NA	NA	1.29
2	1318	111,151		3.06	3.18	106,944		NA	NA	NA	NA	NA	NA	1.07
2	1332	96,822		3.12	2.97	101,839		NA	NA	NA	NA	NA	NA	2.04
2	1346	107,080		3.14	3.37	99,745		NA	NA	NA	NA	NA	NA	1.00
2	1360	114,541		3.02	3.51	98,449		NA	NA	NA	NA	NA	NA	0.98
2	1374	97,893		3.01	2.89	102,049		NA	NA	NA	NA	NA	NA	1.02
2	1388R	122,937		3.05	2.97	126,607		NA	NA	NA	NA	NA	NA	1.27
2	1402	112,272		3.05	2.70	126,904		NA	NA	NA	NA	NA	NA	1.27
2	1416	114,110		3.08	2.743	128,016		NA	NA	NA	NA	NA	NA	2.56

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	7/30/98 9:00	0.0	4B-R3-T0-3	401	GW Only	0.0	10	10	401.0	NA
3	7/30/98 9:30	0.5	4B-R3-T30MIN-3	401	GW Only	0	10	20	392.0	NA
3	7/30/98 11:00	2.0	4B-R3-T2HR-3A	401	GW Only	0	20	40	382.0	NA
3	7/30/98 13:00	4.0	4B-R3-T4HR-3	401	GW Only	0	10	50	362.0	NA
3	7/30/98 15:00	6.0	4B-R3-T0-1A	401	GW Only	0	10	60	352.0	NA
3	7/31/98 6:55	21.9	4B-R3-T20HR-3	401	GW Only	0	10	70	342.0	NA
3	7/31/98 9:00	24.0	4B-R3-T24HR-3	401	GW Only	0	10	80	332.0	NA
3	8/3/98 9:00	96.0	4B-R3-T96HR-3	401	GW Only	0	10	90	322.0	NA
4	7/30/98 9:00	0.0	4B-R3-T0-4	401	GW Only	0.0	10	10	401.0	NA
4	7/30/98 9:30	0.5	4B-R3-T30MIN-4	401	GW Only	0	10	20	392.0	NA
4	7/30/98 11:00	2.0	4B-R3-T2HR-4	401	GW Only	0	10	30	382.0	NA
4	7/30/98 13:00	4.0	4B-R3-T4HR-4A	401	GW Only	0	20	50	372.0	NA
4	7/30/98 15:00	6.0	4B-R3-T6HR-4	401	GW Only	0	10	60	352.0	NA
4	7/31/98 6:55	21.9	4B-R3-T20HR-4	401	GW Only	0	10	70	342.0	NA
4	7/31/98 9:00	24.0	4B-R3-T24HR-4	401	GW Only	0	10	80	332.0	NA
4	8/3/98 9:00	96.0	4B-R3-T96HR-4	401	GW Only	0	10	90	322.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm)	39600
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn(	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquo	pH
No.	Added (mL	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0	NA	NA	101.0	0	0	0.00	0	8.17
3	1	101.0	29.50	1	29.5	28	28	0.07	0.3	6.78
3	1	29.5	10.50	1	10.5	7	35	0.09	0.2	6.03
3	1	10.5	2.37	1	2.4	3	38	0.10	0.0	6.31
3	1	2.4	1.01	1	1.0	0	39	0.10	0.0	6.08
3	1	1.0	0.61	1	0.6	0	39	0.10	0.0	6.42
3	1	0.6	0.45	1	0.5	0	39	0.10	0.0	6.1
3	1	0.5	1.10	1	1.1	0	39	0.10	0.0	6.67
4	0	0	NA	NA	101.0	0	0	0.00	0	8.18
4	1	101.0	27.60	1	27.6	29	29	0.07	0.3	6.79
4	1	27.6	11.50	1	11.5	6	35	0.09	0.1	6.11
4	1	11.5	2.55	1	2.6	3	38	0.10	0.1	6.41
4	1	2.6	1.07	1	1.1	1	39	0.10	0.0	6.2
4	1	1.1	0.58	1	0.6	0	39	0.10	0.0	6.47
4	1	0.6	0.50	1	0.5	0	39	0.10	0.0	6.17
4	1	0.5	1.1	1	1.1	0	39	0.10	0.0	6.71

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
3	1319	100,293		3.05	2.89	106,024		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.06
3	1333R	50,690		3.13	3.25	48,844		0.46	22.4	22.4	52.7%	52.7%	52.7%	0.49
3	1347R	43,307		3.13	3.45	39,385		0.37	3.6	26.0	8.5%	8.5%	61.2%	0.79
3	1361	28,860	E	3.03	3.07	28,421	E	0.27	4.0	30.0	9.3%	9.3%	70.6%	0.28
3	1375R	36,530		3.03	3.42	32,396		0.31	-1.4	28.6	-3.3%	-3.3%	67.3%	0.32
3	1389R	32,635		3.07	3.16	31,692		0.30	0.2	28.8	0.6%	0.6%	67.8%	0.32
3	1403R	28,983		3.07	2.68	33,202		0.31	-0.5	28.3	-1.2%	-1.2%	66.7%	0.33
3	1417	31,349		3.09	3.177	30,499		0.29	0.9	29.2	2.0%	2.0%	68.7%	0.30
4	1320	96,366		3.05	2.74	107,060		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.07
4	1334R	44,869		3.12	2.51	55,777		0.52	20.1	20.1	46.8%	46.8%	46.8%	0.56
4	1348R	41,370		3.11	3.22	40,041		0.37	6.0	26.1	14.0%	14.0%	60.8%	0.40
4	1362R	35,512		3.02	3.18	33,701		0.31	2.4	28.5	5.5%	5.5%	66.3%	0.67
4	1376R	34,518		3.04	3.21	32,699		0.31	0.4	28.8	0.8%	0.8%	67.1%	0.33
4	1390R	31,688		3.08	3.00	32,503		0.30	0.1	28.9	0.2%	0.2%	67.3%	0.33
4	1404R	31,117		3.06	2.95	32,273		0.30	0.1	29.0	0.2%	0.2%	67.5%	0.32
4	1418	34,406		3.09	3.28	32,375		0.30	0.0	28.9	-0.1%	-0.1%	67.4%	0.32

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	7/30/98 9:00	0.0	4B-R3-T0-5	400	GW Only	0.0	10	10	400.0	NA
5	7/30/98 9:30	0.5	4B-R3-T30MIN-5	400	GW Only	0	10	20	400.0	NA
5	7/30/98 11:00	2.0	4B-R3-T2HR-5	400	GW Only	0	10	30	390.0	NA
5	7/30/98 13:00	4.0	4B-R3-T4HR-5	400	GW Only	0	10	40	380.0	NA
5	7/30/98 15:00	6.0	4B-R3-T6HR-5A	400	GW Only	0	20	60	370.0	NA
5	7/31/98 6:55	21.9	4B-R3-T20HR-5	400	GW Only	0	10	70	350.0	NA
5	7/31/98 9:00	24.0	4B-R3-T24HR-5	400	GW Only	0	10	80	340.0	NA
5	8/3/98 9:00	96.0	4B-R3-T96HR-5	400	GW Only	0	10	90	330.0	NA
6	7/30/98 9:00	0.0	4B-R3-T0-6	401	GW Only	0.0	10	10	401.0	NA
6	7/30/98 9:30	0.5	4B-R3-T30MIN-6	401	GW Only	0	10	20	401.0	NA
6	7/30/98 11:00	2.0	4B-R3-T2HR-6	401	GW Only	0	10	30	391.0	NA
6	7/30/98 13:00	4.0	4B-R3-T4HR-6	401	GW Only	0	10	40	381.0	NA
6	7/30/98 15:00	6.0	4B-R3-T6HR-6	401	GW Only	0	10	50	371.0	NA
6	7/31/98 6:55	21.9	4B-R3-T20HR-6A	401	GW Only	0	20	70	361.0	NA
6	7/31/98 9:00	24.0	4B-R3-T24HR-6	401	GW Only	0	10	80	341.0	NA
6	8/3/98 9:00	96.0	4B-R3-T96HR-6	401	GW Only	0	10	90	331.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm)	39600
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock MnO4 Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	990.0	0	0	0.00	0	8.23
5	10	990.0	49.8	17	846.60	57	57	0.14	8.5	6.26
5	10	846.6	49.6	17	843.20	1	59	0.15	8.4	5.93
5	10	843.2	48.8	17	829.60	5	64	0.16	8.3	6.35
5	10	829.6	49.4	17	839.80	-4	60	0.15	16.8	6.11
5	10	839.8	47.7	17	810.90	10	70	0.18	8.1	6.17
5	10	810.9	47.5	17	807.50	1	71	0.18	8.1	6.04
5	10	807.5	47.2	17	802.40	2	73	0.18	8.0	6.44
6	0	0	NA	NA	987.53	0	0	0.00	0	8.23
6	10	987.5	48.9	17	831.30	63	63	0.16	8.3	6.26
6	10	831.3	49.4	17	839.80	-3	59	0.15	8.4	6
6	10	839.8	48.7	17	827.90	5	64	0.16	8.3	6.39
6	10	827.9	49.5	17	841.50	-5	59	0.15	8.4	6.13
6	10	841.5	48.0	17	816.00	9	68	0.17	16.3	6.21
6	10	816.0	48.1	17	817.70	-1	67	0.17	8.2	6.05
6	10	817.7	47.4	17	805.80	4	71	0.18	8.1	6.41

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R3	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1321	99,109		3.07	2.92	104,107		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.04
5	1335	0		3.11	3.04	1		0.00	41.6	41.6	100.0%	100.0%	100.0%	0.00
5	1349	0		3.12	2.84	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
5	1363	0		3.02	2.99	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
5	1377	0		3.03	3.26	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
5	1391	0		3.03	2.74	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
5	1405	0		3.06	3.60	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
5	1419	0		3.09	3.259	1		0.00	0.0	41.6	0.0%	0.0%	100.0%	0.00
6	1322	102,240		3.09	3.24	97,517		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.98
6	1336	0		3.13	3.05	1		0.00	39.1	39.1	100.0%	100.0%	100.0%	0.00
6	1350	0		3.11	3.57	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00
6	1364	0		3.02	2.73	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00
6	1378	0		3.04	3.45	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00
6	1392	0		3.07	2.90	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00
6	1406	0		3.08	2.90	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00
6	1420	0		3.09	3.68	1		0.00	0.0	39.1	0.0%	0.0%	100.0%	0.00

Steven Robert Cline:
NO, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R3 For additional comments, RMAL Laboratory Research Book

MnO4 Calib. Slope 0.066 STOCK Conc (ppm) 49.5 DF 800 Conc (ppm) 39.6

Calibration Date 5/5/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data vol (mL) aqueous aliquot	Qum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	pH Data ORNL GC #	Extract Conc (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	6/11/98 8:45	-1176.2	4B-R3-T0-1B	401	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.07	1323	89,741		3.09	3.04	91,184		15.5%	99515.85	11782.54
2	6/11/98 9:15	-1175.8	4B-R3-T30MIN-2B	401	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.10	1337	98,499		3.12	3.06	100,502		1.3%	########	945.94
3	6/11/98 10:45	-1174.3	4B-R3-T2HR-3B	401	GW Only	0.0	10	NA	NA	NA	1	NA	10.5	1	10.5	6.04	1351R	39,440		3.11	3.09	39,703		-0.8%	39544.08	224.84
4	6/11/98 12:45	-1172.3	4B-R3-T4HR-4B	401	GW Only	0.0	10	NA	NA	NA	1	NA	2.6	1	2.6	6.47	1365R	32,285		3.04	2.91	33,697		0.0%	33699.25	2.56
5	6/11/98 14:45	-1170.2	4B-R3-T6HR-5B	400	GW Only	0.0	10	NA	NA	NA	10	NA	49.3	17	838.1	6.11	1379	0		3.04	3.16	1		0.0%	1.00	0.00
6	6/12/98 4:50	-1156.2	4B-R3-T20HR-6B	401	GW Only	0.0	10	NA	NA	NA	10	NA	48.0	17	816.0	6.21	1393	0		3.04	2.85	1		0.0%	1.00	0.00
1	6/12/98 8:45	-1152.2	4B-R3-T24HR-1	401	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.02	1407	110,733		3.07	2.72	124,940		2.1%	########	1926.82
2	8/3/98 9:00	96.0	4B-R3-T96HR-2b	401	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.84	1421	117,136		3.10	2.82	128,704		-1%	128,360	487
	Extraction of the Remaining Reactor Contents																									
1																										
2																										
																					mass (g)	soil/gw TCE (mg/L)				
3	8/3/98 9:00	96.0	4B-R3-F3	401	GW Only	0					NA	NA	NA	NA	NA	NT	1457	21,995		445.30	308.7	9.7847				
4	8/3/98 9:00	96.0	4B-R3-F4	401	GW Only	0					NA	NA	NA	NA	NA	NT	1458	23,606		425.91	312.6	10.0542				
5	8/3/98 9:00	96.0	4B-R3-F5	400	GW Only	0					NA	NA	NA	NA	NA	NT	1459	0		424.24	319.7	0.0000				
6	8/3/98 9:00	96.0	4B-R3-F6	401	GW Only	0					NA	NA	NA	NA	NA	NT	1460	0		439.09	309.8	0.0000				
	Extraction of the Charcoal Fraction																				Mass sorbent	Mass TCE (mg/L)				
1	8/3/98 9:00		4B-R3-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1429R	2,344		5.11	0.10	0.0120				
1	8/3/98 9:00		4B-R3-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1430	0		5.12	0.04	0.0000				
2	8/3/98 9:00		4B-R3-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1431R	1,268		5.18	0.08	0.0066				
2	8/3/98 9:00		4B-R3-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1432	0		5.19	0.04	0.0000				
3	8/3/98 9:00		4B-R3-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1433R	1,180		5.18	0.09	0.0061				
3	8/3/98 9:00		4B-R3-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1434	0		5.18	0.04	0.0000				
4	8/3/98 9:00		4B-R3-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1435	6,593	E	5.19	0.09	0.0342	E			
4	8/3/98 9:00		4B-R3-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1436	0		5.19	0.04	0.0000				
5	8/3/98 9:00		4B-R3-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1437R	2,918		5.22	0.10	0.0152				
5	8/3/98 9:00		4B-R3-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1438	0		5.18	0.04	0.0000				
6	8/3/98 9:00		4B-R3-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1439R	2,280		5.16	0.10	0.0118				
6	8/3/98 9:00		4B-R3-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1440	0		5.14	0.04	0.0000				

Steven Robert Cline: ND, BUT SWITCHED AS 1 PPB FOR PLOTTING LOG SCALE

Additional Oxidant Information

Flask	Initial Mn4 (mg)	Init Load mg/mL or mg/g	Consumed mg @ t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	39.6	0.10	39.42	0.10	
4	39.6	0.10	39.40	0.10	0.10
5	396.0	0.99	73.00	0.18	
6	396.0	0.99	68.10	0.17	0.18

Prepared by: S R Cline

Last Updated: 11/1/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R4

For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	100,000	NO	1 & 3

Experiment Start Date: 7/29/98

Comments:

SPIKE SOLUTION PREPARATION

Prepared a 100 ppm TCE spiking solution in Tedlar bag using 2500gm of sparged groundwater and 280uL of pure phase TCE. Placed bag in incubator set at 12 C.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1315	4B-R4-TB-A	7/30/98 8:20	139,895		5.11	4.85	147,334
1316	4B-R4-TB-B	7/30/98 8:20	133,723		5.12	4.67	146,730

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	7/30/98 9:05	0.0	4B-R4-T0-1A	400	GW Only	0.0	20	20	400.0	NA
1	7/30/98 9:35	0.5	4B-R4-T30MIN-1	400	GW Only	0	10	30	380.0	NA
1	7/30/98 11:00	1.9	4B-R4-T2HR-1	400	GW Only	0	10	40	370.0	NA
1	7/30/98 13:05	4.0	4B-R4-T4HR-1	400	GW Only	0	10	50	360.0	NA
1	7/30/98 15:05	6.0	4B-R4-T6HR-1	400	GW Only	0	10	60	350.0	NA
1	7/31/98 6:55	21.8	4B-R4-T20HR-1	400	GW Only	0	10	70	340.0	NA
1	7/31/98 9:05	24.0	4B-R4-T24HR-1A	400	GW Only	0	20	90	330.0	NA
1	8/3/98 9:05	96.0	4B-R4-T96HR-1	400	GW Only	0	10	100	310.0	NA
2	6/24/98 8:45	0.0	4B-R4-T0-2	400	GW Only	0.0	10	10	400.0	NA
2	6/24/98 9:15	0.5	4B-R4-T30MIN-2A	400	GW Only	0	20	30	390.0	NA
2	6/24/98 10:45	2.0	4B-R4-T2HR-2	400	GW Only	0	10	40	370.0	NA
2	6/24/98 12:45	4.0	4B-R4-T4HR-2	400	GW Only	0	10	50	360.0	NA
2	6/24/98 14:45	6.0	4B-R4-T6HR-2	400	GW Only	0	10	60	350.0	NA
2	6/25/98 7:02	22.3	4B-R4-T20HR-2	400	GW Only	0	10	70	340.0	NA
2	6/25/98 8:45	24.0	4B-R4-T24HR-2	400	GW Only	0	10	80	330.0	NA
2	8/3/98 9:05	96.0	4B-R4-T96HR-2a	400	GW Only	0	20	100	320.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK	NA	DF:	NA	CONC:	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4 Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.37
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.29
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.25
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.38
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.32
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.08
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.00
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.91
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.35
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.38
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.26
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.4
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.36
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.09
2	0	0	NA	NA	NA	NA	NA	NA	NA	8
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.92

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Fla	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1324	110,280		3.10	3.16	108,204		NA	NA	NA	NA	NA	NA	2.16
1	1338	107,813		3.13	3.42	98,642		NA	NA	NA	NA	NA	NA	0.99
1	1352	95,030		3.09	2.84	103,215		NA	NA	NA	NA	NA	NA	1.03
1	1366	118,327		3.02	3.16	113,022		NA	NA	NA	NA	NA	NA	1.13
1	1380	101,684		3.05	3.01	102,814		NA	NA	NA	NA	NA	NA	1.03
1	1394	101,714		3.06	2.97	104,868		NA	NA	NA	NA	NA	NA	1.05
1	1408	117,979		3.08	2.84	127,728		NA	NA	NA	NA	NA	NA	2.55
1	1422	107,601		3.11	2.77	120,830		NA	NA	NA	NA	NA	NA	1.21
2	1325	117,700		3.08	3.38	107,180		NA	NA	NA	NA	NA	NA	1.07
2	1339	97,974		3.13	2.97	103,327		NA	NA	NA	NA	NA	NA	2.07
2	1353	98,430		3.10	2.93	104,101		NA	NA	NA	NA	NA	NA	1.04
2	1367	117,477		3.03	3.25	109,578		NA	NA	NA	NA	NA	NA	1.10
2	1381	99,311		3.05	2.90	104,712		NA	NA	NA	NA	NA	NA	1.05
2	1395	99,499		3.07	2.83	107,972		NA	NA	NA	NA	NA	NA	1.08
2	1409	117,145		3.08	2.80	129,074		NA	NA	NA	NA	NA	NA	1.29
2	1423	111,574		3.11	2.77	125,323		NA	NA	NA	NA	NA	NA	2.51

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	6/24/98 8:45	0.0	4B-R4-T0-3	400	GW Only	0.0	10	10	400.0	NA
3	6/24/98 9:15	0.5	4B-R4-T30MIN-3	400	GW Only	0	10	20	390.0	NA
3	6/24/98 10:45	2.0	4B-R4-T2HR-3A	400	GW Only	0	20	40	380.0	NA
3	6/24/98 12:45	4.0	4B-R4-T4HR-3	400	GW Only	0	10	50	360.0	NA
3	6/24/98 14:45	6.0	4B-R4-T0-1A	400	GW Only	0	10	60	350.0	NA
3	6/25/98 7:02	22.3	4B-R4-T20HR-3	400	GW Only	0	10	70	340.0	NA
3	6/25/98 8:45	24.0	4B-R4-T24HR-3	400	GW Only	0	10	80	330.0	NA
3	8/3/98 9:05	96.0	4B-R4-T96HR-3	400	GW Only	0	10	90	320.0	NA
4	6/24/98 8:45	0.0	4B-R4-T0-4	400	GW Only	0.0	10	10	400.0	NA
4	6/24/98 9:15	0.5	4B-R4-T30MIN-4	400	GW Only	0	10	20	390.0	NA
4	6/24/98 10:45	2.0	4B-R4-T2HR-4	400	GW Only	0	10	30	380.0	NA
4	6/24/98 12:45	4.0	4B-R4-T4HR-4A	400	GW Only	0	20	50	370.0	NA
4	6/24/98 14:45	6.0	4B-R4-T6HR-4	400	GW Only	0	10	60	350.0	NA
4	6/25/98 7:02	22.3	4B-R4-T20HR-4	400	GW Only	0	10	70	340.0	NA
4	6/25/98 8:45	24.0	4B-R4-T24HR-4	400	GW Only	0	10	80	330.0	NA
4	8/3/98 9:05	96.0	4B-R4-T96HR-4	400	GW Only	0	10	90	320.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK	NA	DF:	NA	CONC:	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0	NA	NA	10197	0	0	0.00	0	8.38
3	**5280**	10197	12.4	801	9932	103	103	0.26	99.3	6.67
3	5280	9932	25.4	401	10185	-96	7	0.02	203.7	6.38
3	5280	10185	24.7	401	9905	101	108	0.27	99.0	6.71
3	5280	9905	25.4	401	10185	-98	10	0.02	101.9	6.62
3	5280	10185	25.3	401	10145	14	23	0.06	101.5	6.73
3	5280	10145	24.9	401	9985	53	76	0.19	99.8	6.59
3	5280	9985	25.4	401	10185	-64	12	0.03	101.9	6.86
4	0	0	NA	NA	10197	0	0	0.00	0	8.36
4	**5280**	10197	12.4	801	9932	103	103	0.26	99.3	6.61
4	5280	9932	25.1	401	10065	-50	53	0.13	100.7	6.32
4	5280	10065	25.2	401	10105	-15	38	0.09	202.1	6.71
4	5280	10105	25.8	401	10346	-84	-46	-0.12	103.5	6.6
4	5280	10346	25.3	401	10145	68	22	0.05	101.5	6.72
4	5280	10145	25.1	401	10065	26	48	0.12	100.7	6.61
4	5280	10065	25.2	401	10105	-13	35	0.09	101.1	6.73

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Fla	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
3	1326	101,352		3.09	2.83	110,587		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.11
3	1340	0		3.15	3.31	1		[illegible]	[illegible]	43.1	97.5%	97.5%	97.5%	0.00
3	1354	0		3.07	3.01	1		[illegible]	[illegible]	43.1	0.0%	0.0%	97.5%	0.00
3	1368	0		3.03	3.27	1		0.00	0.0	43.1	0.0%	0.0%	97.5%	0.00
3	1382	0		3.05	3.22	1		0.00	0.0	43.1	0.0%	0.0%	97.5%	0.00
3	1396	0		3.07	3.26	1		0.00	0.0	43.1	0.0%	0.0%	97.5%	0.00
3	1410	0		3.08	2.93	1		0.00	0.0	43.1	0.0%	0.0%	97.5%	0.00
3	1424	0		3.12	2.93	1		0.00	0.0	43.1	0.0%	0.0%	97.5%	0.00
4	1327	102,991		3.09	2.95	108,200		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.08
4	1341	0		3.14	3.50	1		0.00	42.2	42.2	97.5%	97.5%	97.5%	0.00
4	1355	0		3.12	3.09	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00
4	1369	0		3.02	2.62	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00
4	1383	0		3.06	3.31	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00
4	1397	0		3.05	3.03	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00
4	1411	0		3.07	3.28	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00
4	1425	0		3.12	3.31	1		0.00	0.0	42.2	0.0%	0.0%	97.5%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	6/24/98 8:45	0.0	4B-R4-T0-5	400	GW Only	0.0	10	10	400.0	NA
5	6/24/98 9:15	0.5	4B-R4-T30MIN-5	400	GW Only	0	10	20	390.0	NA
5	6/24/98 10:45	2.0	4B-R4-T2HR-5	400	GW Only	0	10	30	380.0	NA
5	6/24/98 12:45	4.0	4B-R4-T4HR-5	400	GW Only	0	10	40	370.0	NA
5	6/24/98 14:45	6.0	4B-R4-T6HR-5A	400	GW Only	0	20	60	360.0	NA
5	6/25/98 7:02	22.3	4B-R4-T20HR-5	400	GW Only	0	10	70	340.0	NA
5	6/25/98 8:45	24.0	4B-R4-T24HR-5	400	GW Only	0	10	80	330.0	NA
5	8/3/98 9:05	96.0	4B-R4-T96HR-5	400	GW Only	0	10	90	320.0	NA
6	6/24/98 8:45	0.0	4B-R4-T0-6	400	GW Only	0.0	10	10	400.0	NA
6	6/24/98 9:15	0.5	4B-R4-T30MIN-6	400	GW Only	0	10	20	390.0	NA
6	6/24/98 10:45	2.0	4B-R4-T2HR-6	400	GW Only	0	10	30	380.0	NA
6	6/24/98 12:45	4.0	4B-R4-T4HR-6	400	GW Only	0	10	40	370.0	NA
6	6/24/98 14:45	6.0	4B-R4-T6HR-6	400	GW Only	0	10	50	360.0	NA
6	6/25/98 7:02	22.3	4B-R4-T20HR-6A	400	GW Only	0	20	70	350.0	NA
6	6/25/98 8:45	24.0	4B-R4-T24HR-6	400	GW Only	0	10	80	330.0	NA
6	8/3/98 9:05	96.0	4B-R4-T96HR-6	400	GW Only	0	10	90	320.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK	NA	DF:	NA	CONC:	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4 Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	30899	0	0	0.00	0	8.39
5	16000	30899	34.6	801	27715	1242	1242	3.10	277.1	7
5	16000	27715	37.6	801	30118	-913	329	0.82	301.2	6.85
5	16000	30118	38.0	801	30438	-119	210	0.53	304.4	7.19
5	16000	30438	38.6	801	30919	-173	37	0.09	618.4	7.1
5	16000	30919	37.0	801	29637	436	473	1.18	296.4	7.3
5	16000	29637	38.1	801	30518	-291	182	0.46	305.2	7.13
5	16000	30518	37.4	801	29957	179	362	0.90	299.6	7.35
6	0	0	NA	NA	30899	0	0	0.00	0	8.4
6	16000	30899	35.4	801	28355	992	992	2.48	283.6	7.03
6	16000	28355	37.7	801	30198	-700	292	0.73	302.0	6.92
6	16000	30198	37.7	801	30198	0	292	0.73	302.0	7.22
6	16000	30198	38.6	801	30919	-260	32	0.08	309.2	7.19
6	16000	30919	38.0	801	30438	168	201	0.50	608.8	7.32
6	16000	30438	38.1	801	30518	-26	174	0.44	305.2	7.19
6	16000	30518	37.9	801	30358	51	225	0.56	303.6	7.41

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R4	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Fla	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1328	109,939		3.08	3.17	107,035		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.07
5	1342	0		3.12	3.23	1		0.00	41.7	41.7	97.5%	97.5%	97.5%	0.00
5	1356	0		3.11	3.27	1		0.00	0.0	41.7	0.0%	0.0%	97.5%	0.00
5	1370	0		3.05	3.34	1				41.7	0.0%	0.0%	97.5%	0.00
5	1384	0		3.05	2.83	1				41.7	0.0%	0.0%	97.5%	0.00
5	1398	0		3.06	3.35	1		0.00	0.0	41.7	0.0%	0.0%	97.5%	0.00
5	1412	0		3.07	3.19	1		0.00	0.0	41.7	0.0%	0.0%	97.5%	0.00
5	1426	0		3.10	3.05	1		0.00	0.0	41.7	0.0%	0.0%	97.5%	0.00
6	1329	117,695		3.10	3.55	102,897		1.00	0.0	0.0	0.0%	0.0%	0.0%	1.03
6	1343	0		3.12	3.36	1		0.00	40.1	40.1	97.5%	97.5%	97.5%	0.00
6	1357	0		3.11	3.30	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00
6	1371	0		3.05	3.32	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00
6	1385	0		3.05	3.66	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00
6	1399	0		3.07	3.02	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00
6	1413	0		3.06	3.28	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00
6	1427	0		3.10	3.70	1		0.00	0.0	40.1	0.0%	0.0%	97.5%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp	4b-R4	For additional comments, RMAL Laboratory Research Book																											
											Mat'l- Calib. Slope		0.000	STOCK	NA	DF	NA	CYNIC	Conc (ppm)									
											Calibration Date: 5/5/98																			
						Sample Data										pH Data														
Reaction No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	CRNL GC #	Extract Conc (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																													
1	6/24/98 8.45	-864.3	4B-R4-T0-1B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.37	1330	98,716		3.09	2.85	107,165		1.0%	107684.62	734.90
2	6/24/98 9.15	0.5	4B-R4-T30MIN-2B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.38	1344	109,124		3.13	2.93	118,614		-12.9%	109970.53	9395.28
3	6/24/98 10.45	2.0	4B-R4-T2HR-3B	400	GW Only	0	10	NA	NA	NA	5280	NA	25.3	401	10145	6.38	1358	0		3.12	2.94	1		0.0%	1.00	0.00
4	6/24/98 12.45	4.0	4B-R4-T4HR-4B	400	GW Only	0	10	NA	NA	NA	5280	NA	25.2	401	10105	6.71	1372	0		3.04	3.28	1		0.0%	1.00	0.00
5	6/24/98 14.45	6.0	4B-R4-T6HR-5B	400	GW Only	0	10	NA	NA	NA	16000	NA	38.6	801	30919	7.11	1386	0		3.05	3.23	1		0.0%	1.00	0.00
6	6/25/98 7.02	22.3	4B-R4-T20HR-6B	400	GW Only	0	10	NA	NA	NA	16000	NA	38.1	801	30518	7.31	1400	0		3.08	3.04	1		0.0%	1.00	0.00
1	6/25/98 8.45	24.0	4B-R4-T24HR-1B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8	1414	113,997		3.10	2.79	126,953		0.6%	127340.51	547.87
2	8/3/98 9.05	96.0	4B-R4-T96HR-2b		GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.92	1429	115,559		3.11	2.86	125,553		0%	125,438	1.41
	Extraction of the Remaining Reactor Contents																													
1																														
2																					mass (g)									
3	8/3/98 9.05	960.3	4B-R4-F3	400	TSF Sludge	0					NA	NA	NA	NA	NA	NT	1453	0		411.7	314.9	0.0000							
4	8/3/98 9.05	960.3	4B-R4-F4	400	TSF Sludge	0					NA	NA	NA	NA	NA	NT	1454	0		427.1	313.6	0.0000							
5	8/3/98 9.05	960.3	4B-R4-F5	400	TSF Sludge	0					NA	NA	NA	NA	NA	NT	1455	0		435.9	321.3	0.0000							
6	8/3/98 9.05	960.3	4B-R4-F6	400	TSF Sludge	0					NA	NA	NA	NA	NA	NT	1456	0		439.5	321.5	0.0000							
	Extraction of the Charcoal Beads																				Mass	Mass								
1	8/3/98 9.05		4B-R4-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1441R	5,139		5.22	0.07	0.0264							
1	8/3/98 9.05		4B-R4-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1442	0		5.21	0.04	0.0000							
2	8/3/98 9.05		4B-R4-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1443	878		5.21	0.10	0.0046							
2	8/3/98 9.05		4B-R4-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1444	0		5.20	0.04	0.0000							
3	8/3/98 9.05		4B-R4-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1445R	1,563		5.20	0.09	0.0081							
3	8/3/98 9.05		4B-R4-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1446	0		5.20	0.04	0.0000							
4	8/3/98 9.05		4B-R4-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1447	226		5.19	0.10	0.0012							
4	8/3/98 9.05		4B-R4-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1448	0		5.20	0.04	0.0000							
5	8/3/98 9.05		4B-R4-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1449	822		5.21	0.10	0.0043							
5	8/3/98 9.05		4B-R4-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1450	0		5.19	0.04	0.0000							
6	8/3/98 9.05		4B-R4-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1451R	1,519		5.21	0.10	0.0079							
6	8/3/98 9.05		4B-R4-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1452	0		5.20	0.05	0.0000							

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Additional Oxidant Information

Flask	Initial Mat'l. (mg)	Init. Load mg/mL IV mg/g	Consumed mg @t=96 hrs	Consumed mg/mL IV mg/g	AVG (mg/g)
1	n.a.	0.000	NA	NA	NA
2	n.a.	0.000	NA	NA	NA
3	3977	10.2	83	0.2	
4	3977	10.2	51	0.1	0.17
5	12051	30.9	149	0.4	
6	12051	30.9	149	0.4	0.38

Prepared by: S.R. Cline

Last Updated: 11/0/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R5 For additional comments, see Laboratory Notebook B000025 Pages: 115-119

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	100,000	YES @ 10ppm	0.01 & 0.1

Experiment Start Date: 8/26/98

Comments:
See general procedure on pages 95-97 in the laboratory Notebook.

Sequence stopped for approx 38 hrs (immediately before GC sample 1871)

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	3.08 liters	
Pure TCE ADDED	0.2 mL	
	291200 ug	
Predicted Spike Conc:	94563 ppb	TCE

Also added 25uL of each contaminant for approx init conc of 10,000 ppb each.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Extract Conc. (ppb)		Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
1861b	4b-R5-tb-a	1,1DCE:	1956		4.95	5.53	1,749
1862b	4b-R5-tb-b		2038		4.99	5.09	1,995
1861b	4b-R5-tb-a	Trans-1,2DCE:	3672.57		4.95	5.53	3,284
1862b	4b-R5-tb-b		3784.27		4.99	5.09	3,706
1861b	4b-R5-tb-a	Cis-1,2DCE:	7555.39		4.95	5.53	6,756
1862b	4b-R5-tb-b		5325.27		4.99	5.09	5,215
1861	4b-R5-tb-a	TCE:	19773.91		4.95	5.53	17,682
1862	4b-R5-tb-b		20339.63		4.99	5.09	19,920

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	8/27/98 11:01	0.0	4b-r5-t0-1a	492.34	GW Only	0.0	7.32	7.32	492.3	NA
1	8/27/98 11:36	0.6	4b-r5-t30min-1	492.34	GW Only	0	7.2	14.52	485.0	NA
1	8/27/98 12:30	1.5	4b-r5-t1.5h-1	492.34	GW Only	0	7.32	21.84	477.8	NA
1	8/27/98 14:02	3.0	4b-r5-t3h-1	492.34	GW Only	0	7.35	29.19	470.5	NA
1	8/27/98 16:00	5.0	4b-r5-t5h-1	492.34	GW Only	0	7.48	36.67	463.2	NA
1	8/28/98 8:10	21.2	4b-r5-t20h-1	492.34	GW Only	0	7.4	44.07	455.7	NA
1	8/28/98 11:05	24.1	4b-r5-t24h-1	492.34	GW Only	0	7	51.52	448.3	NA
2	8/27/98 11:03	0.0	4b-r5-t0-2	499.65	GW Only	0.0	7.08	7.08	499.7	NA
2	8/27/98 11:37	0.6	4b-r5-t30min-2a	499.65	GW Only	0	7.22	14.3	492.6	NA
2	8/27/98 12:31	1.5	4b-r5-t1.5h-2	499.65	GW Only	0	7.31	21.61	485.4	NA
2	8/27/98 14:03	3.0	4b-r5-t3h-2	499.65	GW Only	0	7.14	28.75	478.0	NA
2	8/27/98 16:01	5.0	4b-r5-t5h-2	499.65	GW Only	0	7.39	36.14	470.9	NA
2	8/28/98 8:11	21.1	4b-r5-t20h-2	499.65	GW Only	0	7.29	43.43	463.5	NA
2	8/28/98 11:06	24.0	4b-r5-t24h-2	499.65	GW Only	0	7.31	50.74	456.2	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calib. Slope:		0.022	STOCK SOLN ABS:		0.522	DF:	1667	Conc (ppm):	38981.43
	Calibration Date: 6/10/98									
	[redacted]									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4-	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4-	mg MnO4-	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.65
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.48
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.46
1	0	0	0.004	1	NA	NA	NA	NA	NA	8.44
1	0	0	0.005	1	NA	NA	NA	NA	NA	8.46
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.44
1	0	0	0.003	1	NA	NA	NA	NA	NA	8.46
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.5
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.5
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.46
2	0	0	0.003	1	NA	NA	NA	NA	NA	8.45
2	0	0	0.005	1	NA	NA	NA	NA	NA	8.46
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.44
2	0	0	0.004	1	NA	NA	NA	NA	NA	8.46

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025																									
	ORNL	1-1DCE	Flag	ORNL	TransD	Flag	ORNL	CisDCE	Flag	ORNL	TCE	Flag	Hexane	Aqueous	1-1DCE	Flag	TransDCE	Flag	CisDCE	Flag	TCE	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Extract		GC #	Extract		GC #	Extract		GC #	Extract		Volume	Volume	Aqueous		Aqueous		Aqueous		Aqueous		C/Co	Oxidized	mg TCE	TCE Oxid	TCE Oxid	Total TCE	in Aliquot
No.		(ppb)			(ppb)			(ppb)			(ppb)		(mL)	(mL)	(ppb)		(ppb)		(ppb)		(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	1863b	3,837		1863b	3,837		1863b	5,738		1863	22,345		2.94	3.40	3,320		3,320		4,966		19,339		NA	NA	NA	NA	NA	NA	0.14
1	1870b	1,891		1870b	3,681		1870b	7,858		1870	23,424		3.00	3.32	1,713		3,334		7,117		21,213		NA	NA	NA	NA	NA	NA	0.15
1	1877b	1,239		1877b	2,755		1877b	7,505		1877	23,229		2.80	3.22	1,078		2,398		6,532		20,219		NA	NA	NA	NA	NA	NA	0.15
1	1884b			1884b			1884b			1884	21,947		2.97	3.08							21,147		NA	NA	NA	NA	NA	NA	0.16
1	1891b	1,805		1891b	3,598		1891b	4,854		1891	22,076		2.98	3.07	1,751		3,491		4,710		21,421		NA	NA	NA	NA	NA	NA	0.16
1	1898b	1,748		1898b	3,548		1898b	5,029		1898	20,341		2.99	3.16	1,656		3,362		4,766		19,277		NA	NA	NA	NA	NA	NA	0.14
1	1905b	1,763		1905b	3,697		1905b	5,198		1905	23,039		2.96	3.20	1,628		3,414		4,800		21,276		NA	NA	NA	NA	NA	NA	0.16
2	1865b	2,128		1865b	3,945		1865b	5,523		1865	23,281		2.99	3.43	1,854		3,437		4,812		20,286		NA	NA	NA	NA	NA	NA	0.14
2	1871b	1,850		1871b	3,588		1871b	4,993		1871	22,654		3.00	3.18	1,747		3,389		4,715		21,396		NA	NA	NA	NA	NA	NA	0.15
2	1878b	1,781		1878b	3,489		1878b	5,063		1878	22,170		2.98	3.16	1,683		3,297		4,784		20,951		NA	NA	NA	NA	NA	NA	0.15
2	1885b			1885b			1885b			1885	23,230		2.99	3.26							21,306		NA	NA	NA	NA	NA	NA	0.15
2	1892b	1,705		1892b	3,717		1892b	5,783		1892	22,023		2.97	3.18	1,590		3,467		5,393		20,541		NA	NA	NA	NA	NA	NA	0.15
2	1899b	1,837		1899b	3,811		1899b	5,468		1899	24,147		2.97	3.28	1,660		3,443		4,940		21,815		NA	NA	NA	NA	NA	NA	0.16
2	1906b	1,697		1906b	3,509		1906b	7,348		1906	22,519		2.91	3.08	1,604		3,317		6,947		21,289		NA	NA	NA	NA	NA	NA	0.16

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	8/27/98 11:04	0.0	4b-r5-t0-3	500.36	GW Only	0.0	7.15	7.15	500.4	NA
3	8/27/98 11:39	0.6	4b-r5-t30min-3	500.36	GW Only	0	6.9	14.05	494.5	NA
3	8/27/98 12:32	1.5	4b-r5-t1.5h-3a	500.36	GW Only	0	6.75	20.8	487.6	NA
3	8/27/98 14:04	3.0	4b-r5-t3h-3	500.36	GW Only	0	6.93	27.73	480.8	NA
3	8/27/98 16:02	5.0	4b-r5-t5h-3	500.36	GW Only	0	6.85	34.58	473.9	NA
3	8/28/98 8:12	21.1	4b-r5-t20h-3	500.36	GW Only	0	6.59	41.17	467.0	NA
3	8/28/98 11:07	24.0	4b-r5-t24h-3	500.36	GW Only	0	6.67	47.84	460.4	NA
4	8/27/98 11:05	0.0	4b-r5-t0-4	498.71	GW Only	0.0	7.21	7.21	498.7	NA
4	8/27/98 11:40	0.6	4b-r5-t30min-4	498.71	GW Only	0	7.17	14.38	492.8	NA
4	8/27/98 12:34	1.5	4b-r5-t1.5h-4	498.71	GW Only	0	7.45	21.83	485.6	NA
4	8/27/98 14:05	3.0	4b-r5-t3h-4a	498.71	GW Only	0	7.38	29.21	478.1	NA
4	8/27/98 16:03	5.0	4b-r5-t5h-4	498.71	GW Only	0	7.4	36.61	470.8	NA
4	8/28/98 8:13	21.1	4b-r5-t20h-4	498.71	GW Only	0	7.02	43.63	463.4	NA
4	8/28/98 11:08	24.0	4b-r5-t24h-4	498.71	GW Only	0	7.44	51.07	456.3	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		0.522	DF:	1667	Conc (ppm):	38981.43
	Calibration Date: 6/10/98									
	[redacted]									pH Data
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0.0	0.003	1	98.5	0	0	0.00	0	8.51
3	1.25	98.5	0.307	5	68.8	15	15	0.03	0.5	7.63
3	1.25	68.8	0.246	5	55.1	7	21	0.04	0.4	7.57
3	1.25	55.1	0.218	5	48.8	3	24	0.05	0.3	7.47
3	1.25	48.8	0.19	5	42.6	3	27	0.05	0.3	7.54
3	1.25	42.6	0.404	2	36.2	3	30	0.06	0.2	7.49
3	1.25	36.2	0.406	2	36.4	0	30	0.06	0.2	7.53
4	0	0.0	0.003	1	98.9	0	0	0.00	0	8.5
4	1.25	98.9	0.323	5	72.4	13	13	0.03	0.5	7.5
4	1.25	72.4	0.26	5	58.2	7	20	0.04	0.4	7.35
4	1.25	58.2	0.218	5	48.8	4	24	0.05	0.4	7.3
4	1.25	48.8	0.199	5	44.6	2	26	0.05	0.3	7.38
4	1.25	44.6	0.426	2	38.2	3	29	0.06	0.3	7.33
4	1.25	38.2	0.43	2	38.5	0	29	0.06	0.3	7.36

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025																									
Reactor No.	ORNL GC #	1-1DCE Extract (ppb)	Flag	ORNL GC #	TransD Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-1DCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxid In Interval	% of Total TCE Oxid In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1866b	2,080		1866b	3,849		1866b	5,523		1866	23,382		2.98	3.28	1,891		3,500		5,022		21,263		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.15
3	1873	129		1873	0		1873	596		1873	3,034		2.98	3.19	121		4		558		2,842		0.13	9.1	9.1	85.6%	85.6%	85.6%	0.02
3	1879	0		1879	0		1879	81		1879R	1,339		2.95	3.25	1		1		74		1,216		0.06	0.8	9.9	7.5%	7.5%	93.1%	0.01
3	1886	0		1886	0		1886	0		1886	243		2.99	3.29	1		1		1		221		0.01	0.5	10.4	4.5%	4.5%	97.6%	0.00
3	1893	0		1893	0		1893	0		1893	199		2.98	3.11	1		1		1		191		0.01	0.0	10.4	0.1%	0.1%	97.7%	0.00
3	1900	-25	U	1900	0		1900	0		1900	78		2.99	3.15	-23	U	1		1		74		0.00	0.1	10.4	0.5%	0.5%	98.2%	0.00
3	1907	-34	U	1907	0		1907	0		1907	190		2.90	3.33	-30	U	1		1		165		0.01	0.0	10.4	-0.4%	-0.4%	97.8%	0.00
4	1867b	1,794		1867b	3,496		1867b	7,577		1867	24,493		2.98	3.31	1,618		3,154		6,836		22,098		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.16
4	1874	107		1874	0		1874	512		1874	2,692		2.99	3.29	98		1		466		2,450		0.11	9.7	9.7	87.8%	87.8%	87.8%	0.02
4	1881	0		1881	0		1881	84		1881R	1,286		2.98	3.12	1		1		80		1,230		0.06	0.6	10.3	5.4%	5.4%	93.2%	0.01
4	1887	0		1887	0		1887	0		1887	393		2.98	3.29	1		1		1		357		0.02	0.4	10.7	3.8%	3.8%	97.0%	0.00
4	1894	0		1894	0		1894	0		1894	167		2.97	3.25	1		1		1		153		0.01	0.1	10.8	0.9%	0.9%	97.9%	0.00
4	1901	0		1901	0		1901	0		1901	16		2.97	3.27	1		1		1		15		0.00	0.1	10.9	0.6%	0.6%	98.5%	0.00
4	1908	-38	U	1908	0		1908	0		1908	28		2.91	3.05	-36	U	1		1		25		0.00	0.0	10.8	0.0%	0.0%	98.4%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	8/27/98 11:06	0.0	4b-r5-t0-5	**506.82**	GW Only	**0.0**	6.99	6.99	506.8	NA
5	8/27/98 11:41	0.6	4b-r5-t30min-5	506.82	GW Only	0	7.28	14.27	512.3	NA
5	8/27/98 12:35	1.5	4b-r5-t1.5h-5	506.82	GW Only	0	7.23	21.5	505.1	NA
5	8/27/98 14:07	3.0	4b-r5-t3h-5	506.82	GW Only	0	7.25	28.75	497.8	NA
5	8/27/98 16:04	5.0	4b-r5-t5h-5a	506.82	GW Only	0	7.3	36.05	490.6	NA
5	8/28/98 8:14	21.1	4b-r5-t20h-5	506.82	GW Only	0	7.11	43.16	483.3	NA
5	8/28/98 11:09	24.0	4b-r5-t24h-5a	506.82	GW Only	0	7	50.36	476.2	NA
6	8/27/98 11:07	0.0	4b-r5-t0-6	**501.33**	GW Only	**0.0**	7.18	7.18	501.3	NA
6	8/27/98 11:42	0.6	4b-r5-t30min-6	501.33	GW Only	0	7.09	14.27	506.7	NA
6	8/27/98 12:36	1.5	4b-r5-t1.5h-6	501.33	GW Only	0	7.43	21.7	499.6	NA
6	8/27/98 14:08	3.0	4b-r5-t3h-6	501.33	GW Only	0	7.38	29.08	492.1	NA
6	8/27/98 16:06	5.0	4b-r5-t5h-6	501.33	GW Only	0	7.49	36.57	484.8	NA
6	8/28/98 8:15	21.1	4b-r5-t20h-6a	501.33	GW Only	0	7.1	43.67	477.3	NA
6	8/28/98 11:11	24.1	4b-r5-t24h-6	501.33	GW Only	0	7.31	50.98	470.2	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		0.522	DF:	1667	Conc (ppm):	38981.43
	Calibration Date: 6/10/98									
	[redacted]									pH Date
	Volume	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock Mr	MnO4-	MnO4-	Spec	MnO4-	Consume	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (m	(mg/L)	ABS	DF	(mg/L)	in Interval	Consume	per mL GW		
5	0	0.0	0.004	1	951.1	0	0	0.00	0	8.5
5	12.5	951.1	0.368	50	824.4	65	65	0.13	6.0	7.2
5	12.5	824.4	0.373	50	835.6	-6	59	0.12	6.0	7.22
5	12.5	835.6	0.37	50	828.9	3	63	0.12	6.0	7.17
5	12.5	828.9	0.36	50	806.5	11	74	0.15	5.9	7.13
5	12.5	806.5	0.373	50	835.6	-14	59	0.12	5.9	7.2
5	12.5	835.6	0.372	50	833.4	1	61	0.12	6.0	7.27
6	0	0.0	0.004	1	961.7	0	0	0.00	0	8.5
6	12.5	961.7	0.390	50	873.7	45	45	0.09	6.2	7.09
6	12.5	873.7	0.404	50	905.1	-16	29	0.06	6.7	7.14
6	12.5	905.1	0.400	50	896.1	4	33	0.07	6.6	7.08
6	12.5	896.1	0.399	50	893.9	1	34	0.07	6.7	7.07
6	12.5	893.9	0.395	50	884.9	4	39	0.08	6.3	7.12
6	12.5	884.9	0.397	50	889.4	-2	37	0.07	6.5	7.13

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025																										
	ORNL	1-1DCE	Flag	ORNL	TransD	Flag	ORNL	CisDCE	Flag	ORNL	TCE	Flag	Hexane	Aqueous	1-1DCE	Flag	TransDCE	Flag	CisDCE	Flag	TCE	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Extract		GC #	Extract		GC #	Extract		GC #	Extract		Volume	Volume	Aqueous		Aqueous		Aqueous		Aqueous		C/Co	Oxidized	mg TCE	TCE Oxid	TCE Oxid	Total TCE	in Aliquot
No.		(ppb)			(ppb)			(ppb)			(ppb)		(mL)	(mL)	(ppb)		(ppb)		(ppb)		(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	1868b	1,915		1868b	4,117		1868b	8,942		1868	34,157		2.98	3.35	1,705		[illegible]		[illegible],962		30,412		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.21
5	1875	0		1875	0		1875	0		1875	66		3.00	3.26	1		1		1		60		0.00	15.6	15.6	100.9%	100.9%	100.9%	0.00
5	1882	0		1882	0		1882	0		1882	14		2.97	3.28	1		1		1		13		0.00	0.0	15.6	0.2%	0.2%	101.0%	0.00
5	1889	0		1889	0		1889	0		1889	7	U	2.98	3.36	1		1		1		7	U	0.00	0.0	15.6	0.0%	0.0%	101.1%	0.00
5	1895	0		1895	0		1895	0		1895	6	U	2.98	3.34	1		1		1		6	U	0.00	0.0	15.6	0.0%	0.0%	101.1%	0.00
5	1902	0		1902	0		1902	0		1902	3	U	2.97	3.26	1		1		1		3	U	0.00	0.0	15.6	0.0%	0.0%	101.1%	0.00
5	1909	0		1909	0		1909	0		1909	4	U	2.91	3.28	1		1		1		4	U	0.00	0.0	15.6	0.0%	0.0%	101.1%	0.00
6	1869b	1,941		1869b	3,817		1869b	7,891		1869	33,023		2.97	3.21	1,797		3,534		7,306		30,576		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.22
6	1876	0		1876	0		1876	0		1876	76		2.99	3.21	1		1		1		71		0.00	15.5	15.5	100.8%	100.8%	100.8%	0.00
6	1883	0		1883	0		1883	0		1883	8	U	2.83	3.33	1		1		1		7	U	0.00	0.0	15.5	0.2%	0.2%	101.0%	0.00
6	1890	0		1890	0		1890	0		1890	6	U	2.98	2.39	1		1		1		6	U	0.00	0.0	15.5	0.0%	0.0%	101.0%	0.00
6	1897	-9		1897	0		1897	0		1897	3	U	2.97	3.34	-8		1		1		2	U	0.00	0.0	15.5	0.0%	0.0%	101.0%	0.00
6	1903	0		1903	0		1903	0		1903	3	U	2.98	3.25	1		1		1		3	U	0.00	0.0	15.5	0.0%	0.0%	101.0%	0.00
6	1911	0		1911	0		1911	0		1911	2	U	2.91	3.16	1		1		1		2	U	0.00	0.0	15.5	0.0%	0.0%	101.1%	0.00

Steven Robert Cline
FD, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B0000025													
							MnO4- Calb. Slope:	0.022	STOCK SOLN ABS:		0.522	DF:	1667	Conc (ppm)	38981.432
							Calibration Date: 6/10/98									
							Sample Data									pH Data
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Curr Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (m	Initial MnO4- (mg/L)	Final MnO4- ABS	Final Spec DF	Final MnO4- (mg/L)	pH
	Duplicate VOC Sample!															
1	8/27/98 11:02	0.0	4b-r5-t0-1b	492.34	GW Only	0	7.28	NA	NA	NA	0	NA	0.003	1	NA	
2	8/27/98 11:38	0.6	4b-r5-t30min-2b	499.65	GW Only	0	7.18	NA	NA	NA	0	NA	0.007	1	NA	8.51
3	8/27/98 12:33	1.5	4b-r5-t1.5h-3b	500.36	GW Only	0	7.38	NA	NA	NA	1.25	NA	0.256	5	57.4	7.43
4	8/27/98 14:06	3.0	4b-r5-t3h-4b	498.71	GW Only	0	7.32	NA	NA	NA	1.25	NA	0.22	5	49.3	7.25
5	8/27/98 16:05	5.0	4b-r5-t5h-5b	506.82	GW Only	0	7.38	NA	NA	NA	12.5	NA	0.397	50	889.4	7.1
6	8/28/98 6:16	21.2	4b-r5-t20h-6b	501.33	GW Only	0	7.12	NA	NA	NA	12.5	NA	0.398	50	891.6	7.1
1	8/28/98 11:10	24.1	4b-r5-t24h-5b	506.82	GW Only	0	7	NA	NA	NA	12.5	NA	0.392	50	878.2	7.18
1	NOT EXTRACTED															
2	NOT EXTRACTED															
3	NOT EXTRACTED															
4	NOT EXTRACTED															
5	NOT EXTRACTED															
6	NOT EXTRACTED															
1	8/28/98 11:12		4b-R5-char-1a		Charcoal	NA					NA	NA	NA	NA	NA	NT
1	8/28/98 11:12		4b-R5-char-1b		Charcoal	NA					NA	NA	NA	NA	NA	NT
2	8/28/98 11:13		4b-R5-char-2a		Charcoal	NA					NA	NA	NA	NA	NA	NT
2	8/28/98 11:13		4b-R5-char-2b		Charcoal	NA					NA	NA	NA	NA	NA	NT
3	8/28/98 11:14		4b-R5-char-3a		Charcoal	NA					NA	NA	NA	NA	NA	NT
3	8/28/98 11:14		4b-R5-char-3b		Charcoal	NA					NA	NA	NA	NA	NA	NT
4	8/28/98 11:15		4b-R5-char-4a		Charcoal	NA					NA	NA	NA	NA	NA	NT
4	8/28/98 11:15		4b-R5-char-4b		Charcoal	NA					NA	NA	NA	NA	NA	NT
5	8/28/98 11:16		4b-R5-char-5a		Charcoal	NA					NA	NA	NA	NA	NA	NT
5	8/28/98 11:16		4b-R5-char-5b		Charcoal	NA					NA	NA	NA	NA	NA	NT
6	8/28/98 11:17		4b-R5-char-6a		Charcoal	NA					NA	NA	NA	NA	NA	NT
6	8/28/98 11:17		4b-R5-char-6b		Charcoal	NA					NA	NA	NA	NA	NA	NT

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	48.7	0.10	30.7	0.06	
4	48.7	0.10	29.7	0.06	0.06
5	487.3	0.95	60.3	0.12	
6	487.3	0.96	36.7	0.07	0.10

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R5	For additional comments, see Laboratory Notebook B000025																							
Reactor No.	ORNL GC #	1-1DCE Extract (ppb)	Flag	ORNL GC #	TransDC Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-1DCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
Duplicate VOC Samples																										
1	1864b	2,088		1864b	3,796		1864b	5,916		1864	22,577		2.98	3.25	1,918		3,487		5,433		20,735		-7%	20,037	987
2	1872b	1,973		1872b	3,747		1872b	5,224		1872	22,966		3.00	3.33	1,779		3,377		4,708		20,700		3%	21,048	492
3	1880	18		1880	0		1880	80		1880r	1,276		2.96	3.06	18		1		77		1,233		-1%	1,225	12
4	1888	0		1888	0		1888	0		1888	394		2.99	3.12	1		1		1		378		-6%	367	14
5	1896	0		1896	0		1896	0		1896	4	U	2.97	3.20	1		1		1		3	U	38%	5	1
6	1904	0		1904	0		1904	0		1904	2	U	2.95	3.30	1		1		1		2	U	42%	2	1
1	1910	0		1910	0		1910	0		1910	3	U	2.91	3.10	1		1		1		3	U	33%	3	1
Extraction of the Remaining Reactor Contents																										
1	NOT EXTRACTED																									
2	NOT EXTRACTED																									
3	NOT EXTRACTED																									
4	NOT EXTRACTED																									
5	NOT EXTRACTED																									
6	NOT EXTRACTED																									
Extraction of the Charcoal Beds																										
1	1912	nd-diluted		1912	nd-diluted		1912	nd-diluted		1912	2	U	2.92	0.08	7.2E-06											
1	1913	0		1913	0		1913	0		1913	0		2.92	0.03	0.0E+00											
2	1914	nd-diluted		1914	nd-diluted		1914	nd-diluted		1914	1	U	2.93	0.08	3.3E-06											
2	1915	0		1915	0		1915	0		1915	0	U	2.92	0.03	1.2E-06											
3	1916	nd-diluted		1916	nd-diluted		1916	nd-diluted		1916	1	U	2.91	0.09	3.8E-06											
3	1917	0		1917	0		1917	0		1917	0	U	2.92	0.03	1.1E-06											
4	1918	nd-diluted		1918	nd-diluted		1918	nd-diluted		1918	0		2.93	0.08	0.0E+00											
4	1919	0		1919	0		1919	0		1919	0	U	2.92	0.03	0.0E+00											
5	1920	nd-diluted		1920	nd-diluted		1920	nd-diluted		1920	0		2.91	0.08	0.0E+00											
5	1921	0		1921	0		1921	0		1921	0	U	2.91	0.02	0.0E+00											
6	1922	nd-diluted		1922	nd-diluted		1922	nd-diluted		1922	0		2.92	0.08	0.0E+00											
6	1923	0		1923	0		1923	0		1923	0	U	2.93	0.03	0.0E+00											
Flask																										
1																										
2																										
3																										
4																										
5																										
6																										

Mass carbon (g) TCE (mg)

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R6 For additional comments, see Laboratory Notebook B000025 Pages: **120-124**

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	100,000	YES @ 10ppm	1 & 3

Experiment Start Date: 8/31/98

Comments:

bigger t=0 values for latter flasks may be due to TCE not in solution during dist. From tedlar bag

SPIKE SOLUTION PREPARATION

Volume GW in Tedlar	2.99 liters
Pure TCE	0.2 mL
	291200 ug
Predicted Spike Conc:	97391 ppb

GC Analysis of Spike Solution

ORNL	Sample	Extract		Flag	Hexane	Aqueous	Aqueous
GC #	Name	Conc.	9/1/98 11:10		Volume	Volume	Conc.
		(ppb)	9/1/98 11:10		(mL)	(mL)	(ppb)
1924	4b-R6-tb-a	1,1DCE:	16585		4.48	4.84	15,338
1925	4b-R6-tb-b		18329		4.60	5.28	15,965
1924	4b-R6-tb-a	Trans-1,2DCE:	18060.24		4.48	4.84	16,702
1925	4b-R6-tb-b		19320.30		4.60	5.28	16,829
1924	4b-R6-tb-a	Cis-1,2DCE:	11212.25		4.48	4.84	10,369
1925	4b-R6-tb-b		13609.59		4.60	5.28	11,855
1924	4b-R6-tb-a	TCE:	12084.78		4.48	4.84	11,176
1925	4b-R6-tb-b		13127.57		4.60	5.28	11,435

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B000025							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	9/1/98 11:14	0.0	4b-r6-t0-1a	**489.49**	GW Only	**0.0**	7.1	7.1	489.5	NA
1	9/1/98 11:40	0.4	4b-r6-t30min-1	489.49	GW Only	0	7.04	14.14	482.4	NA
1	9/1/98 12:37	1.4	4b-r6-t1.5h-1	489.49	GW Only	0	7.09	21.23	475.4	NA
1	9/1/98 14:00	2.8	4b-r6-t3h-1	489.49	GW Only	0	7.03	28.26	468.3	NA
1	9/1/98 16:07	4.9	4b-r6-t5h-1	489.49	GW Only	0	7.1	35.36	461.2	NA
1	9/2/98 9:15	22.0	4b-r6-t20h-1	489.49	GW Only	0	7.11	42.47	454.1	NA
1	9/2/98 11:04	23.8	4b-r6-t24h-1	489.49	GW Only	0	6.96	49.43	447.0	NA
2	9/1/98 11:16	0.0	4b-r6-t0-2	**485.07**	GW Only	**0.0**	7.22	7.22	485.1	NA
2	9/1/98 11:41	0.4	4b-r6-t30min-2a	485.07	GW Only	0	6.98	14.2	477.9	NA
2	9/1/98 12:38	1.4	4b-r6-t1.5h-2	485.07	GW Only	0	7.13	21.33	470.9	NA
2	9/1/98 14:01	2.7	4b-r6-t3h-2	485.07	GW Only	0	7.07	28.4	463.7	NA
2	9/1/98 16:07	4.8	4b-r6-t5h-2	485.07	GW Only	0	7.07	35.47	456.7	NA
2	9/2/98 9:16	22.0	4b-r6-t20h-2	485.07	GW Only	0	7.18	42.65	449.6	NA
2	9/2/98 11:05	23.8	4b-r6-t24h-2	485.07	GW Only	0	7.12	49.77	442.4	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	[redacted]									pH Dat
	KMnO4	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.42
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.43
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.37
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.37
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.37
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.42
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.4
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.42
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.42
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.39
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.39
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.38
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.42
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.4

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R6 For additional comments, see Laboratory Notebook B0000025

Reactor No	ORNL GC #	1-IDCE Extract (ppb)	Flag	ORNL GC #	TransDC Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-IDCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1926	18,887		1926	18,102		1926	13,633		1926	13,666		2.709091	3.108	16,463		15,778		11,883		11,912		NA	NA	NA	NA	NA	NA	0.08
1	1933	17,397		1933	17,317		1933	12,085		1933	12,622		2.951515	3.117	16,474		16,398		11,444		11,952		NA	NA	NA	NA	NA	NA	0.08
1	1940	15,955		1940	15,799		1940	12,875		1940	12,890		2.825758	3.124	14,431		14,290		11,646		11,659		NA	NA	NA	NA	NA	NA	0.08
1	1947	15,637		1947	15,868		1947	13,152		1947	12,253		2.807576	2.86	15,351		15,577		12,911		12,028		NA	NA	NA	NA	NA	NA	0.08
1	1954	15,988		1954	11,633		1954	13,235		1954	12,249		2.834848	2.898	15,640		11,380		12,947		11,982		NA	NA	NA	NA	NA	NA	0.09
1	1961	15,552		1961	10,990		1961	12,792		1961	11,976		2.939394	2.954	15,475		10,935		12,729		11,917		NA	NA	NA	NA	NA	NA	0.08
1	1968	15,147		1968	10,547		1968	13,356		1968	12,438		2.856061	3.093	13,987		9,739		12,332		11,485		NA	NA	NA	NA	NA	NA	0.08
2	1928	18,823		1928	18,677		1928	13,453		1928	13,071		2.822727	3.31	16,052		15,927		11,472		11,147		NA	NA	NA	NA	NA	NA	0.08
2	1934	19,331		1934	18,679		1934	15,236		1934	14,347		2.743939	3.324	15,957		15,420		12,577		11,844		NA	NA	NA	NA	NA	NA	0.08
2	1941	17,179		1941	18,487		1941b	13,102		1941	13,324		2.795455	3.149	15,250		16,411		11,631		11,828		NA	NA	NA	NA	NA	NA	0.08
2	1948	16,130		1948	16,957		1948	12,145		1948	12,321		2.893939	3.049	15,310		16,095		11,528		11,695		NA	NA	NA	NA	NA	NA	0.08
2	1955	16,224		1955	11,790		1955	13,379		1955	13,379		2.828788	2.986	15,370		11,169		12,674		12,674		NA	NA	NA	NA	NA	NA	0.09
2	1962	15,415		1962	16,564		1962	11,813		1962	11,532		2.916667	2.92	15,397		16,545		11,799		11,519		NA	NA	NA	NA	NA	NA	0.08
2	1969	16,527		1969	12,316		1969	14,538		1969	12,899		2.907576	3.24	14,832		11,052		13,046		11,576		NA	NA	NA	NA	NA	NA	0.08

Prepared by: S.R. Cline

Last Updated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B0XX025							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	9/1/98 11:17	0.0	4b-r6-t0-3	**482.63**	GW Only	**0.0**	7.21	7.21	482.6	NA
3	9/1/98 11:43	0.4	4b-r6-t30min-3	482.63	GW Only	0	7.1	14.31	475.4	NA
3	9/1/98 12:39	1.4	4b-r6-t1.5h-3a	482.63	GW Only	0	6.71	21.02	468.3	NA
3	9/1/98 14:02	2.8	4b-r6-t3h-3	482.63	GW Only	0	6.64	27.66	461.6	NA
3	9/1/98 16:09	4.9	4b-r6-t5h-3	482.63	GW Only	0	6.57	34.23	455.0	NA
3	9/2/98 9:17	22.0	4b-r6-t20h-3	482.63	GW Only	0	6.43	40.66	448.4	NA
3	9/2/98 11:06	23.8	4b-r6-t24h-3	482.63	GW Only	0	6.77	47.43	442.0	NA
4	9/1/98 11:18	0.0	4b-r6-t0-4	**490.72**	GW Only	**0.0**	7	7	490.7	NA
4	9/1/98 11:44	0.4	4b-r6-t30min-4	490.72	GW Only	0	6.46	13.46	483.7	NA
4	9/1/98 12:41	1.4	4b-r6-t1.5h-4	490.72	GW Only	0	7.33	20.79	477.3	NA
4	9/1/98 14:03	2.8	4b-r6-t3h-4a	490.72	GW Only	0	6.97	27.76	469.9	NA
4	9/1/98 16:10	4.9	4b-r6-t5h-4	490.72	GW Only	0	7.08	34.84	463.0	NA
4	9/2/98 9:18	22.0	4b-r6-t20h-4	490.72	GW Only	0	6.91	41.75	455.9	NA
4	9/2/98 11:07	23.8	4b-r6-t24h-4	490.72	GW Only	0	7.12	48.87	449.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B0000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	[redacted]									pH Dai
	KMnO4	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0	NA	NA	10462.1	0	0	0.00	0	8.43
3	6604	10462	0.195	500	4369	2897	2897	6.00	31.0	7.4
3	6604	4369	0.443	500	9925	-2602	295	0.61	66.6	7.44
3	6604	9925	0.462	500	10350	-196	99	0.20	68.7	7.47
3	6604	10350	0.451	500	10104	112	211	0.44	66.4	7.48
3	6604	10104	0.449	500	10059	20	231	0.48	64.7	7.38
3	6604	10059	0.447	500	10014	20	251	0.52	67.8	7.34
4	0	0	NA	NA	10290	0	0	0.00	0	8.43
4	6609	10290	0.217	500	4861	2626	2626	5.35	31.4	7.16
4	6609	4861	0.439	500	9835	-2374	252	0.51	72.1	7.21
4	6609	9835	0.457	500	10238	-190	63	0.13	71.4	7.3
4	6609	10238	0.435	500	9745	228	291	0.59	69.0	7.33
4	6609	9745	0.452	500	10126	-174	117	0.24	70.0	7.24
4	6609	10126	0.451	500	10104	10	128	0.26	71.9	7.23

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B000025																									
Reactor No.	ORNL GC #	1-1DCE Extract (ppb)	Flag	ORNL GC #	TransDC Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-1DCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1929	21,791		1929	21,428		1929b	16,559		1929	17,307		2.806061	3.454	17,703		17,408		13,453		14,060		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.10
3	1936	0		1936	0		1936	0		1936	15		2.690909	3.306	1		1		1		13		0.00	6.7	6.7	98.4%	98.4%	98.4%	0.00
3	1942	0		1942	0		1942	0		1942	9	U	2.733333	3.144	1		1		1		8	U	0.00	0.0	6.7	0.0%	0.0%	98.5%	0.00
3	1949	0		1949	0		1949	0		1949	9	U	2.883333	3.174	1		1		1		8	U	0.00	0.0	6.7	0.0%	0.0%	98.4%	0.00
3	1956	0		1956	0		1956	0		1956	9	U	2.851515	3.217	1		1		1		8	U	0.00	0.0	6.7	0.0%	0.0%	98.4%	0.00
3	1963	0		1963	0		1963	0		1963	8	U	2.930303	3.207	1		1		1		7	U	0.00	0.0	6.7	0.0%	0.0%	98.5%	0.00
3	1970	0		1970	0		1970	0		1970	11	U	2.907576	3.134	1		1		1		11	U	0.00	0.0	6.7	0.0%	0.0%	98.4%	0.00
4	1930	21,365		1930	20,993		1930	17,236		1930	16,184		2.85	3.301	18,446		18,125		14,881		13,973		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.10
4	1937	0		1937	0		1937	0		1937	8	U	2.821212	3.686	1		1		1		6	U	0.00	6.8	6.8	98.5%	98.5%	98.5%	0.00
4	1944	0		1944	0		1944	0		1944	2	U	2.75	2.919	1		1		1		2	U	0.00	0.0	6.8	0.0%	0.0%	98.6%	0.00
4	1950	0		1950	0		1950	0		1950	2	U	2.884848	3.056	1		1		1		2	U	0.00	0.0	6.8	0.0%	0.0%	98.6%	0.00
4	1957	0		1957	0		1957	0		1957	3	U	2.793939	3.179	1		1		1		2	U	0.00	0.0	6.8	0.0%	0.0%	98.6%	0.00
4	1964	0		1964	0		1964	0		1964	1	U	2.925758	3.184	1		1		1		1	U	0.00	0.0	6.8	0.0%	0.0%	98.6%	0.00
4	1971	0		1971	0		1971	0		1971	2	U	2.84697	3.173	1		1		1		2	U	0.00	0.0	6.8	0.0%	0.0%	98.6%	0.00

Steven Robert Cline:
NO, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B(XXX)25							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	9/1/98 11:19	0.0	4b-r6-t0-5	477.05	GW Only	0.0	7.05	7.05	477.1	NA
5	9/1/98 11:45	0.4	4b-r6-t30min-5	477.05	GW Only	0	7.01	14.06	470.0	NA
5	9/1/98 12:42	1.4	4b-r6-t1.5h-5	477.05	GW Only	0	7.05	21.11	463.0	NA
5	9/1/98 14:05	2.8	4b-r6-t3h-5	477.05	GW Only	0	6.95	28.06	455.9	NA
5	9/1/98 16:11	4.9	4b-r6-t5h-5a	477.05	GW Only	0	6.76	34.82	449.0	NA
5	9/2/98 9:19	22.0	4b-r6-t20h-5	477.05	GW Only	0	6.65	41.47	442.2	NA
5	9/2/98 11:08	23.8	4b-r6-t24h-5	477.05	GW Only	0	6.75	48.22	435.6	NA
6	9/1/98 11:20	0.0	4b-r6-t0-6	481.52	GW Only	0.0	7.11	7.11	481.5	NA
6	9/1/98 11:46	0.4	4b-r6-t30min-6	481.52	GW Only	0	6.99	14.1	474.4	NA
6	9/1/98 12:43	1.4	4b-r6-t1.5h-6	481.52	GW Only	0	7.46	21.56	467.4	NA
6	9/1/98 14:06	2.8	4b-r6-t3h-6	481.52	GW Only	0	7.19	28.75	460.0	NA
6	9/1/98 16:13	4.9	4b-r6-t5h-6	481.52	GW Only	0	7.19	35.94	452.8	NA
6	9/2/98 9:20	22.0	4b-r6-t20h-6a	481.52	GW Only	0	7.09	43.03	445.6	NA
6	9/2/98 11:09	23.8	4b-r6-t24h-6a	481.52	GW Only	0	7.12	50.15	438.5	NA
						0				

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B0000025							
	MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 6/10/98									
	[redacted]									pH Dat
	KMnO4	Initial	Final	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	ABS	DF	(mg/L)	in Interval	Consumed	per mL GW		
5	0	0	NA	NA	32053	0	0	0.00	0	8.42
5	20002	32053	0.240	1000	10754	10011	10011	20.98	75.4	7.1
5	20002	10754	0.487	1000	21821	-5124	4887	10.24	153.8	7.26
5	20002	21821	0.553	1000	24778	-1348	3538	7.42	172.2	7.3
5	20002	24778	0.547	1000	24509	121	3659	7.67	165.7	7.32
5	20002	24509	0.591	1000	26481	-872	2787	5.84	176.1	7.27
5	20002	26481	0.540	1000	24195	995	3783	7.93	163.3	7.26
6	0	0	NA	NA	31756	0	0	0.00	0	8.43
6	20003	31756	0.323	1000	14472	8200	8200	17.03	101.2	7.06
6	20003	14472	0.440	1000	19715	-2450	5749	11.94	147.1	7.32
6	20003	19715	0.559	1000	25047	-2452	3297	6.85	180.1	7.38
6	20003	25047	0.592	1000	26525	-669	2627	5.46	190.7	7.36
6	20003	26525	0.573	1000	25674	379	3007	6.24	182.0	7.62
6	20003	25674	0.557	1000	24957	314	3321	6.90	177.7	7.62

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R6 For additional comments, see Laboratory Notebook B0000025

Reactor No.	ORNL GC #	1-1DCE Extract (ppb)	Flag	ORNL GC #	TransDC Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-1DCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1931	21,582		1931	24,008		1931b	19,367		1931	45,540		2.82	3.15	19,354		21,530		17,368		40,839		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.29
5	1938	0		1938	0		1938	0		1938	3	U	3.05	3.73	1		1		1		2	U	0.00	19.2	19.2	98.5%	98.5%	98.5%	0.00
5	1945	0		1945	0		1945	0		1945	1	U	2.76	2.97	1		1		1		1	U	0.00	0.0	19.2	0.0%	0.0%	98.5%	0.00
5	1952	0		1952	0		1952	0		1952	1	U	2.84	3.00	1		1		1		1	U	0.00	0.0	19.2	0.0%	0.0%	98.5%	0.00
5	1958	0		1958	0		1958	0		1958	1	U	2.70	3.24	1		1		1		1	U	0.00	0.0	19.2	0.0%	0.0%	98.5%	0.00
5	1965	0		1965	0		1965	0		1965	10	U	2.90	3.14	1		1		1		10	U	0.00	0.0	19.2	0.0%	0.0%	98.5%	0.00
5	1972	0		1972	0		1972	0		1972	1	U	2.96	3.21	1		1		1		1	U	0.00	0.0	19.2	0.0%	0.0%	98.5%	0.00
6	1932	22,655		1932	24,173		1932	20,904		1932	38,558		2.74	3.33	18,659		19,909		17,216		31,756		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.23
6	1939	0		1939	0		1939	0		1939	3	U	2.87	3.60	1		1		1		2	U	0.00	15.1	15.1	98.5%	98.5%	98.5%	0.00
6	1946	0		1946	0		1946	0		1946	1	U	2.80	3.08	1		1		1		1	U	0.00	0.0	15.1	0.0%	0.0%	98.5%	0.00
6	1953	0		1953	0		1953	0		1953	1	U	2.87	3.21	1		1		1		1	U	0.00	0.0	15.1	0.0%	0.0%	98.5%	0.00
6	1960	0		1960	0		1960	0		1960	0	U	2.90	3.17	1		1		1		0.1	U	0.00	0.0	15.1	0.0%	0.0%	98.5%	0.00
6	1966	0		1966	0		1966	0		1966	1	U	2.93	3.15	1		1		1		1	U	0.00	0.0	15.1	0.0%	0.0%	98.5%	0.00
6	1973	0		1973	0		1973	0		1973	0	U	2.97	3.36	1		1		1		0.1	U	0.00	0.0	15.1	0.0%	0.0%	98.5%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

	Exp.	4b-R6	For additional comments, see Laboratory Notebook B0000125													
								MnO4- Calb. Slope:		0.022	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm)
								Calibration Date: 6/10/98								
							Sample Data									pH Data
		RXN		Volume		Solid	vol (mL)	Corr	Actual	Actual	KMnO4	Initial	Final	Final	Final	
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S	Added	MnO4-	MnO4-	Spec	MnO4-	pH
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio	(mg)	(mg/L)	ABS	DF	(mg/L)	
	Duplicate VOC Samples															
1	9/1/98 11:15	0.0	4b-r6-t0-1b	489.49	GW Only	0	6.97	NA	NA	NA	0	NA	NA	NA	NA	8.42
2	9/1/98 11:42	0.4	4b-r6-t30min-2b	485.07	GW Only	0	6.99	NA	NA	NA	0	NA	NA	NA	NA	8.42
3	9/1/98 12:40	1.4	4b-r6-t1.5h-3b	482.63	GW Only	0	7.16	NA	NA	NA	6604	NA	0.453	500	10149	7.29
4	9/1/98 14:04	2.8	4b-r6-t3h-4b	490.72	GW Only	0	7.12	NA	NA	NA	6609	NA	0.468	500	10485	7.23
5	9/1/98 16:12	4.9	4b-r6-t5h-5b	477.05	GW Only	0	7.18	NA	NA	NA	20002	NA	0.579	1000	25943	7.29
6	9/2/98 9:21	22.0	4b-r6-t20h-6b	481.52	GW Only	0	7.2	NA	NA	NA	20003	NA	0.569	1000	25495	7.6
6	9/2/98 11:10	23.8	4b-r6-t24h-6b	481.52	GW Only	0.0	7.21	NA	NA	NA	20003	NA	0.552	1000	24733	7.60
	Extraction of the Remaining Reactor Contents															
1	NOT EXTRACTED															
2	NOT EXTRACTED															
3	NOT EXTRACTED															
4	NOT EXTRACTED															
5	NOT EXTRACTED															
6	NOT EXTRACTED															
	Extraction of the Charcoal Beds															
1	9/2/98 11:12		4b-R6-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT
1	9/2/98 11:12		4b-R6-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT
2	9/2/98 11:14		4b-R6-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT
2	9/2/98 11:14		4b-R6-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT
3	9/2/98 11:15		4b-R6-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT
3	9/2/98 11:15		4b-R6-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT
4	9/2/98 11:16		4b-R6-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT
4	9/2/98 11:16		4b-R6-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT
5	9/2/98 11:17		4b-R6-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT
5	9/2/98 11:17		4b-R6-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT
6	9/2/98 11:18		4b-R6-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT
6	9/2/98 11:18		4b-R6-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	4974	10.5	213	0.4	
4	4978	10.3	90	0.2	0.32
5	15065	32.1	3693	7.9	
6	15066	31.8	3226	6.8	7.33

Prepared by: S.R. Cline

LastUpdated: 11/3/98

	Exp.	4h-R6	For additional comments, see Laboratory Notebook B0000025																						
Reactor No.	ORNL GC #	1-1DCE Extract (ppb)	Flag	ORNL GC #	TransDC Extract (ppb)	Flag	ORNL GC #	CisDCE Extract (ppb)	Flag	ORNL GC #	TCE Extract (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	1-1DCE Aqueous (ppb)	Flag	TransDCE Aqueous (ppb)	Flag	CisDCE Aqueous (ppb)	Flag	TCE Aqueous (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																								
1	1927	20,254		1927	20,254		1927	15,305		1927	14,544		2.77	3.38	16,624		16,624		12,562		11,937		0%	11,925	18
2	1935	18,322		1935	17,912		1935	14,774		1935	13,768		2.82	3.22	16,025		15,665		12,921		12,041		-2%	11942.49	140
3	1943	0		1943	0		1943	0		1943	3	U	2.85	3.14	1		1		1		3	U	66%	5.26	4
4	1951	0		1951	0		1951	0		1951	2	U	3.04	-6.91	1		1		1		1	U	56%	1.64	1
5	1959	0		1959	0		1959	0		1959	1	U	2.69	3.01	1		1		1		1	U	19%	0.91	0
6	1967	0		1967	0		1967	0		1967	0	U	2.90	3.09	1		1		1		0.1	U	80%	0.30	0
6	1974	0		1974	0		1974	0		1974	0	U	2.98	3.31	1		1		1		0.1	U	0%	0.10	0
	Extraction of the Remaining Reactor Contents																								
1																									
2														mass (g)											
3																									
4																									
5																									
6																									
	Extraction of the Charcoal Beds													Mass Carbon (g)	Mass 1-1DCE (g)										
1	1975	10		1975	10		1975	10		1975	1	U	2.96	0.09	2.8E-06										
1	1976	0		1976	0		1976	0		1976	0		2.96	0.04	0.0E+00										
2	1977	10		1977	10		1977	10		1977	1	U	2.96	0.08	3.2E-06										
2	1978	0		1978	0		1978	0		1978	0		2.94	-0.96	0.0E+00										
3	1979	10		1979	10		1979	10		1979	1	U	2.95	0.09	3.8E-06										
3	1980	0		1980	0		1980	0		1980	0		2.96	0.04	0.0E+00										
4	1981	10		1981	10		1981	10		1981	9	U	2.96	0.08	2.6E-05										
4	1982	0		1982	0		1982	0		1982	0		3.03	0.04	0.0E+00										
5	1983	176		1983	10		1983	10		1983	44		2.92	0.09	1.3E-04										
5	1984	0		1984	0		1984	0		1984	0		2.95	0.04	0.0E+00										
6	1985	10		1985	10		1985	10		1985	0		2.98	0.09	0.0E+00										
6	1986	0		1986	0		1986	0		1986	0		2.97	0.05	0.0E+00										
Addit																									
Flask																									
1																									
2																									
3																									
4																									
5																									
6																									

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R7 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	**DNAPL	NO	.01&.1

Experiment Start Date: 8/12/98

Comments:
Per Procedure: Pure TCE added directly into each Reactor/Flask, A Single Spike Solution Could Not Be Prepared
NOTE: All 8/12 & 8/14 final dilutions in GC vials placed under refrigeration to be analyzed 8-17-98.

SPIKE SOLUTION PREPARATION
8/12/98
NA, See Above

Predicted Spike Concentrations			Resulting
Reactor No.	TCE Added (mg)	GW Added (mL)	Aq. Conc (ppb)
1	797.5	400	1,993,750
2	815.1	400	2,037,750
3	807.2	400	2,018,000
4	794.5	400	1,986,250
5	805.5	400	2,013,750
6	807.7	400	2,019,250

NOTE: Aqueous Solubility of TCE is only approx. 1,100 mg/L (1,100,000 ppb)
Thus, some TCE is present in each react as DNAPL

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	8/13/98 8:45	0.0	4B-R7-T0-1A	400	GW Only		20	20	400.0	NA
1	8/13/98 9:15	0.5	4B-R7-T30MIN-1	400	GW Only	0	10	30	380.0	NA
1	8/13/98 10:45	2.0	4B-R7-T2HR-1	400	GW Only	0	10	40	370.0	NA
1	8/13/98 12:45	4.0	4B-R7-T4HR-1	400	GW Only	0	10	50	360.0	NA
1	8/13/98 14:45	6.0	4B-R7-T6HR-1	400	GW Only	0	10	60	350.0	NA
1	8/14/98 7:00	22.2	4B-R7-T20HR-1	400	GW Only	0	10	70	340.0	NA
1	8/14/98 8:45	24.0	4B-R7-T24HR-1A	400	GW Only	0	20	90	330.0	NA
1	8/17/98 8:45	96.0	4B-R7-T96hr	400	GW Only	0	10	100	310.0	NA
2	8/13/98 8:45	0.0	4B-R7-T0-2	400	GW Only		10	10	400.0	NA
2	8/13/98 9:15	0.5	4B-R7-T30MIN-2A	400	GW Only	0	20	30	390.0	NA
2	8/13/98 10:45	2.0	4B-R7-T2HR-2	400	GW Only	0	10	40	370.0	NA
2	8/13/98 12:45	4.0	4B-R7-T4HR-2	400	GW Only	0	10	50	360.0	NA
2	8/13/98 14:45	6.0	4B-R7-T6HR-2	400	GW Only	0	10	60	350.0	NA
2	8/14/98 7:00	22.2	4B-R7-T20HR-2	400	GW Only	0	10	70	340.0	NA
2	8/14/98 8:45	24.0	4B-R7-T24HR-2	400	GW Only	0	10	80	330.0	NA
2	8/17/98 8:45	96.0	4B-R7-T96hr-2a	400	GW Only	0	20	100	320.0	NA

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm):	39600
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.79
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.51
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.36
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.85
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.16
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.22
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.15
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.8
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.45
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.36
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.04

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1524	1025100		3.03	2.87	1,082,570		NA	NA	NA	NA	NA	NA	21.65
1	1538	905617		3.05	2.55	1,081,150		NA	NA	NA	NA	NA	NA	10.81
1	1552	1052830		3.01	3.03	1,046,420		NA	NA	NA	NA	NA	NA	10.46
1	1566	1021252		3.02	2.69	1,145,973		NA	NA	NA	NA	NA	NA	11.46
1	1580	1026132		2.96	2.65	1,145,108		NA	NA	NA	NA	NA	NA	11.45
1	1594	1314538		2.95	3.29	1,181,090		NA	NA	NA	NA	NA	NA	11.81
1	1608	1478841		2.99	3.06	1,446,443		NA	NA	NA	NA	NA	NA	28.93
1	1622	1330498		3.00	3.28	1,219,544		NA	NA	NA	NA	NA	NA	12.20
2	1525	1180808		2.82	3.07	1,083,952		NA	NA	NA	NA	NA	NA	10.84
2	1539	1019713		2.98	2.81	1,083,993		NA	NA	NA	NA	NA	NA	21.68
2	1553	953605		3.01	2.63	1,093,538		NA	NA	NA	NA	NA	NA	10.94
2	1567	1035172		3.01	2.73	1,142,304		NA	NA	NA	NA	NA	NA	11.42
2	1581	991527		3.01	2.58	1,153,479		NA	NA	NA	NA	NA	NA	11.53
2	1595	1343284		2.98	3.49	1,147,359		NA	NA	NA	NA	NA	NA	11.47
2	1609	1312051		3.06	2.83	1,418,464		NA	NA	NA	NA	NA	NA	14.18
2	1623	1368451		3.00	3.53	1,163,649		NA	NA	NA	NA	NA	NA	23.27

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	8/13/98 8:45	0.0	4B-R7-T0-3	400	GW Only	0.0	10	10	400.0	NA
3	8/13/98 9:15	0.5	4B-R7-T30MIN-3	400	GW Only	0	10	20	391.0	NA
3	8/13/98 10:45	2.0	4B-R7-T2HR-3A	400	GW Only	0	20	40	381.0	NA
3	8/13/98 12:45	4.0	4B-R7-T4HR-3	400	GW Only	0	10	50	361.0	NA
3	8/13/98 14:45	6.0	4B-R7-T0-1A	400	GW Only	0	10	60	351.0	NA
3	8/14/98 7:00	22.2	4B-R7-T20HR-3	400	GW Only	0	10	70	341.0	NA
3	8/14/98 8:45	24.0	4B-R7-T24HR-3	400	GW Only	0	10	80	331.0	NA
3	8/17/98 8:45	96.0	4B-R7-T96hr-3	400	GW Only	0	10	90	321.0	NA
4	8/13/98 8:45	0.0	4B-R7-T0-4	400	GW Only	0.0	10	10	400.0	NA
4	8/13/98 9:15	0.5	4B-R7-T30MIN-4	400	GW Only	0	10	20	391.0	NA
4	8/13/98 10:45	2.0	4B-R7-T2HR-4	400	GW Only	0	10	30	381.0	NA
4	8/13/98 12:45	4.0	4B-R7-T4HR-4A	400	GW Only	0	20	50	371.0	NA
4	8/13/98 14:45	6.0	4B-R7-T6HR-4	400	GW Only	0	10	60	351.0	NA
4	8/14/98 7:00	22.2	4B-R7-T20HR-4	400	GW Only	0	10	70	341.0	NA
4	8/14/98 8:45	24.0	4B-R7-T24HR-4	400	GW Only	0	10	80	331.0	NA
4	8/17/98 8:45	96.0	4B-R7-T96hr-4	400	GW Only	0	10	90	321.0	NA

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm):	39600
	Calibration Date: 5/5/98									
	MnO4- Dat									pH Dat
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
3	0	0	NA	NA	101.3	0.0	0.0	0.00	0.0	8.23
3	1	101.3	0.5	1	0.5	39.4	39.4	0.10	0.0	5.98
3	1	0.5	0.6	1	0.6	0.0	39.4	0.10	0.0	6.01
3	1	0.6	0.3	1	0.3	0.1	39.5	0.10	0.0	5.69
3	1	0.3	0.4	1	0.4	0.0	39.4	0.10	0.0	5.57
3	1	0.4	0.5	1	0.5	0.0	39.4	0.10	0.0	5.86
3	1	0.5	0.3	1	0.3	0.1	39.5	0.10	0.0	5.68
3	1	0.3	0.2	1	0.2	0.0	39.5	0.10	0.0	6.15
4	0	0	NA	NA	101.3	0.0	0.0	0.00	0.0	8.27
4	1	101.3	0.5	1	0.5	39.4	39.4	0.10	0.0	6.01
4	1	0.5	0.6	1	0.6	0.0	39.4	0.10	0.0	5.94
4	1	0.6	0.2	1	0.2	0.1	39.5	0.10	0.0	5.81
4	1	0.2	0.4	1	0.4	-0.1	39.5	0.10	0.0	5.7
4	1	0.4	0.5	1	0.5	0.0	39.4	0.10	0.0	5.96
4	1	0.5	0.2	1	0.2	0.1	39.5	0.10	0.0	5.64
4	1	0.2	0.3	1	0.3	0.0	39.5	0.10	0.0	5.98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1526	1044550		2.73	2.73	1,045,246		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.45
3	1540	882570		3.01	2.78	956,951		0.92	34.5	34.5	8.3%	4.3%	4.3%	9.57
3	1554	808923		3.04	2.46	999,315		0.96	-16.1	18.4	-3.9%	-2.0%	2.3%	19.99
3	1568	963152		3.01	2.82	1,026,489		0.98	-9.8	8.6	-2.3%	-1.2%	1.1%	10.26
3	1582	992963		2.99	2.93	1,016,366		0.97	3.6	12.1	0.8%	0.4%	1.5%	10.16
3	1596	1181473		2.97	3.32	1,057,768		1.01	-14.1	-2.0	-3.4%	-1.7%	-0.2%	10.58
3	1610	1409355		3.08	3.25	1,337,492		1.28	-92.6	-94.6	-22.1%	-11.5%	-11.7%	13.37
3	1624	1185487		3.02	3.35	1,069,558		1.02	86.0	-8.6	20.6%	10.7%	-1.1%	10.70
4	1527	1029105		2.82	2.73	1,064,449		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.64
4	1541	891062		3.02	2.84	947,827		0.89	45.6	45.6	10.7%	5.7%	5.7%	9.48
4	1555	897705		3.04	2.83	966,935		0.91	-7.3	38.3	-1.7%	-0.9%	4.8%	9.67
4	1569	1136703		3.00	3.02	1,126,346		1.06	-59.1	-20.8	-13.9%	-7.4%	-2.6%	22.53
4	1583	954175		3.02	2.74	1,050,377		0.99	26.7	5.8	6.3%	3.4%	0.7%	10.50
4	1597	1350831		2.98	3.65	1,102,508		1.04	-17.8	-11.9	-4.2%	-2.2%	-1.5%	11.03
4	1611	1361851		3.09	3.02	1,393,828		1.31	-96.4	-108.4	-22.6%	-12.1%	-13.6%	13.94
4	1625	1310613		3.02	3.45	1,147,632		1.08	79.0	-29.3	18.6%	9.9%	-3.7%	11.48

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	8/13/98 8:45	0.0	4B-R7-T0-5	400	GW Only	0.0	10	10	400.0	NA
5	8/13/98 9:15	0.5	4B-R7-T30MIN-5	400	GW Only	0	10	20	400.0	NA
5	8/13/98 10:45	2.0	4B-R7-T2HR-5	400	GW Only	0	10	30	390.0	NA
5	8/13/98 12:45	4.0	4B-R7-T4HR-5	400	GW Only	0	10	40	380.0	NA
5	8/13/98 14:45	6.0	4B-R7-T6HR-5A	400	GW Only	0	20	60	370.0	NA
5	8/14/98 7:00	22.2	4B-R7-T20HR-5	400	GW Only	0	10	70	350.0	NA
5	8/14/98 8:45	24.0	4B-R7-T24HR-5	400	GW Only	0	10	80	340.0	NA
5	8/17/98 8:45	96.0	4B-R7-T96hr-5	400	GW Only	0	10	90	330.0	NA
6	8/13/98 8:45	0.0	4B-R7-T0-6	400	GW Only	0.0	10	10	400.0	NA
6	8/13/98 9:15	0.5	4B-R7-T30MIN-6	400	GW Only	0	10	20	400.0	NA
6	8/13/98 10:45	2.0	4B-R7-T2HR-6	400	GW Only	0	10	30	390.0	NA
6	8/13/98 12:45	4.0	4B-R7-T4HR-6	400	GW Only	0	10	40	380.0	NA
6	8/13/98 14:45	6.0	4B-R7-T6HR-6	400	GW Only	0	10	50	370.0	NA
6	8/14/98 7:00	22.2	4B-R7-T20HR-6A	400	GW Only	0	20	70	360.0	NA
6	8/14/98 8:45	24.0	4B-R7-T24HR-6	400	GW Only	0	10	80	340.0	NA
6	8/17/98 8:45	96.0	4B-R7-T96hr-6	400	GW Only	0	10	90	330.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.5	DF:	800	Conc (ppm):	39600
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per mL GW	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	990.0	0.0	0.0	0.00	0.0	8.15
5	10	990.0	0.4	1	0.40	395.8	395.8	0.99	0.0	3.12
5	10	0.4	0.4	1	0.42	0.0	395.8	0.99	0.0	2.9
5	10	0.4	0.3	1	0.33	0.0	395.9	0.99	0.0	2.79
5	10	0.3	0.5	1	0.47	-0.1	395.8	0.99	0.0	2.72
5	10	0.5	0.3	1	0.34	0.0	395.9	0.99	0.0	3.16
5	10	0.3	0.3	1	0.27	0.0	395.9	0.99	0.0	3.09
5	10	0.3	0.1	1	0.13	0.0	395.9	0.99	0.0	2.74
6	0	0	NA	NA	990.00	0.0	0.0	0.00	0.0	8.1
6	10	990.0	0.4	1	0.40	395.8	395.8	0.99	0.0	3.12
6	10	0.4	0.4	1	0.43	0.0	395.8	0.99	0.0	2.92
6	10	0.4	0.3	1	0.34	0.0	395.9	0.99	0.0	2.78
6	10	0.3	0.4	1	0.39	0.0	395.8	0.99	0.0	2.75
6	10	0.4	0.3	1	0.29	0.0	395.9	0.99	0.0	3.2
6	10	0.3	0.3	1	0.28	0.0	395.9	0.99	0.0	3.23
6	10	0.3	0.3	1	0.26	0.0	395.9	0.99	0.0	2.74

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R7	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1528	1012182		2.81	2.62	1,087,063		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.87
5	1542	572884		3.00	3.01	572,417		0.53	205.9	205.9	47.3%	25.6%	25.6%	5.72
5	1556	543041		3.06	2.61	637,141		0.59	-25.2	180.6	-5.8%	-3.1%	22.4%	6.37
5	1570	633796		3.01	2.87	664,178		0.61	-10.3	170.3	-2.4%	-1.3%	21.1%	6.64
5	1584	673605		3.01	2.90	701,209		0.65	-13.7	156.6	-3.2%	-1.7%	19.4%	14.02
5	1598	981730		2.98	3.41	856,462		0.79	-54.3	102.3	-12.5%	-6.7%	12.7%	8.56
5	1612	1066664		3.10	3.00	1,102,048		1.01	-83.5	18.8	-19.2%	-10.4%	2.3%	11.02
5	1626	1081256		3.03	3.47	942,486		0.87	52.7	71.5	12.1%	6.5%	8.9%	9.42
6	1529	1227748		2.82	3.37	1,026,160		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.26
6	1543	581220		3.03	3.07	575,215		0.56	180.4	180.4	43.9%	22.3%	22.3%	5.75
6	1557	617511		3.05	3.09	609,334		0.59	-13.3	167.1	-3.2%	-1.6%	20.7%	6.09
6	1571	719594		3.00	3.30	654,111		0.64	-17.0	150.1	-4.1%	-2.1%	18.6%	6.54
6	1585	761699		3.02	3.39	678,956		0.66	-9.2	140.9	-2.2%	-1.1%	17.4%	6.79
6	1599	942782		2.97	3.16	885,616		0.86	-74.4	66.5	-18.1%	-9.2%	8.2%	17.71
6	1613	981734		3.09	2.83	1,071,865		1.04	-63.3	3.1	-15.4%	-7.8%	0.4%	10.72
6	1627	1096497		3.04	3.50	952,265		0.93	39.5	42.6	9.6%	4.9%	5.3%	9.52

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R7 For additional comments, RMAL Laboratory Research Book

Metal Calib. Slope: 0.044 STOCK Conc (ppm): 49.5 DF: RD Conc (ppm): 396.0

Calibration Date: 3/5/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock Mn Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	GRNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Extraction of the Charcoal Beds																									
1	8/17/98 8:45		4B-R7-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1636	115463		5.06	0.10	0.5848				
1	8/17/98 8:45		4B-R7-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1637	243		5.08	0.04	0.0012				
2	8/17/98 8:45		4B-R7-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1638	42200		5.10	0.10	0.2151				
2	8/17/98 8:45		4B-R7-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1639	238		5.07	0.05	0.0012				
3	8/17/98 8:45		4B-R7-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1640	49098		5.07	0.10	0.2491				
3	8/17/98 8:45		4B-R7-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1641	237		5.08	0.04	0.0012				
4	8/17/98 8:45		4B-R7-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1642R	567715		5.08	0.10	2.8859				
4	8/17/98 8:45		4B-R7-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1643	289		5.12	0.04	0.0015				
5	8/17/98 8:45		4B-R7-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1644	414003		5.11	0.07	2.1139				
5	8/17/98 8:45		4B-R7-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1645	445		5.05	0.05	0.0022				
6	8/17/98 8:45		4B-R7-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1646R	876319		5.06	0.10	4.4360				
6	8/17/98 8:45		4B-R7-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1647	524		5.05	0.04	0.0026				

Additional Oxidant Information

Flask	Total Metal (mg)	Init Level mg/mL or mg/g	Consumed mg 4b1=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	39.6	0.10	39.5	0.10	
4	39.6	0.10	39.5	0.10	0.10
5	396.0	0.99	395.9	0.99	
6	396.0	0.99	395.9	0.99	0.99

Prepared by: S.R. Cline

Last Updated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4B-R8

For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
NONE	**DNAPL	NO	1 & 3

Experiment Start Date: 8/12/98

Comments:
Per Procedure: Pure TCE added directly into each Reactor/Flask, A Single Spike Solution Could Not Be Prepared
Note: 4b-R8-5 and 4b-R8-6 produced significant off-gassing during the 1st 30 min check
Note: After T=4hrs, Reactor 4b-R8-3 developed a crack. Contents moved to back-up reactor without orbo tube.

SPIKE SOLUTION PREPARATION
NA, See Above

Predicted Spike Concentrations

Reactor No.	TCE Added (mg)	GW Added (mL)	Resulting Aq. Conc (ppb)
1	811.7	400	2,029,250
2	805.8	400	2,014,500
3	809.5	400	2,023,750
4	817.1	400	2,042,750
5	805.9	400	2,014,750
6	809.2	400	2,023,000

NOTE: Aqueous Solubility of TCE is only approx. 1,100 mg/L (1,100,000 ppb)
Thus, some TCE is present in each react as DNAPL

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	8/13/98 8:50	0.0	4B-R8-T0-1A	400	GW Only	0.0	20	20	400.0	NA
1	8/13/98 9:20	0.5	4B-R8-T30MIN-1	400	GW Only	0	10	30	380.0	NA
1	8/13/98 10:50	2.0	4B-R8-T2HR-1	400	GW Only	0	10	40	370.0	NA
1	8/13/98 12:50	4.0	4B-R8-T4HR-1	400	GW Only	0	10	50	360.0	NA
1	8/13/98 14:50	6.0	4B-R8-T6HR-1	400	GW Only	0	10	60	350.0	NA
1	8/14/98 7:05	22.3	4B-R8-T20HR-1	400	GW Only	0	10	70	340.0	NA
1	8/14/98 8:50	24.0	4B-R8-T24HR-1A	400	GW Only	0	20	90	330.0	NA
1	8/17/98 8:50	96.0	4B-R8-T120HR	400	GW Only	0	10	100	310.0	NA
2	8/13/98 8:50	0.0	4B-R8-T0-2	400	GW Only	0.0	10	10	400.0	NA
2	8/13/98 9:20	0.5	4B-R8-T30MIN-2A	400	GW Only	0	20	30	390.0	NA
2	8/13/98 10:50	2.0	4B-R8-T2HR-2	400	GW Only	0	10	40	370.0	NA
2	8/13/98 12:50	4.0	4B-R8-T4HR-2	400	GW Only	0	10	50	360.0	NA
2	8/13/98 14:50	6.0	4B-R8-T6HR-2	400	GW Only	0	10	60	350.0	NA
2	8/14/98 7:05	22.3	4B-R8-T20HR-2	400	GW Only	0	10	70	340.0	NA
2	8/14/98 8:50	24.0	4B-R8-T24HR-2	400	GW Only	0	10	80	330.0	NA
2	8/17/98 8:50	96.0	4B-R8-T120HR-2a	400	GW Only	0	20	100	320.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per mL GW		
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.11
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.06
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.03
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.82
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.83
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.32
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.28
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.88
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.12
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.08
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.08
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.85
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.84
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.31
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.35
2	0	0	NA	NA	NA	NA	NA	NA	NA	7.89

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1531	1,103,891		2.79	3.10	990,928		NA	NA	NA	NA	NA	NA	19.82
1	1545	936,307		3.02	2.79	1,012,884		NA	NA	NA	NA	NA	NA	10.13
1	1559	907,027		3.04	2.66	1,039,900		NA	NA	NA	NA	NA	NA	10.40
1	1573	968,759		3.02	2.63	1,111,172		NA	NA	NA	NA	NA	NA	11.11
1	1587	1,115,102		2.98	3.05	1,089,942		NA	NA	NA	NA	NA	NA	10.90
1	1601	1,461,013		2.97	3.71	1,168,949		NA	NA	NA	NA	NA	NA	11.69
1	1615	1,157,555		3.08	2.97	1,200,700		NA	NA	NA	NA	NA	NA	24.01
1	1629	1,302,973		3.04	3.64	1,088,091		NA	NA	NA	NA	NA	NA	10.88
2	1532	1,133,312		2.73	2.97	1,041,867		NA	NA	NA	NA	NA	NA	10.42
2	1546	947,710		3.03	2.78	1,033,845		NA	NA	NA	NA	NA	NA	20.68
2	1560	942,126		3.05	2.75	1,045,525		NA	NA	NA	NA	NA	NA	10.46
2	1574	901,045		3.02	2.46	1,103,700		NA	NA	NA	NA	NA	NA	11.04
2	1588	1,069,223		3.02	3.00	1,077,682		NA	NA	NA	NA	NA	NA	10.78
2	1602	1,332,041		2.98	3.48	1,140,847		NA	NA	NA	NA	NA	NA	11.41
2	1616	1,216,001		3.15	3.40	1,126,679		NA	NA	NA	NA	NA	NA	11.27
2	1630	1,229,347		3.06	3.41	1,105,229		NA	NA	NA	NA	NA	NA	22.10

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	8/13/98 8:50	0.0	4B-R8-T0-3	**400**	GW Only	**0.0**	10	10	400.0	#DIV/0!
3	8/13/98 9:20	0.5	4B-R8-T30MIN-3	400	GW Only	0	10	20	390.0	#DIV/0!
3	8/13/98 10:50	2.0	4B-R8-T2HR-3A	400	GW Only	0	20	40	380.0	#DIV/0!
3	8/13/98 12:50	4.0	4B-R8-T4HR-3	400	GW Only	0	10	50	360.0	#DIV/0!
3	8/13/98 14:50	6.0	4B-R8-T0-1A	400	GW Only	0	10	60	350.0	#DIV/0!
3	8/14/98 7:05	22.3	4B-R8-T20HR-3	400	GW Only	0	10	70	340.0	#DIV/0!
3	8/14/98 8:50	24.0	4B-R8-T24HR-3	400	GW Only	0	10	80	330.0	#DIV/0!
3	8/17/98 8:50	96.0	4B-R8-T120HR-3	400	GW Only	0	10	90	320.0	#DIV/0!
4	8/13/98 8:50	0.0	4B-R8-T0-4	**400**	GW Only	**0.0**	10	10	400.0	#DIV/0!
4	8/13/98 9:20	0.5	4B-R8-T30MIN-4	400	GW Only	0	10	20	390.0	#DIV/0!
4	8/13/98 10:50	2.0	4B-R8-T2HR-4	400	GW Only	0	10	30	380.0	#DIV/0!
4	8/13/98 12:50	4.0	4B-R8-T4HR-4A	400	GW Only	0	20	50	370.0	#DIV/0!
4	8/13/98 14:50	6.0	4B-R8-T6HR-4	400	GW Only	0	10	60	350.0	#DIV/0!
4	8/14/98 7:05	22.3	4B-R8-T20HR-4	400	GW Only	0	10	70	340.0	#DIV/0!
4	8/14/98 8:50	24.0	4B-R8-T24HR-4	400	GW Only	0	10	80	330.0	#DIV/0!
4	8/17/98 8:50	96.0	4B-R8-T120HR-4	400	GW Only	0	10	90	320.0	#DIV/0!

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per mL GW		
3	0	0	NA	NA	10301	0	0	0.00	0	8.12
3	5334	10301	19	401	7619	1046	1046	2.61	76.2	2.76
3	5334	7619	19	401	7779	-61	985	2.46	155.6	2.78
3	5334	7779	19	401	7539	87	1072	2.68	75.4	2.65
3	5334	7539	18	401	7138	140	1212	3.03	71.4	2.57
3	5334	7138	17	401	6777	123	1335	3.34	67.8	2.71
3	5334	6777	17	401	6657	40	1374	3.44	66.6	3.08
3	5334	6657	16	401	6496	51	1426	3.56	65.0	1.9
4	0	0	NA	NA	10301	0	0	0.00	0	8.17
4	5334	10301	18	401	7298	1171	1171	2.93	73.0	2.69
4	5334	7298	19	401	7779	-183	988	2.47	77.8	2.71
4	5334	7779	19	401	7619	59	1048	2.62	152.4	2.58
4	5334	7619	19	401	7419	70	1118	2.79	74.2	2.56
4	5334	7419	17	401	6857	191	1309	3.27	68.6	2.63
4	5334	6857	17	401	6657	66	1375	3.44	66.6	2.98
4	5334	6657	16	401	6336	103	1477	3.69	63.4	1.83

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1533	1,082,282		2.62	2.81	1,009,570		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.10
3	1547	956		3.04	3.19	912		0.00	393.4	393.4	97.4%	48.6%	48.6%	0.01
3	1561	383		3.07	2.89	407		0.00	0.2	393.6	0.0%	0.0%	48.6%	0.01
3	1575	243		3.02	3.44	214		0.00	0.1	393.6	0.0%	0.0%	48.6%	0.00
3	1589	319		3.01	4.13	232		0.00	0.0	393.6	0.0%	0.0%	48.6%	0.00
3	1603	142		2.98	3.46	122		0.00	0.0	393.7	0.0%	0.0%	48.6%	0.00
3	1617	0		3.16	2.93	1			0.0	393.7	0.0%	0.0%	48.6%	0.00
3	1631	0		3.06	3.51	1			0.0	393.7	0.0%	0.0%	48.6%	0.00
4	1534	1,091,112		2.62	2.79	1,026,943		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.27
4	1548	1,009		3.03	2.98	1,024		0.00	400.1	400.1	97.4%	49.0%	49.0%	0.01
4	1562	341		3.05	3.02	345		0.00	0.3	400.4	0.1%	0.0%	49.0%	0.00
4	1576	200		3.00	3.28	183		0.00	0.1	400.4	0.0%	0.0%	49.0%	0.00
4	1590	252		2.98	3.54	212		0.00	0.0	400.4	0.0%	0.0%	49.0%	0.00
4	1604	133		2.97	3.43	115		0.00	0.0	400.4	0.0%	0.0%	49.0%	0.00
4	1618	56		3.14	3.06	57		0.00	0.0	400.5	0.0%	0.0%	49.0%	0.00
4	1632	0		3.05	3.39	1		0.00	0.0	400.5	0.0%	0.0%	49.0%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	8/13/98 8:50	0.0	4B-R8-T0-5	400	GW Only	0.0	10	10	400.0	#DIV/0!
5	8/13/98 9:20	0.5	4B-R8-T30MIN-5	400	GW Only	0	10	20	390.0	#DIV/0!
5	8/13/98 10:50	2.0	4B-R8-T2HR-5	400	GW Only	0	10	30	380.0	#DIV/0!
5	8/13/98 12:50	4.0	4B-R8-T4HR-5	400	GW Only	0	10	40	370.0	#DIV/0!
5	8/13/98 14:50	6.0	4B-R8-T6HR-5A	400	GW Only	0	20	60	360.0	#DIV/0!
5	8/14/98 7:05	22.3	4B-R8-T20HR-5	400	GW Only	0	10	70	340.0	#DIV/0!
5	8/14/98 8:50	24.0	4B-R8-T24HR-5	400	GW Only	0	10	80	330.0	#DIV/0!
5	8/17/98 8:50	96.0	4B-R8-T120HR-5	400	GW Only	0	10	90	320.0	#DIV/0!
6	8/13/98 8:50	0.0	4B-R8-T0-6	400	GW Only	0.0	10	10	400.0	#DIV/0!
6	8/13/98 9:20	0.5	4B-R8-T30MIN-6	400	GW Only	0	10	20	390.0	#DIV/0!
6	8/13/98 10:50	2.0	4B-R8-T2HR-6	400	GW Only	0	10	30	380.0	#DIV/0!
6	8/13/98 12:50	4.0	4B-R8-T4HR-6	400	GW Only	0	10	40	370.0	#DIV/0!
6	8/13/98 14:50	6.0	4B-R8-T6HR-6	400	GW Only	0	10	50	360.0	#DIV/0!
6	8/14/98 7:05	22.3	4B-R8-T20HR-6A	400	GW Only	0	20	70	350.0	#DIV/0!
6	8/14/98 8:50	24.0	4B-R8-T24HR-6	400	GW Only	0	10	80	330.0	#DIV/0!
6	8/17/98 8:50	96.0	4B-R8-T120HR-6	400	GW Only	0	10	90	320.0	#DIV/0!

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per mL GW		
5	0	0	NA	NA	30900	0	0	0.00	0	8.18
5	**16000.7**	30900	34	801	27314	1399	1399	3.50	273.1	2.89
5	16000.7	27314	35	801	27715	-152	1246	3.12	277.1	2.95
5	16000.7	27715	34	801	27474	89	1335	3.34	274.7	2.84
5	16000.7	27474	34	801	27394	29	1364	3.41	547.9	2.86
5	16000.7	27394	33	801	26673	245	1609	4.02	266.7	2.95
5	16000.7	26673	33	801	26673	0	1609	4.02	266.7	3.36
5	16000.7	26673	33	801	26033	205	1814	4.54	260.3	2.23
6	0	0	NA	NA	30900	0	0	0.00	0	8.15
6	**16000.7**	30900	34	801	27074	1492	1492	3.73	270.7	2.89
6	16000.7	27074	34	801	27554	-183	1310	3.27	275.5	3.02
6	16000.7	27554	33	801	26353	445	1754	4.39	263.5	2.93
6	16000.7	26353	34	801	27474	-404	1351	3.38	274.7	2.93
6	16000.7	27474	34	801	26834	224	1575	3.94	536.7	2.93
6	16000.7	26834	33	801	26593	79	1654	4.14	265.9	3.36
6	16000.7	26593	33	801	26753	-51	1603	4.01	267.5	2.27

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R8	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1535	982,190		2.73	2.65	1,009,507		1.00	0.0	0.0	0.0%	0.0%	0.0%	10.10
5	1549	621		3.02	3.10	603		0.00	393.5	393.5	97.4%	48.8%	48.8%	0.01
5	1563	249		3.05	3.29	231		0.00	0.1	393.6	0.0%	0.0%	48.8%	0.00
5	1577	139		3.01	3.55	118		0.00	0.0	393.7	0.0%	0.0%	48.8%	0.00
5	1591	169		2.99	3.95	127		0.00	0.0	393.7	0.0%	0.0%	48.8%	0.00
5	1605	79		2.96	3.56	66		0.00	0.0	393.7	0.0%	0.0%	48.8%	0.00
5	1619	0		3.14	3.37	1			0.0	393.7	0.0%	0.0%	48.9%	0.00
5	1633	0		3.04	3.46	1			0.0	393.7	0.0%	0.0%	48.9%	0.00
6	1536	1,211,953		2.83	3.10	1,105,686		1.00	0.0	0.0	0.0%	0.0%	0.0%	11.06
6	1550	659		3.02	2.80	709		0.00	430.9	430.9	97.4%	53.3%	53.3%	0.01
6	1564	221		3.02	3.38	198		0.00	0.2	431.1	0.0%	0.0%	53.3%	0.00
6	1578	0		3.00	3.60	1		0.00	0.1	431.2	0.0%	0.0%	53.3%	0.00
6	1592	190		2.98	3.13	182		0.00	-0.1	431.1	0.0%	0.0%	53.3%	0.00
6	1606	0		2.94	2.90	1		0.00	0.1	431.2	0.0%	0.0%	53.3%	0.00
6	1620	0		3.14	3.22	1		0.00	0.0	431.2	0.0%	0.0%	53.3%	0.00
6	1634	0		3.06	3.71	1		0.00	0.0	431.2	0.0%	0.0%	53.3%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4B-R8	For additional comments, RMAL Laboratory Research Book								Exp.	4B-R8	For additional comments, RMAL Laboratory Research Book								Exp.	4B-R8	For additional comments, RMAL Laboratory Re			
											MnO4- Calb. Slope		0.046	STOCK SOLN ABS:	NA	DF:	NA	Conc (ppm):							
											Calibration Date: 5/5/98															
							Sample Data									pH Data										
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc (ppb)	Flag	%-Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	8/13/98 8:50	0.0	4B-R8-T0-1B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.11	1537	1,120,287		2.66	2.90	1,028,624		-3.8%	1009776.09	26654.74
2	8/13/98 9:20	0.5	4B-R8-T30MIN-2B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.07	1551	947,978		3.05	2.79	1,039,353		-0.5%	1036598.67	3894.57
3	8/13/98 10:50	2.0	4B-R8-T2HR-3B	400	GW Only	0	10	NA	NA	NA	5334	NA	19	401	7779	2.79	1565	363		3.02	2.67	411		-1.0%	408.93	2.93
4	8/13/98 12:50	4.0	4B-R8-T4HR-4B	400	GW Only	0	10	NA	NA	NA	5334	NA	19	401	7619	2.58	1579	235		3.02	2.84	250		-36.6%	216.73	47.41
5	8/13/98 14:50	6.0	4B-R8-T6HR-5B	400	GW Only	0	10	NA	NA	NA	16000.7	NA	34	801	27314	2.86	1593	147		2.98	4.02	109		14.6%	118.14	13.18
6	8/14/98 7:05	22.3	4B-R8-T20HR-6B	400	GW Only	0	10	NA	NA	NA	16000.7	NA	34	801	26834	2.94	1607	0		2.93	4.35	1		0.0%	1.00	0.00
1	8/14/98 8:50	24.0	4B-R8-T24HR-1B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.30	1621	1,172,237		3.13	3.00	1,224,337		-2.0%	1212518.46	16713.25
2	8/17/98 8:50	96.0	4B-R8-T120HR-2B	400	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.88	1635	1,214,810		3.05	3.13	1,182,585				
	Extraction of the Nitrobenzene Recovery Charcoal																									
1	NOT EXTRACTED																									
2	NOT EXTRACTED																									
3	NOT EXTRACTED																									
4	NOT EXTRACTED																									
5	NOT EXTRACTED																									
6	NOT EXTRACTED																									
																					Mass	Mass				
	Extraction of the Charcoal Beds																									
1	8/17/98 8:50		4B-R8-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1648R	166,691		5.04	0.10	0.0395				
1	8/17/98 8:50		4B-R8-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1649	303		5.09	0.04	0.0015				
2	8/17/98 8:50		4B-R8-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1650R	27,979		5.03	0.09	0.1408				
2	8/17/98 8:50		4B-R8-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1651	295		5.08	0.05	0.0015				
3	8/17/98 8:50		4B-R8-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1652	lost sample		NA	NA	NA				
3	8/17/98 8:50		4B-R8-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1653	lost sample		NA	NA	NA				
4	8/17/98 8:50		4B-R8-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1654	6,024		5.05	0.10	0.0305				
4	8/17/98 8:50		4B-R8-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1655	256		5.04	0.04	0.0013				
5	8/17/98 8:50		4B-R8-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1656	2,287		5.07	0.09	0.0118				
5	8/17/98 8:50		4B-R8-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1657	262		5.05	0.04	0.0013				
6	8/17/98 8:50		4B-R8-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1658	6,343		5.01	0.10	0.0318				
6	8/17/98 8:50		4B-R8-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1659	258		5.03	0.04	0.0013				

Additional Oxidant Information

Flask	Initial MnO4 (mg)	Init Lead mg/mL or mg/g	Consumed mg g(t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	4017	10.3	1421	3.6	
4	4017	10.3	1421	3.6	3.64
5	12051	30.9	1649	4.2	
6	12051	30.9	1680	4.3	4.27

Steven Robert Cline
N.D. BUT ENTERED AS 1 PPB FOR PLOTTING LOG SCALE

Prepared by: S R. Cline

LastUpdated 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R11 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	10,000	NO	.01&.1

Experiment Start Date: 6/9/98

Comments:
The spike goal for this experiment in Table 2-7 was originally 100 ppm.
However, it turned out to be approx 40 ppm, but continued with the run, Thus, this is essentially Run 9 in the original Table 2-7.

SPIKE SOLUTION PREPARATION
Prepared a 100 ppm TCE spiking solution in Tedlar bag using 2272.7gm of sparged groundwater and 227.3mL of saturated (1100 ppm) TCE solution. Placed bag in incubator set at 12 C.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
696	4B-R11-TB-A	6/10/98 10:30	42,920		5.04	5.00	43,266
697	4B-R11-TB-B	6/10/98 10:30	41,653		5.07	5.00	42,247

Prepared by: S.R. Cline LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	6/11/98 8:45	0.0	4B-R11-T0-1A	**360**	GW Only	**0.0**	20	20	360.0	NA
1	6/11/98 9:15	0.5	4B-R11-T30MIN-1	360	GW Only	0	10	30	340.0	NA
1	6/11/98 10:45	2.0	4B-R11-T2HR-1	360	GW Only	0	10	40	330.0	NA
1	6/11/98 12:45	4.0	4B-R11-T4HR-1	360	GW Only	0	10	50	320.0	NA
1	6/11/98 14:45	6.0	4B-R11-T6HR-1	360	GW Only	0	10	60	310.0	NA
1	6/12/98 4:50	20.1	4B-R11-T20HR-1	360	GW Only	0	10	70	300.0	NA
1	6/12/98 8:45	24.0	4B-R11-T24HR-1A	360	GW Only	0	20	90	290.0	NA
2	6/11/98 8:45	0.0	4B-R11-T0-2	**363**	GW Only	**0.0**	10	10	363.0	NA
2	6/11/98 9:15	0.5	4B-R11-T30MIN-2A	363	GW Only	0	20	30	353.0	NA
2	6/11/98 10:45	2.0	4B-R11-T2HR-2	363	GW Only	0	10	40	333.0	NA
2	6/11/98 12:45	4.0	4B-R11-T4HR-2	363	GW Only	0	10	50	323.0	NA
2	6/11/98 14:45	6.0	4B-R11-T6HR-2	363	GW Only	0	10	60	313.0	NA
2	6/12/98 4:50	20.1	4B-R11-T20HR-2	363	GW Only	0	10	70	303.0	NA
2	6/12/98 8:45	24.0	4B-R11-T24HR-2	363	GW Only	0	10	80	293.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCKConc.(ppm):		50.1	DF:	800	Conc (ppm):	40080
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock MnO4-	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (mL)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.98
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.99
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.13
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.08
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.11
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.13
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.19

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init Aq	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidized	TCE Oxidized	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	698	29,269		3.05	2.89	30,903		NA	NA	NA	NA	NA	NA	0.62
1	705	32,191		3.06	3.66	26,893		NA	NA	NA	NA	NA	NA	0.27
1	712	34,929		3.05	3.42	31,199		NA	NA	NA	NA	NA	NA	0.31
1	719	38,293		3.07	3.57	32,922		NA	NA	NA	NA	NA	NA	0.33
1	726	40,592		2.95	3.68	32,581		NA	NA	NA	NA	NA	NA	0.33
1	733	0	ERR?	3.06	3.50		ERR?	NA	NA	NA	NA	NA	NA	0.00
1	740	35,694		3.04	3.40	32,003		NA	NA	NA	NA	NA	NA	0.64
2	699	36,867		3.05	3.74	30,078		NA	NA	NA	NA	NA	NA	0.30
2	706	30,289		3.07	2.96	31,391		NA	NA	NA	NA	NA	NA	0.63
2	713	35,660		3.04	3.51	30,917		NA	NA	NA	NA	NA	NA	0.31
2	720	39,446		3.06	3.56	33,916		NA	NA	NA	NA	NA	NA	0.34
2	727	36,701		3.05	3.61	30,952		NA	NA	NA	NA	NA	NA	0.31
2	734	37,043		3.05	3.60	31,394		NA	NA	NA	NA	NA	NA	0.31
2	741	39,903		3.04	3.61	33,544		NA	NA	NA	NA	NA	NA	0.34

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Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	6/11/98 8:45	0.0	4B-R11-T0-3	**379**	TSF Sludg	**94.2**	10	10	379.0	4.0
3	6/11/98 9:15	0.5	4B-R11-T30MIN-3	379	TSF Sludg	94.2	10	20	369.9	3.9
3	6/11/98 10:45	2.0	4B-R11-T2HR-3A	379	TSF Sludg	94.2	20	40	359.9	3.8
3	6/11/98 12:45	4.0	4B-R11-T4HR-3	379	TSF Sludg	94.2	10	50	339.9	3.6
3	6/11/98 14:45	6.0	4B-R11-T0-1A	379	TSF Sludg	94.2	10	60	329.9	3.5
3	6/12/98 4:50	20.1	4B-R11-T20HR-3	379	TSF Sludg	94.2	10	70	319.9	3.4
3	6/12/98 8:45	24.0	4B-R11-T24HR-3	379	TSF Sludg	94.2	10	80	309.9	3.3
4	6/11/98 8:45	0.0	4B-R11-T0-4	**381**	TSF Sludg	**95.2**	10	10	381.0	4.0
4	6/11/98 9:15	0.5	4B-R11-T30MIN-4	381	TSF Sludg	95.2	10	20	372.0	3.9
4	6/11/98 10:45	2.0	4B-R11-T2HR-4	381	TSF Sludg	95.2	10	30	362.0	3.8
4	6/11/98 12:45	4.0	4B-R11-T4HR-4A	381	TSF Sludg	95.2	20	50	352.0	3.7
4	6/11/98 14:45	6.0	4B-R11-T6HR-4	381	TSF Sludg	95.2	10	60	332.0	3.5
4	6/12/98 4:50	20.1	4B-R11-T20HR-4	381	TSF Sludg	95.2	10	70	322.0	3.4
4	6/12/98 8:45	24.0	4B-R11-T24HR-4	381	TSF Sludg	95.2	10	80	312.0	3.3

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCKConc.(ppm):		50.1	DF:	800	Conc (ppm):	40080
	Calibration Date: 5/5/98									
	[redacted]									pH Dat
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock MnO4-	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (mL)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0	NA	NA	102.7	0	0	0	0	7.21
3	**0.948**	102.7	0.04	1	0.0	38.0	38.0	0.4	0.0	7.13
3	0.948	0.0	0.50	1	0.5	-0.2	37.8	0.4	0.0	7.1
3	0.948	0.5	0.34	1	0.3	0.1	37.9	0.4	0.0	7.11
3	0.948	0.3	0.30	1	0.3	0.0	37.9	0.4	0.0	7.13
3	0.948	0.3	0.99	1	1.0	-0.2	37.7	0.4	0.0	7.2
3	0.948	1.0	0.97	1	1.0	0.0	37.7	0.4	0.0	7.32
4	0	0	NA	NA	102.7	0.0	0.0	0.0	0.0	7.2
4	**0.953**	102.7	0.27	1	0.3	38.1	38.1	0.4	0.0	7.2
4	0.953	0.3	0.36	1	0.4	0.0	38.1	0.4	0.0	7.16
4	0.953	0.4	0.31	1	0.3	0.0	38.1	0.4	0.0	7.19
4	0.953	0.3	0.25	1	0.3	0.0	38.1	0.4	0.0	7.2
4	0.953	0.3	0.84	1	0.8	-0.2	37.9	0.4	0.0	7.26
4	0.953	0.8	1.03	1	1.0	-0.1	37.9	0.4	0.0	7.39

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LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init Aq TCE Oxidized In Interval	% of Total TCE Oxidized In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	700	17,264		3.05	3.49	15,127		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.15
3	707	12,457		3.06	3.39	11,271		0.75	1.4	1.4	24.9%	12.3%	12.3%	0.11
3	714	13,673		3.03	3.73	11,134		0.74	0.0	1.5	0.9%	0.4%	12.8%	0.22
3	721	14,137		3.08	3.52	12,359		0.82	-0.4	1.1	-7.3%	-3.6%	9.2%	0.12
3	728	14,335		3.06	3.61	12,155		0.80	0.1	1.1	1.2%	0.6%	9.7%	0.12
3	735	14,698		3.04	3.48	12,849		0.85	-0.2	0.9	-3.9%	-1.9%	7.8%	0.13
3	742	13,021		3.07	3.15	12,697		0.84	0.0	1.0	0.8%	0.4%	8.2%	0.13
4	701	14,827		3.06	3.22	14,109		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.14
4	708	12,553		3.06	3.47	11,076		0.79	1.1	1.1	21.0%	9.7%	9.7%	0.11
4	715	13,040		3.07	3.73	10,713		0.76	0.1	1.3	2.4%	1.1%	10.8%	0.11
4	722	11,665		3.08	2.97	12,072		0.86	-0.5	0.8	-8.9%	-4.1%	6.7%	0.24
4	729	14,688		3.08	3.85	11,748		0.83	0.1	0.9	2.0%	0.9%	7.6%	0.12
4	736	12,394		3.07	3.43	11,090		0.79	0.2	1.1	3.9%	1.8%	9.5%	0.11
4	743	11,347		3.08	2.93	11,910		0.84	-0.3	0.8	-4.8%	-2.2%	7.3%	0.12

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	6/11/98 8:45	0.0	4B-R11-T0-5	**376**	TSF Sludg	**93.7**	10	10	376.0	4.0
5	6/11/98 9:15	0.5	4B-R11-T30MIN-5	376	TSF Sludg	93.7	10	20	375.7	4.0
5	6/11/98 10:45	2.0	4B-R11-T2HR-5	376	TSF Sludg	93.7	10	30	365.7	3.9
5	6/11/98 12:45	4.0	4B-R11-T4HR-5	376	TSF Sludg	93.7	10	40	355.7	3.8
5	6/11/98 14:45	6.0	4B-R11-T6HR-5A	376	TSF Sludg	93.7	20	60	345.7	3.7
5	6/12/98 4:50	20.1	4B-R11-T20HR-5	376	TSF Sludg	93.7	10	70	325.7	3.5
5	6/12/98 8:45	24.0	4B-R11-T24HR-5	376	TSF Sludg	93.7	10	80	315.7	3.4
6	6/11/98 8:45	0.0	4B-R11-T0-6	**365**	TSF Sludg	**90.6**	10	10	365.0	4.0
6	6/11/98 9:15	0.5	4B-R11-T30MIN-6	365	TSF Sludg	90.6	10	20	364.4	4.0
6	6/11/98 10:45	2.0	4B-R11-T2HR-6	365	TSF Sludg	90.6	10	30	354.4	3.9
6	6/11/98 12:45	4.0	4B-R11-T4HR-6	365	TSF Sludg	90.6	10	40	344.4	3.8
6	6/11/98 14:45	6.0	4B-R11-T6HR-6	365	TSF Sludg	90.6	10	50	334.4	3.7
6	6/12/98 4:50	20.1	4B-R11-T20HR-6A	365	TSF Sludg	90.6	20	70	324.4	3.6
6	6/12/98 8:45	24.0	4B-R11-T24HR-6	365	TSF Sludg	90.6	10	80	304.4	3.4

Prepared by: S.R. Cline

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	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK	Conc.(ppm):	50.1	DF:	800	Conc (ppm):	40080
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	Volume Stock MnO4 Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	1029.6	0.0	0.0	0.0	0.0	7.11
5	9.65	1029.6	90.8	2	181.6	318.6	318.6	3.4	1.8	7.08
5	9.65	181.6	0.0	1	0.0	66.4	384.9	4.1	0.0	7.25
5	9.65	0.0	0.2	1	0.2	0.0	384.9	4.1	0.0	7.31
5	9.65	0.2	0.4	1	0.4	-0.1	384.8	4.1	0.0	7.3
5	9.65	0.4	1.0	1	1.0	-0.2	384.6	4.1	0.0	7.4
5	9.65	1.0	1.0	1	1.0	0.0	384.6	4.1	0.0	7.52
6	0	0	NA	NA	1033.9	0.0	0.0	0.0	0.0	7
6	9.4	1033.9	0.1	1	0.1	376.7	376.7	4.2	0.0	7.02
6	9.4	0.1	0.1	1	0.1	0.0	376.7	4.2	0.0	7.23
6	9.4	0.1	0.2	1	0.2	0.0	376.7	4.2	0.0	7.26
6	9.4	0.2	0.2	1	0.2	0.0	376.7	4.2	0.0	7.28
6	9.4	0.2	0.8	1	0.8	-0.2	376.5	4.2	0.0	7.38
6	9.4	0.8	1.1	1	1.1	-0.1	376.4	4.2	0.0	7.55

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R11	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init Aq	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidized	TCE Oxidized	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	702	15,813		3.04	3.73	12,885		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.13
5	709	2,670		3.07	3.72	2,198		0.17	4.0	4.0	82.9%	35.0%	35.0%	0.02
5	716	5,401		3.07	3.56	4,664		0.36	-0.9	3.1	-18.6%	-7.9%	27.2%	0.05
5	723	6,209		3.08	3.58	5,341		0.41	-0.2	2.9	-5.0%	-2.1%	25.1%	0.05
5	730	6,141		3.08	3.28	5,758		0.45	-0.1	2.7	-3.0%	-1.3%	23.8%	0.12
5	737	6,676		3.07	3.13	6,532		0.51	-0.3	2.5	-5.2%	-2.2%	21.6%	0.07
5	744	7,595		3.08	3.30	7,074		0.55	-0.2	2.3	-3.5%	-1.5%	20.1%	0.07
6	703	14,399		3.06	3.75	11,739		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.12
6	710	6,370		3.07	3.50	5,589		0.48	2.2	2.2	52.3%	20.1%	20.1%	0.06
6	717	8,134		3.07	3.46	7,226		0.62	-0.6	1.7	-13.5%	-5.2%	14.9%	0.07
6	724	7,967		3.09	3.40	7,247		0.62	0.0	1.7	-0.2%	-0.1%	14.9%	0.07
6	731	7,105		3.08	2.90	7,552		0.64	-0.1	1.6	-2.4%	-0.9%	13.9%	0.08
6	738	9,290		3.07	3.15	9,058		0.77	-0.5	1.1	-11.4%	-4.4%	9.6%	0.18
6	745	17,724		3.08	3.25	16,795		1.43	-2.4	-1.3	-55.0%	-21.2%	-11.6%	0.17

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R11 For additional comments, RMAL Laboratory Research Book

MnO4- Calib. Slope: 0.044 STICK Conc (ppm): 50.1 DF: RH Conc (ppm): 40000

Calibration Date: 5/5/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Sample Data: Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Volume Stock MnO4 Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH Data: pH	ORNL OC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	6/11/98 8:45	0.0	4B-R11-T0-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.99	704	34,389		3.07	3.62	29,150		5.7%	30026.74	1239.82
2	6/11/98 9:15	0.5	4B-R11-T30MIN-2B	363	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.09	711	32,386		3.07	3.67	27,152		13.5%	29271.61	2997.02
3	6/11/98 10:45	2.0	4B-R11-T2HR-3B	379	TSF Sludge	94.2	10	NA	NA	NA	0.948	NA	0.5	1	0.5	7.1	718	12,491		3.07	3.01	12,733		-14.4%	11933.26	1130.60
4	6/11/98 12:45	4.0	4B-R11-T4HR-4B	381	TSF Sludge	95.2	10	NA	NA	NA	0.953	NA	0.3	1	0.3	7.17	725	13,151		3.08	3.42	11,855		1.8%	11963.78	153.25
5	6/11/98 14:45	6.0	4B-R11-T6HR-5B	376	TSF Sludge	93.7	10	NA	NA	NA	9.65	NA	0.4	1	0.4	7.31	732	5,993		3.08	3.29	5,614		2.5%	5685.79	102.21
6	6/12/98 4:50	20.1	4B-R11-T20HR-6B	365	TSF Sludge	90.6	10	NA	NA	NA	9.4	NA	0.8	1	0.8	7.38	739	7,926		3.07	2.78	8,841		2.4%	8949.13	153.52
1	6/12/98 8:45	24.0	4B-R11-T24HR-1	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.12	746	37,561		3.04	3.17	38,095		-12.8%	34048.85	2893.75
	Extraction of the Remaining Reactor Contents																									
1																										
2																										
3	6/12/98 8:45	24.0	4B-R11-F3	379	TSF Sludge	94.2					NA	NA	NA	NA	NA	NT	759R	20,649		418.8	373.2	8.6				
4	6/12/98 8:45	24.0	4B-R11-F4	381	TSF Sludge	95.2					NA	NA	NA	NA	NA	NT	760	17,084		422.6	379.7	7.2				
5	6/12/98 8:45	24.0	4B-R11-F5	376	TSF Sludge	93.7					NA	NA	NA	NA	NA	NT	761	10,284		418.8	393.6	4.3				
6	6/12/98 8:45	24.0	4B-R11-F6	365	TSF Sludge	90.6					NA	NA	NA	NA	NA	NT	762	13,928		386.2	374.9	5.4				
	Extraction of the Charcoal Beds																									
1	6/12/98 8:45		4B-R11-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	747	60		5.20	0.10	0.0004				
1	6/12/98 8:45		4B-R11-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	748	0		5.20	0.04	0.0000				
2	6/12/98 8:45		4B-R11-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	749	98		5.21	0.10	0.0005				
2	6/12/98 8:45		4B-R11-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	750	0		5.20	0.04	0.0000				
3	6/12/98 8:45		4B-R11-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	751	198		5.19	0.09	0.0010				
3	6/12/98 8:45		4B-R11-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	752	0		5.20	0.05	0.0000				
4	6/12/98 8:45		4B-R11-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	753	32		5.08	0.09	0.0002				
4	6/12/98 8:45		4B-R11-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	754	0		5.18	0.04	0.0000				
5	6/12/98 8:45		4B-R11-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	755	324		5.18	0.07	0.0017				
5	6/12/98 8:45		4B-R11-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	756	0		5.18	0.04	0.0000				
6	6/12/98 8:45		4B-R11-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	757	692		5.16	0.10	0.0036				
6	6/12/98 8:45		4B-R11-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	758	0		5.18	0.04	0.0000				

Additional Oxidant Information

Flask	Initial MnO4 (mg)	Init Load mg/mL or mg/g	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	nu	0.000	NA	NA	NA
2	no	0.000	NA	NA	NA
3	38.0	0.08	37.64	0.08	
4	38.2	0.08	37.81	0.08	0.08
5	386.8	0.82	386.40	0.82	
6	376.8	0.83	376.34	0.83	0.83

Prepared by: S.R. Cline

Last Updated: 11/1/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R12 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	100,000	NO	1 & 3

Experiment Start Date: 6/16/98

Comments:

SPIKE SOLUTION PREPARATION

Prepared a 100 ppm TCE spiking solution in Tedlar bag using 2222.2 gm of sparged groundwater and and 277.8 mL of saturated TCE spiking solution. Contents were analyzed and analysis proved solution concentration average of 60 ppm.
Added an additional 375 mL of saturated TCE and let equilibrate overnight at 12 C.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
830	4b-R12-TB-A	6/16/98 8:00	110,301		4.50	5.00	99,285
831	4b-R12-TB-B	6/16/98 8:00	98,512		5.07	4.93	101,296

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	6/17/98 9:00	0.0	4B-R12-T0-1A	360	GW Only	0.0	20	20	360.0	NA
1	6/17/98 9:30	0.5	4B-R12-T30MIN-1	360	GW Only	0	10	30	340.0	NA
1	6/17/98 11:00	2.0	4B-R12-T2HR-1	360	GW Only	0	10	40	330.0	NA
1	6/17/98 13:00	4.0	4B-R12-T4HR-1	360	GW Only	0	10	50	320.0	NA
1	6/17/98 15:00	6.0	4B-R12-T6HR-1	360	GW Only	0	10	60	310.0	NA
1	6/18/98 4:55	19.9	4B-R12-T20HR-1	360	GW Only	0	10	70	300.0	NA
1	6/18/98 9:00	24.0	4B-R12-T24HR-1A	360	GW Only	0	20	90	290.0	NA
2	6/17/98 9:00	0.0	4B-R12-T0-2	361	GW Only	0.0	10	10	361.0	NA
2	6/17/98 9:30	0.5	4B-R12-T30MIN-2A	361	GW Only	0	20	30	351.0	NA
2	6/17/98 11:00	2.0	4B-R12-T2HR-2	361	GW Only	0	10	40	331.0	NA
2	6/17/98 13:00	4.0	4B-R12-T4HR-2	361	GW Only	0	10	50	321.0	NA
2	6/17/98 15:00	6.0	4B-R12-T6HR-2	361	GW Only	0	10	60	311.0	NA
2	6/18/98 4:55	19.9	4B-R12-T20HR-2	361	GW Only	0	10	70	301.0	NA
2	6/18/98 9:00	24.0	4B-R12-T24HR-2	361	GW Only	0	10	80	291.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	[redacted]									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4-	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4-	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.88
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.98
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.97
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.96
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.96
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.94
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.94
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.03
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.02
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.02
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.02
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.04
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.08

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	832	91,247		3.06	3.43	81,505		NA	NA	NA	NA	NA	NA	1.63
1	839	97,278		3.10	3.81	79,093		NA	NA	NA	NA	NA	NA	0.79
1	846	94,476		3.05	3.67	78,412		NA	NA	NA	NA	NA	NA	0.78
1	853	87,039		3.06	3.40	78,303		NA	NA	NA	NA	NA	NA	0.78
1	860	95,405		3.05	3.92	74,289		NA	NA	NA	NA	NA	NA	0.74
1	867	95,399		3.05	3.98	73,035		NA	NA	NA	NA	NA	NA	0.73
1	874	89,408		3.05	3.20	84,984		NA	NA	NA	NA	NA	NA	1.70
2	833	95,993		3.05	3.68	79,624		NA	NA	NA	NA	NA	NA	0.80
2	840	74,005		3.09	2.84	80,736		NA	NA	NA	NA	NA	NA	1.61
2	847	97,188		3.03	3.59	82,113		NA	NA	NA	NA	NA	NA	0.82
2	854	94,891		3.05	3.63	79,755		NA	NA	NA	NA	NA	NA	0.80
2	861	98,652		3.02	3.83	77,999		NA	NA	NA	NA	NA	NA	0.78
2	868	101,141		3.02	4.02	76,012		NA	NA	NA	NA	NA	NA	0.76
2	875	89,732		3.05	3.59	76,244		NA	NA	NA	NA	NA	NA	0.76

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	6/17/98 9:00	0.0	4B-R12-T0-3	**368**	TSF Sludg	**91.9**	10	10	368.0	4.0
3	6/17/98 9:30	0.5	4B-R12-T30MIN-3	368	TSF Sludg	91.9	10	20	358.0	3.9
3	6/17/98 11:00	2.0	4B-R12-T2HR-3A	368	TSF Sludg	91.9	20	40	348.0	3.8
3	6/17/98 13:00	4.0	4B-R12-T4HR-3	368	TSF Sludg	91.9	10	50	328.0	3.6
3	6/17/98 15:00	6.0	4B-R12-T0-1A	368	TSF Sludg	91.9	10	60	318.0	3.5
3	6/18/98 4:55	19.9	4B-R12-T20HR-3	368	TSF Sludg	91.9	10	70	308.0	3.4
3	6/18/98 9:00	24.0	4B-R12-T24HR-3	368	TSF Sludg	91.9	10	80	298.0	3.2
4	6/17/98 9:00	0.0	4B-R12-T0-4	**371**	TSF Sludg	**92.9**	10	10	371.0	4.0
4	6/17/98 9:30	0.5	4B-R12-T30MIN-4	371	TSF Sludg	92.9	10	20	361.0	3.9
4	6/17/98 11:00	2.0	4B-R12-T2HR-4	371	TSF Sludg	92.9	10	30	351.0	3.8
4	6/17/98 13:00	4.0	4B-R12-T4HR-4A	371	TSF Sludg	92.9	20	50	341.0	3.7
4	6/17/98 15:00	6.0	4B-R12-T6HR-4	371	TSF Sludg	92.9	10	60	321.0	3.5
4	6/18/98 4:55	19.9	4B-R12-T20HR-4	371	TSF Sludg	92.9	10	70	311.0	3.3
4	6/18/98 9:00	24.0	4B-R12-T24HR-4	371	TSF Sludg	92.9	10	80	301.0	3.2

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4-	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4-	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0	NA	NA	10224.5	0	0	0	0	6.47
3	**4860**	10225	8.7	401	3488.7	2411	2411	26	34.9	6.79
3	4860	3489	5.7	401	2265.7	426	2837	31	45.3	6.95
3	4860	2266	9.6	201	1935.6	108	2945	32	19.4	7.03
3	4860	1936	15.4	101	1555.4	121	3066	33	15.6	7.11
3	4860	1555	0.7	1	0.7	479	3545	39	0.0	7.18
3	4860	1	0.1	1	0.1	0	3545	39	0.0	7.2
4	0	0	NA	NA	10223.0	0	0	0	0	6.46
4	**4900**	10223	6.9	401	2758.9	2695	2695	29	27.6	6.75
4	4900	2759	6.1	401	2462.1	104	2799	30	24.6	6.92
4	4900	2462	10.9	201	2190.9	92	2891	31	43.8	6.99
4	4900	2191	19.9	101	2009.9	58	2949	32	20.1	7
4	4900	2010	21.2	41	869.2	355	3304	36	8.7	7.13
4	4900	869	15.5	41	635.5	70	3374	36	6.4	7.27

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	834R	62,170		3.06	3.44	55,286		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.55
3	841	274		3.10	3.64	233		0.00	19.7	19.7	96.9%	66.5%	66.5%	0.00
3	848	265		3.06	3.86	210			0.0	19.7	0.0%	0.0%	66.5%	0.00
3	855	290		3.06	3.70	240			0.0	19.7	0.0%	0.0%	66.5%	0.00
3	862	108	U	3.06	4.40	75			0.1	19.8	0.3%	0.2%	66.6%	0.00
3	869	192		3.04	3.86	152			0.0	19.7	-0.1%	-0.1%	66.6%	0.00
3	876	415		3.08	3.69	347		0.01	-0.1	19.7	-0.3%	-0.2%	66.4%	0.00
4	835R	63,514		3.07	3.58	54,538		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.55
4	842	244		3.08	3.93	191		0.00	19.6	19.6	97.0%	65.6%	65.6%	0.00
4	849	356		3.06	3.75	291		0.01	0.0	19.6	-0.2%	-0.1%	65.5%	0.00
4	856	291		3.07	4.02	222		0.00	0.0	19.6	0.1%	0.1%	65.6%	0.00
4	863	109	U	3.10	4.36	77	U	0.00	0.0	19.7	0.2%	0.2%	65.8%	0.00
4	870	116	U	3.10	3.97	91	U	0.00	0.0	19.7	0.0%	0.0%	65.7%	0.00
4	877	93	U	3.14	3.54	83	U	0.00	0.0	19.7	0.0%	0.0%	65.8%	0.00

Steven Robert Cline: attempt to rediltue unsecessful

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	6/17/98 9:00	0.0	4B-R12-T0-5	**369**	TSF Sludg	**92.2**	10	10	369.0	4.0
5	6/17/98 9:30	0.5	4B-R12-T30MIN-5	369	TSF Sludg	92.2	10	20	359.0	3.9
5	6/17/98 11:00	2.0	4B-R12-T2HR-5	369	TSF Sludg	92.2	10	30	349.0	3.8
5	6/17/98 13:00	4.0	4B-R12-T4HR-5	369	TSF Sludg	92.2	10	40	339.0	3.7
5	6/17/98 15:00	6.0	4B-R12-T6HR-5A	369	TSF Sludg	92.2	20	60	329.0	3.6
5	6/18/98 4:55	19.9	4B-R12-T20HR-5	369	TSF Sludg	92.2	10	70	309.0	3.4
5	6/18/98 9:00	24.0	4B-R12-T24HR-5	369	TSF Sludg	92.2	10	80	299.0	3.2
6	6/17/98 9:00	0.0	4B-R12-T0-6	**372**	TSF Sludg	**91.9**	10	10	372.0	4.0
6	6/17/98 9:30	0.5	4B-R12-T30MIN-6	372	TSF Sludg	91.9	10	20	362.0	3.9
6	6/17/98 11:00	2.0	4B-R12-T2HR-6	372	TSF Sludg	91.9	10	30	352.0	3.8
6	6/17/98 13:00	4.0	4B-R12-T4HR-6	372	TSF Sludg	91.9	10	40	342.0	3.7
6	6/17/98 15:00	6.0	4B-R12-T6HR-6	372	TSF Sludg	91.9	10	50	332.0	3.6
6	6/18/98 4:55	19.9	4B-R12-T20HR-6A	372	TSF Sludg	91.9	20	70	322.0	3.5
6	6/18/98 9:00	24.0	4B-R12-T24HR-6	372	TSF Sludg	91.9	10	80	302.0	3.3

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4 Data									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4-	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4-	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0	NA	NA	30986.7	0	0	0	0	6.41
5	**14770**	30987	21.4	801	17141.4	4970	4970	54	171.4	6.85
5	14770	17141	17.1	801	13697.1	1202	6173	67	137.0	7.01
5	14770	13697	36.8	401	14756.8	-359	5813	63	147.6	7.12
5	14770	14757	35.1	401	14075.1	224	6038	65	281.5	7.18
5	14770	14075	31.2	401	12511.2	483	6521	71	125.1	7.32
5	14770	12511	28.5	401	11428.5	324	6845	74	114.3	7.49
6	0	0	NA	NA	30938.0	0	0	0	0	6.43
6	**14870**	30938	17.8	801	14257.8	6038	6038	66	142.6	6.75
6	14870	14258	17.9	801	14337.9	-28	6010	65	143.4	6.92
6	14870	14338	34.6	401	13874.6	158	6168	67	138.7	7
6	14870	13875	33.1	401	13273.1	200	6368	69	132.7	7.06
6	14870	13273	33.4	401	13393.4	-39	6329	69	267.9	7.2
6	14870	13393	33.4	401	13393.4	0	6329	69	133.9	7.35

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R12	For additional comments, RMAL Labortory Research Book												
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	836R	63,111		3.08	4.06	47,873		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.48
5	843	244		3.09	3.96	190		0.00	17.1	17.1	96.9%	57.6%	57.6%	0.00
5	850	353		3.08	4.02	270		0.01	0.0	17.1	-0.2%	-0.1%	57.5%	0.00
5	857	283		3.07	3.96	219			0.0	17.1	0.1%	0.1%	57.5%	0.00
5	864	110	U	3.07	2.90	116	U		0.0	17.1	0.2%	0.1%	57.7%	0.00
5	871	168		3.10	4.34	120			0.0	17.1	0.0%	0.0%	57.7%	0.00
5	878	96	U	3.14	3.50	87	U		0.0	17.2	0.1%	0.0%	57.7%	0.00
6	837R	64,633		3.09	3.89	51,301		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.51
6	844	264		3.10	3.92	209		0.00	18.5	18.5	96.9%	61.7%	61.7%	0.00
6	851	242		3.06	4.10	181		0.00	0.0	18.5	0.1%	0.0%	61.7%	0.00
6	858	272		3.07	3.88	215		0.00	0.0	18.5	-0.1%	0.0%	61.7%	0.00
6	865	106	U	3.05	4.49	72	U	0.00	0.0	18.5	0.2%	0.2%	61.9%	0.00
6	872	117	U	3.09	4.32	83	U	0.00	0.0	18.5	0.0%	0.0%	61.9%	0.00
6	879	116	U	3.13	3.61	101	U	0.00	0.0	18.5	0.0%	0.0%	61.8%	0.00

Steven Robert Cline:
Attempted to redilute unsecessfully

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R12	For additional comments, RMAL Laboratory Research Book									Exp.	4b-R12	For additional comments, RMAL Laboratory Research Book										Exp.	4b-R12	For additional comments, RMAL Laboratory			
												MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm)	NA							
												Calibration Date: 5/5/98																	
							Sample Data										pH Data												
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL QC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																												
1	6/17/98 9:00	0.0	4B-R12-T0-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.91	838	88,779		3.09	3.28	83,491		-2.4%	82498.23	1404.03
2	6/17/98 9:30	0.5	4B-R12-T30MIN-2B	361	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.01	845	100,713		3.11	3.88	80,580		0.2%	80658.26	110.05
3	6/17/98 11:00	2.0	4B-R12-T2HR-3B	368	TSF Sludge	91.9	10	NA	NA	NA	4860	NA	5.7	401	2265.7	6.95	852	274		3.06	2.88	292		-38.5%	251.03	57.32
4	6/17/98 13:00	4.0	4B-R12-T4HR-4B	371	TSF Sludge	92.9	10	NA	NA	NA	4900	NA	10.8	201	2170.8	6.98	859	278		3.06	2.68	318		-42.7%	270.03	67.24
5	6/17/98 15:00	6.0	4B-R12-T6HR-5B	369	TSF Sludge	92.2	10	NA	NA	NA	14770	NA	35.0	401	14035.0	7.19	866	141		3.06	4.69	92		21.0%	103.93	17.26
6	6/18/98 4:55	19.9	4B-R12-T20HR-6B	372	TSF Sludge	91.9	10	NA	NA	NA	14870	NA	33.2	401	13313.2	7.2	873	115	U	3.07	2.62	135	U	-62.6%	109.42	36.87
1	6/18/98 9:00	24.0	4B-R12-T24HR-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.95	880	85,822		3.13	3.54	75,787		10.8%	80375.63	6516.89
	Extraction of the Sludge Samples																												
1																													
2																					mass (g)	TCE (mg)							
3	6/19/98 11:30	50.5	4B-R12-F3	368	TSF Sludge	91.9					NA	NA	NA	NA	NA	NT	893	361		419.4	(sludge&GW) 369.6	0.2							
4	6/19/98 11:31	50.5	4B-R12-F4	371	TSF Sludge	92.9					NA	NA	NA	NA	NA	NT	894	226		417.7	375.9	0.1							
5	6/19/98 11:32	50.5	4B-R12-F5	369	TSF Sludge	92.2					NA	NA	NA	NA	NA	NT	895	144		440	381.1	0.1							
6	6/19/98 11:33	50.5	4B-R12-F6	372	TSF Sludge	91.9					NA	NA	NA	NA	NA	NT	896	147		423.6	384.3	0.1							
	Extraction of the Charcoal Samples																												
1	6/19/98 11:49		4B-R12-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	881	335		5.25	0.09	0.0018							
1	6/19/98 11:49		4B-R12-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	882	0		5.21	0.04	0.0000							
2	6/19/98 11:47		4B-R12-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	883	224		5.20	0.10	0.0012							
2	6/19/98 11:47		4B-R12-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	884	0		5.21	0.04	0.0000							
3	6/19/98 11:45		4B-R12-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	885	34		5.20	0.10	0.0002							
3	6/19/98 11:45		4B-R12-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	886	0		5.21	0.04	0.0000							
4	6/19/98 11:40		4B-R12-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	887	27		5.21	0.09	0.0001							
4	6/19/98 11:40		4B-R12-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	888	0		5.20	0.04	0.0000							
5	6/19/98 0:00		4B-R12-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	889	57		5.20	0.10	0.0003							
5	6/19/98 0:00		4B-R12-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	890	0		5.17	0.04	0.0000							
6	6/19/98 11:36		4B-R12-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	891	0		5.17	0.09	0.0000							
6	6/19/98 11:36		4B-R12-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	892	0		5.18	0.04	0.0000							

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg 6hr+24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	3660	8.1	3660	8.1	
4	3691	8.1	3461	7.6	7.88
5	11124	24.7	7021	15.6	
6	11200	24.7	6351	14.0	14.78

Prepared by: S.R. Cline

Last Updated: 11/1/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R13 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	**DNAPL	NO	.01&.1

Experiment Start Date: 7/14/98

Comments:
Per Procedure: Pure TCE added directly into each Reactor/Flask, A Single Spike Solution Could Not Be Prepared

SPIKE SOLUTION PREPARATION
NA, See Above

Predicted Spike Concentrations

Reactor No.	TCE Added (mg)	GW Added (mL)	Resulting Aq. Conc (ppb)
1	750.6	360	2,085,000
2	726.6	362	2,007,182
3	736.4	367	2,006,540
4	721.3	362	1,992,541
5	727.6	368	1,977,174
6	725.3	360	2,014,722

NOTE: Aqueous Solubility of TCE is only approx. 1,100 mg/L (1,100,000 ppb)
Thus, some TCE is present in each react as DNAPL

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	7/15/98 8:50	0.0	4B-R13-T0-1A	**360**	GW Only	**0.0**	20	20	360.0	NA
1	7/15/98 9:20	0.5	4B-R13-T30MIN-1	360	GW Only	0	10	30	340.0	NA
1	7/15/98 10:50	2.0	4B-R13-T2HR-1	360	GW Only	0	10	40	330.0	NA
1	7/15/98 12:50	4.0	4B-R13-T4HR-1	360	GW Only	0	10	50	320.0	NA
1	7/15/98 14:50	6.0	4B-R13-T6HR-1	360	GW Only	0	10	60	310.0	NA
1	7/16/98 7:00	22.2	4B-R13-T20HR-1	360	GW Only	0	10	70	300.0	NA
1	7/16/98 8:50	24.0	4B-R13-T24HR-1A	360	GW Only	0	20	90	290.0	NA
1	7/20/98 8:50	120.0	4B-R13-T120HR	360	GW Only	0	10	100	270.0	NA
2	7/15/98 8:50	0.0	4B-R13-T0-2	**362**	GW Only	**0.0**	10	10	362.0	NA
2	7/15/98 9:20	0.5	4B-R13-T30MIN-2A	362	GW Only	0	20	30	352.0	NA
2	7/15/98 10:50	2.0	4B-R13-T2HR-2	362	GW Only	0	10	40	332.0	NA
2	7/15/98 12:50	4.0	4B-R13-T4HR-2	362	GW Only	0	10	50	322.0	NA
2	7/15/98 14:50	6.0	4B-R13-T6HR-2	362	GW Only	0	10	60	312.0	NA
2	7/16/98 7:00	22.2	4B-R13-T20HR-2	362	GW Only	0	10	70	302.0	NA
2	7/16/98 8:50	24.0	4B-R13-T24HR-2	362	GW Only	0	10	80	292.0	NA
2	7/20/98 8:50	120.0	4B-R13-T120HR-2a	362	GW Only	0	20	100	282.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.8	DF:	800	Conc (ppm):	39840
	Calibration Date: 5/5/98									
	MnO4- Dat									pH Dat
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock MnC	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (mL	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.25
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.12
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.03
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.14
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.27
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.26
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.16
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.13
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.14
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.14
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.13
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.15
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.29

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book											
							57,217							
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	1105	1564799		3.08	3.61	1,334,621		NA	NA	NA	NA	NA	NA	26.69
1	1119	1393518		3.07	3.34	1,280,244		NA	NA	NA	NA	NA	NA	12.80
1	1133	1254883		3.07	3.04	1,267,975		NA	NA	NA	NA	NA	NA	12.68
1	1147	1285923		3.12	3.10	1,295,554		NA	NA	NA	NA	NA	NA	12.96
1	1161	1162801		3.11	3.08	1,173,213		NA	NA	NA	NA	NA	NA	11.73
1	1175	1391448		3.10	3.55	1,214,907		NA	NA	NA	NA	NA	NA	12.15
1	1189	1377764		3.09	3.22	1,320,584		NA	NA	NA	NA	NA	NA	26.41
1	1203	1274431		3.08	3.29	1,193,341		NA	NA	NA	NA	NA	NA	11.93
2	1106	1599413		3.07	3.81	1,289,274		NA	NA	NA	NA	NA	NA	12.89
2	1120	1349734		3.07	3.16	1,313,104		NA	NA	NA	NA	NA	NA	26.26
2	1134	1343460		3.07	3.21	1,285,942		NA	NA	NA	NA	NA	NA	12.86
2	1148	1169203		3.12	3.06	1,192,213		NA	NA	NA	NA	NA	NA	11.92
2	1162	1081026		3.13	2.96	1,145,103		NA	NA	NA	NA	NA	NA	11.45
2	1176	1199899		3.11	3.07	1,214,189		NA	NA	NA	NA	NA	NA	12.14
2	1190	1271064		3.08	3.20	1,225,489		NA	NA	NA	NA	NA	NA	12.25
2	1204	1161823		3.10	2.93	1,232,718		NA	NA	NA	NA	NA	NA	24.65

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	7/15/98 8:50	0.0	4B-R13-T0-3	367	TSF Sludg	91.2	10	10	367.0	4.0
3	7/15/98 9:20	0.5	4B-R13-T30MIN-3	367	TSF Sludg	91.2	10	20	357.9	3.9
3	7/15/98 10:50	2.0	4B-R13-T2HR-3A	367	TSF Sludg	91.2	20	40	347.9	3.8
3	7/15/98 12:50	4.0	4B-R13-T4HR-3	367	TSF Sludg	91.2	10	50	327.9	3.6
3	7/15/98 14:50	6.0	4B-R13-T0-1A	367	TSF Sludg	91.2	10	60	317.9	3.5
3	7/16/98 7:00	22.2	4B-R13-T20HR-3	367	TSF Sludg	91.2	10	70	307.9	3.4
3	7/16/98 8:50	24.0	4B-R13-T24HR-3	367	TSF Sludg	91.2	10	80	297.9	3.3
3	7/20/98 8:50	120.0	4B-R13-T120HR-3	367	TSF Sludg	91.2	10	90	287.0	3.1
4	7/15/98 8:50	0.0	4B-R13-T0-4	362	TSF Sludg	90.4	10	10	362.0	4.0
4	7/15/98 9:20	0.5	4B-R13-T30MIN-4	362	TSF Sludg	90.4	10	20	352.9	3.9
4	7/15/98 10:50	2.0	4B-R13-T2HR-4	362	TSF Sludg	90.4	10	30	342.9	3.8
4	7/15/98 12:50	4.0	4B-R13-T4HR-4A	362	TSF Sludg	90.4	20	50	332.9	3.7
4	7/15/98 14:50	6.0	4B-R13-T6HR-4	362	TSF Sludg	90.4	10	60	312.9	3.5
4	7/16/98 7:00	22.2	4B-R13-T20HR-4	362	TSF Sludg	90.4	10	70	302.9	3.4
4	7/16/98 8:50	24.0	4B-R13-T24HR-4	362	TSF Sludg	90.4	10	80	292.9	3.2
4	7/20/98 8:50	120.0	4B-R13-T120HR-4	362	TSF Sludg	90.4	10	90	282.0	3.1

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.8	DF:	800	Conc (ppm):	39840
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
3	0	0	NA	NA	102.2	0.0	0.0	0.0	0.0	6.58
3	0.918	102.2	1.90	1	1.9	35.9	35.9	0.4	0.0	6.53
3	0.918	1.9	2.10	1	2.1	-0.1	35.8	0.4	0.0	6.51
3	0.918	2.1	2.27	1	2.3	-0.1	35.8	0.4	0.0	6.47
3	0.918	2.3	2.41	1	2.4	0.0	35.7	0.4	0.0	6.61
3	0.918	2.4	2.72	1	2.7	-0.1	35.6	0.4	0.0	6.81
3	0.918	2.7	2.74	1	2.7	0.0	35.6	0.4	0.0	6.81
3	0.918	2.7	4.92	1	4.9	-0.6	35.0	0.4	0.0	6.93
4	0	0	NA	NA	102.2	0.0	0.0	0.0	0.0	6.62
4	0.905	102.2	1.70	1	1.7	35.5	35.5	0.4	0.0	6.66
4	0.905	1.7	1.88	1	1.9	-0.1	35.4	0.4	0.0	6.64
4	0.905	1.9	2.00	1	2.0	0.0	35.4	0.4	0.0	6.65
4	0.905	2.0	2.19	1	2.2	-0.1	35.3	0.4	0.0	6.73
4	0.905	2.2	2.50	1	2.5	-0.1	35.2	0.4	0.0	6.8
4	0.905	2.5	2.43	1	2.4	0.0	35.2	0.4	0.0	6.77
4	0.905	2.4	3.89	1	3.9	-0.4	34.8	0.4	0.0	7.13

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book											
							57,217							
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1107	806012		3.08	3.56	697,355		1.00	0.0	0.0	0.0%	0.0%	0.0%	6.97
3	1121	709234		3.07	3.10	701,608		1.01	-1.5	-1.5	-0.6%	-0.2%	-0.2%	7.02
3	1135	722145		3.09	2.97	749,934		1.08	-16.8	-18.3	-6.6%	-2.3%	-2.5%	15.00
3	1149	876862		3.12	3.64	751,840		1.08	-0.6	-19.0	-0.2%	-0.1%	-2.6%	7.52
3	1163	844639		3.13	3.38	782,642		1.12	-9.8	-28.8	-3.8%	-1.3%	-3.9%	7.83
3	1177	937410		3.10	3.39	856,547		1.23	-22.8	-51.5	-8.9%	-3.1%	-7.0%	8.57
3	1191	1385474		3.09	3.04	1,405,217		2.02	-163.5	-215.0	-63.9%	-22.2%	-29.2%	14.05
3	1205	1608422		3.07	3.41	1,446,770		2.07	-11.9	-226.9	-4.7%	-1.6%	-30.8%	14.47
4	1108	848822		3.08	3.55	734,600		1.00	0.0	0.0	0.0%	0.0%	0.0%	7.35
4	1122	708856		3.06	3.05	711,435		0.97	8.2	8.2	3.1%	1.1%	1.1%	7.11
4	1136	810402		3.07	3.43	727,050		0.99	-5.4	2.8	-2.0%	-0.7%	0.4%	7.27
4	1150	643995		3.12	2.85	704,974		0.96	7.3	10.2	2.8%	1.0%	1.4%	14.10
4	1164	900853		3.10	3.27	853,081		1.16	-46.3	-36.2	-17.4%	-6.4%	-5.0%	8.53
4	1178	1003837		3.10	3.40	914,009		1.24	-18.5	-54.6	-6.9%	-2.6%	-7.6%	9.14
4	1192	1270231		3.08	3.04	1,288,546		1.75	-109.7	-164.3	-41.3%	-15.2%	-22.8%	12.89
4	1206	1646610		3.09	3.26	1,557,951		2.12	-76.0	-240.3	-28.6%	-10.5%	-33.3%	15.58

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	7/15/98 8:50	0.0	4B-R13-T0-5	368	TSF Sludg	91.8	10	10	368.0	4.0
5	7/15/98 9:20	0.5	4B-R13-T30MIN-5	368	TSF Sludg	91.8	10	20	367.2	4.0
5	7/15/98 10:50	2.0	4B-R13-T2HR-5	368	TSF Sludg	91.8	10	30	357.2	3.9
5	7/15/98 12:50	4.0	4B-R13-T4HR-5	368	TSF Sludg	91.8	10	40	347.2	3.8
5	7/15/98 14:50	6.0	4B-R13-T6HR-5A	368	TSF Sludg	91.8	20	60	337.2	3.7
5	7/16/98 7:00	22.2	4B-R13-T20HR-5	368	TSF Sludg	91.8	10	70	317.2	3.5
5	7/16/98 8:50	24.0	4B-R13-T24HR-5	368	TSF Sludg	91.8	10	80	307.2	3.3
5	7/20/98 8:50	120.0	4B-R13-T120HR-5	368	TSF Sludg	91.8	10	90	288.0	3.1
6	7/15/98 8:50	0.0	4B-R13-T0-6	360	TSF Sludg	90.1	10	10	360.0	4.0
6	7/15/98 9:20	0.5	4B-R13-T30MIN-6	360	TSF Sludg	90.1	10	20	359.0	4.0
6	7/15/98 10:50	2.0	4B-R13-T2HR-6	360	TSF Sludg	90.1	10	30	349.0	3.9
6	7/15/98 12:50	4.0	4B-R13-T4HR-6	360	TSF Sludg	90.1	10	40	339.0	3.8
6	7/15/98 14:50	6.0	4B-R13-T6HR-6	360	TSF Sludg	90.1	10	50	329.0	3.7
6	7/16/98 7:00	22.2	4B-R13-T20HR-6A	360	TSF Sludg	90.1	20	70	319.0	3.5
6	7/16/98 8:50	24.0	4B-R13-T24HR-6	360	TSF Sludg	90.1	10	80	299.0	3.3
6	7/20/98 8:50	120.0	4B-R13-T120HR-6	360	TSF Sludg	90.1	10	90	280.0	3.1

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK Conc.(ppm):		49.8	DF:	800	Conc (ppm):	39840
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	998.2	0.0	0.0	0.0	0.0	6.51
5	9.2	998.2	1.0	1	1.0	366.2	366.2	4.0	0.0	6.44
5	9.2	1.0	1.4	1	1.4	-0.2	366.0	4.0	0.0	6.51
5	9.2	1.4	1.6	1	1.6	0.0	366.0	4.0	0.0	6.51
5	9.2	1.6	1.7	1	1.7	0.0	365.9	4.0	0.0	6.66
5	9.2	1.7	2.1	1	2.1	-0.1	365.8	4.0	0.0	6.8
5	9.2	2.1	2.0	1	2.0	0.0	365.8	4.0	0.0	6.72
5	9.2	2.0	4.8	1	4.8	-0.8	365.0	4.0	0.0	7.08
6	0	0	NA	NA	998.8	0.0	0.0	0.0	0.0	7.35
6	9	998.8	0.6	1	0.6	358.4	358.4	4.0	0.0	6.48
6	9	0.6	0.6	1	0.6	0.0	358.4	4.0	0.0	6.8
6	9	0.6	0.5	1	0.5	0.0	358.4	4.0	0.0	6.86
6	9	0.5	0.5	1	0.5	0.0	358.4	4.0	0.0	7.01
6	9	0.5	0.7	1	0.7	-0.1	358.3	4.0	0.0	7.17
6	9	0.7	0.6	1	0.6	0.0	358.3	4.0	0.0	7.13
6	9	0.6	1.1	1	1.1	-0.1	358.2	4.0	0.0	7.68

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R13	For additional comments, RMAL Labortory Research Book											
							57,217							
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1109	723485		3.07	3.63	611,714		1.00	0.0	0.0	0.0%	0.0%	0.0%	6.12
5	1123	461589		3.07	3.07	461,926		0.76	55.0	55.0	24.4%	7.6%	7.6%	4.62
5	1137	494215		3.08	2.81	542,095		0.89	-28.6	26.4	-12.7%	-3.9%	3.6%	5.42
5	1151	468831		3.13	3.73	393,665		0.64	51.5	77.9	22.9%	7.1%	10.7%	3.94
5	1165	598585		3.13	2.98	629,833		1.03	-79.6	-1.7	-35.4%	-10.9%	-0.2%	12.60
5	1179	661657		3.10	3.12	656,673		1.07	-8.5	-10.2	-3.8%	-1.2%	-1.4%	6.57
5	1193	779813		3.09	3.03	796,150		1.30	-42.8	-53.1	-19.0%	-5.9%	-7.3%	7.96
5	1207	1349138		3.10	3.58	1,167,351		1.91	-106.9	-160.0	-47.5%	-14.7%	-22.0%	11.67
6	1110	754116		3.09	3.79	614,249		1.00	0.0	0.0	0.0%	0.0%	0.0%	6.14
6	1124	356152		3.09	3.14	350,807		0.57	94.6	94.6	42.8%	13.0%	13.0%	3.51
6	1138	482759		3.07	3.36	440,700		0.72	-31.4	63.2	-14.2%	-4.3%	8.7%	4.41
6	1152	521458		3.13	3.65	447,399		0.73	-2.3	60.9	-1.0%	-0.3%	8.4%	4.47
6	1166	542263		3.12	3.43	492,918		0.80	-15.0	46.0	-6.8%	-2.1%	6.3%	4.93
6	1180	629866		3.10	3.37	579,007		0.94	-27.5	18.5	-12.4%	-3.8%	2.5%	11.58
6	1194	610815		3.10	3.32	570,921		0.93	2.4	20.9	1.1%	0.3%	2.9%	5.71
6	1208	1344166		3.09	3.26	1,274,446		2.07	-197.0	-176.1	-89.1%	-27.2%	-24.3%	12.74

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp	4b-R13	For additional comments, RMAL Laboratory Research Book																							
											MnO4- Calib. Slope		0.006	STOCK Conc. (ppm)		49.8	DF:		RSD Conc. (pp	30.640						
											Calibration Date: 5/5/98															
						Sample Data										pH Data										
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual	Volume	Initial	Aliquot	Final	Final			ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	% Diff	AVG	STDEV
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S	Stock Mn	MnO4-	MnO4-	Spec	MnO4-	pH		GC #	Conc		Volume	Volume	Conc			(ppb)	(ppb)
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio	Added (mL)	(mg/L)	(mg/L)	DF	(mg/L)				(ppb)		(mL)	(mL)	(ppb)				
	Duplicate VOC Samples																						DUPLICATES				
1	7/15/98 8:50	0.0	4B-R13-T0-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.25	1111	1247108		3.08	2.95	1,304,512		2.3%	1319566.52	21290.22
2	7/15/98 9:20	0.5	4B-R13-T30MIN-2B	362	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.16	1125	1229626		3.08	2.91	1,298,774		1.1%	1305939.10	10132.47
3	7/15/98 10:50	2.0	4B-R13-T2HR-3B	367	TSF Sludg	91.2	10	NA	NA	NA	0.918	NA	2.1	1	2.1	8.51	1139	710991		3.08	2.94	746,048		0.5%	747991.12	2747.46
4	7/15/98 12:50	4.0	4B-R13-T4HR-4B	362	TSF Sludg	90.4	10	NA	NA	NA	0.905	NA	2.0	1	2.0	8.65	1153	858818		3.13	3.77	714,731		-1.4%	709852.78	6898.94
5	7/15/98 14:50	6.0	4B-R13-T6HR-5B	368	TSF Sludg	91.8	10	NA	NA	NA	9.2	NA	1.7	1	1.7	8.65	1167	732453		3.13	3.62	632,365		-0.4%	631098.73	1790.33
6	7/16/98 7:00	22.2	4B-R13-T20HR-6B	360	TSF Sludg	90.1	10	NA	NA	NA	9	NA	0.7	1	0.7	7.17	1181	580662		3.11	3.19	565,758		2.3%	572382.37	9368.88
1	7/16/98 8:50	24.0	4B-R13-T24HR-1	360	TSF Sludg	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.14	1195	1280922		3.10	2.97	1,335,233		-1.1%	1327908.65	10358.04
2	7/20/98 8:50	120.0	4B-R13-T120hr-2B	362	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.29	1209	1307309		3.09	3.00	1,345,815				
	Extraction of the Remaining Reactor Contents																									
1	7/20/98 8:50	120.0	4B-R13-F1	360	GW Only	0.0					NA	NA	NA	NA	NA	NT	1240	977368		434.8	263	425				
2	7/20/98 8:50	120.0	4B-R13-F2	362	GW Only	0.0					NA	NA	NA	NA	NA	NT	1241	985445		430.3	267	424				
3	7/20/98 8:50	120.0	4B-R13-F3	367	TSF Sludg	91.2					NA	NA	NA	NA	NA	NT	1242	1112515		427.3	362	475				
4	7/20/98 8:50	120.0	4B-R13-F4	362	TSF Sludg	90.4					NA	NA	NA	NA	NA	NT	1243	1160912		418.2	355	485				
5	7/20/98 8:50	120.0	4B-R13-F5	368	TSF Sludg	91.8					NA	NA	NA	NA	NA	NT	1244	1043915		419.7	372	438				
6	7/20/98 8:50	120.0	4B-R13-F6	360	TSF Sludg	90.1					NA	NA	NA	NA	NA	NT	1245	1017079		401.5	359	408				
	Extraction of the Charcoal Beds																									
1	7/20/98 8:50		4B-R13-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1222R	426755		5.15	0.09	2.1958				
1	7/20/98 8:50		4B-R13-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1223R	25		5.17	0.04	0.0001				
2	7/20/98 8:50		4B-R13-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1224R	84047		5.17	0.10	0.4345				
2	7/20/98 8:50		4B-R13-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1225R	0		5.18	0.04	0.0000				
3	7/20/98 8:50		4B-R13-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1226R	81011		5.18	0.09	0.4195				
3	7/20/98 8:50		4B-R13-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1227R	10		5.18	0.02	0.0001				
4	7/20/98 8:50		4B-R13-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1228R	92432		5.19	0.10	0.4801				
4	7/20/98 8:50		4B-R13-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1229R	0		5.19	0.04	0.0000				
5	7/20/98 8:50		4B-R13-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1230R	142603		5.19	0.10	0.7398				
5	7/20/98 8:50		4B-R13-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1231R	0		5.20	0.04	0.0000				
6	7/20/98 8:50		4B-R13-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1232	7304		5.20	0.09	0.0380				
6	NA		4B-R13-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1233	NA	OST SAMPLE		NA	NA				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg MnO4 in 24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	36.6	0.08	35.6	0.08	
4	36.1	0.08	35.2	0.08	0.08
5	366.5	0.80	365.8	0.80	
6	358.6	0.80	358.3	0.80	0.80

Prepared by: S.R. Cline

LastUpdated: 11/1/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4B-R14

For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	**DNAPL	NO	1 & 3

Experiment Start Date: 7/14/98

Comments:
Per Procedure: Pure TCE added directly into each Reactor/Flask, A Single Spike Solution Could Not Be Prepared

SPIKE SOLUTION PREPARATION
NA, See Above

Predicted Spike Concentrations

Reactor No.	TCE Added (mg)	GW Added (mL)	Resulting Aq. Conc (ppb)
1	734.1	360	2,039,167
2	791	360	2,197,222
3	735.8	363	2,026,997
4	717.8	367	1,955,858
5	719.6	366	1,966,120
6	734	365	2,010,959

NOTE: Aqueous Solubility of TCE is only approx. 1,100 mg/L (1,100,000 ppb)
Thus, some TCE is present in each react as DNAPL

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	7/15/98 8:45	0.0	4B-R14-T0-1A	360	GW Only	0.0	20	20	360.0	NA
1	7/15/98 9:15	0.5	4B-R14-T30MIN-1	360	GW Only	0	10	30	340.0	NA
1	7/15/98 10:45	2.0	4B-R14-T2HR-1	360	GW Only	0	10	40	330.0	NA
1	7/15/98 12:45	4.0	4B-R14-T4HR-1	360	GW Only	0	10	50	320.0	NA
1	7/15/98 14:45	6.0	4B-R14-T6HR-1	360	GW Only	0	10	60	310.0	NA
1	7/16/98 7:00	22.2	4B-R14-T20HR-1	360	GW Only	0	10	70	300.0	NA
1	7/16/98 8:45	24.0	4B-R14-T24HR-1A	360	GW Only	0	20	90	290.0	NA
1	7/20/98 8:45	120.0	4B-R14-T120HR	360	GW Only	0	10	100	270.0	NA
2	7/15/98 8:45	0.0	4B-R14-T0-2	360	GW Only	0.0	10	10	360.0	NA
2	7/15/98 9:15	0.5	4B-R14-T30MIN-2A	360	GW Only	0	20	30	350.0	NA
2	7/15/98 10:45	2.0	4B-R14-T2HR-2	360	GW Only	0	10	40	330.0	NA
2	7/15/98 12:45	4.0	4B-R14-T4HR-2	360	GW Only	0	10	50	320.0	NA
2	7/15/98 14:45	6.0	4B-R14-T6HR-2	360	GW Only	0	10	60	310.0	NA
2	7/16/98 7:00	22.2	4B-R14-T20HR-2	360	GW Only	0	10	70	300.0	NA
2	7/16/98 8:45	24.0	4B-R14-T24HR-2	360	GW Only	0	10	80	290.0	NA
2	7/20/98 8:45	120.0	4B-R14-T120HR-2a	360	GW Only	0	20	100	280.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Dat									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.05
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.2
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.14
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.21
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.13
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.06
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.08
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.21
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.21
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.15
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.18
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.17
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.12
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.23

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	1098	1,231,806		3.04	3.02	1,241,775		NA	NA	NA	NA	NA	NA	24.84
1	1112	1,540,007		2.96	3.85	1,187,001		NA	NA	NA	NA	NA	NA	11.87
1	1126	1,190,203		3.06	2.99	1,218,129		NA	NA	NA	NA	NA	NA	12.18
1	1140	1,215,551		3.05	2.79	1,331,763		NA	NA	NA	NA	NA	NA	13.32
1	1154	1,249,589		3.06	3.19	1,199,338		NA	NA	NA	NA	NA	NA	11.99
1	1168	1,206,605		3.08	3.02	1,228,466		NA	NA	NA	NA	NA	NA	12.28
1	1182	1,210,519		3.08	3.13	1,191,124		NA	NA	NA	NA	NA	NA	23.82
1	1196	1,392,951		3.01	3.43	1,222,632		NA	NA	NA	NA	NA	NA	12.23
2	1099	1,277,243		3.03	2.97	1,305,505		NA	NA	NA	NA	NA	NA	13.06
2	1113	1,333,451		3.03	3.35	1,207,279		NA	NA	NA	NA	NA	NA	24.15
2	1127	1,117,186		3.06	2.64	1,296,500		NA	NA	NA	NA	NA	NA	12.96
2	1141	1,474,699		3.08	3.28	1,383,228		NA	NA	NA	NA	NA	NA	13.83
2	1155	1,286,191		3.05	3.10	1,266,515		NA	NA	NA	NA	NA	NA	12.67
2	1169	1,282,289		3.08	3.09	1,280,151		NA	NA	NA	NA	NA	NA	12.80
2	1183	1,353,534		3.07	3.41	1,218,326		NA	NA	NA	NA	NA	NA	12.18
2	1197	1,457,037		3.05	3.25	1,365,853		NA	NA	NA	NA	NA	NA	27.32

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LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
3	7/15/98 8:45	0.0	4B-R14-T0-3	363	TSF Sludg	90.4	10	10	363.0	4.0
3	7/15/98 9:15	0.5	4B-R14-T30MIN-3	363	TSF Sludg	90.4	10	20	353.0	3.9
3	7/15/98 10:45	2.0	4B-R14-T2HR-3A	363	TSF Sludg	90.4	20	40	343.0	3.8
3	7/15/98 12:45	4.0	4B-R14-T4HR-3	363	TSF Sludg	90.4	10	50	323.0	3.6
3	7/15/98 14:45	6.0	4B-R14-T0-1A	363	TSF Sludg	90.4	10	60	313.0	3.5
3	7/16/98 7:00	22.2	4B-R14-T20HR-3	363	TSF Sludg	90.4	10	70	303.0	3.4
3	7/16/98 8:45	24.0	4B-R14-T24HR-3	363	TSF Sludg	90.4	10	80	293.0	3.2
3	7/20/98 8:45	120.0	4B-R14-T120HR-3	363	TSF Sludg	90.4	10	90	283.0	3.1
4	7/15/98 8:45	0.0	4B-R14-T0-4	367	TSF Sludg	91.4	10	10	367.0	4.0
4	7/15/98 9:15	0.5	4B-R14-T30MIN-4	367	TSF Sludg	91.4	10	20	357.0	3.9
4	7/15/98 10:45	2.0	4B-R14-T2HR-4	367	TSF Sludg	91.4	10	30	347.0	3.8
4	7/15/98 12:45	4.0	4B-R14-T4HR-4A	367	TSF Sludg	91.4	20	50	337.0	3.7
4	7/15/98 14:45	6.0	4B-R14-T6HR-4	367	TSF Sludg	91.4	10	60	317.0	3.5
4	7/16/98 7:00	22.2	4B-R14-T20HR-4	367	TSF Sludg	91.4	10	70	307.0	3.4
4	7/16/98 8:45	24.0	4B-R14-T24HR-4	367	TSF Sludg	91.4	10	80	297.0	3.2
4	7/20/98 8:45	120.0	4B-R14-T120HR-4	367	TSF Sludg	91.4	10	90	287.0	3.1

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0	NA	NA	10226	0	0	0	0	6.64
3	4792.9	10226	12	401	4776	1924	1924	21	47.8	6.37
3	4792.9	4776	16	201	3296	507	2431	27	65.9	6.51
3	4792.9	3296	8	201	1700	515	2947	33	17.0	6.51
3	4792.9	1700	1	1	1	532	3479	38	0.0	6.62
3	4792.9	1	1	1	1	0	3479	38	0.0	6.74
3	4792.9	1	1	1	1	0	3479	38	0.0	6.83
3	4792.9	1	6	1	6	-1	3477	38	0.1	7
4	0	0	NA	NA	10221	0	0	0	0	6.7
4	4844.7	10221	12	401	4772	1945	1945	21	47.7	5.98
4	4844.7	4772	26	201	5186	-144	1802	20	51.9	6.35
4	4844.7	5186	16	201	3276	644	2445	27	65.5	6.48
4	4844.7	3276	23	81	1855	451	2896	32	18.5	6.63
4	4844.7	1855	1	1	1	569	3465	38	0.0	6.73
4	4844.7	1	0	1	0	0	3465	38	0.0	6.74
4	4844.7	0	3	1	3	-1	3464	38	0.0	7

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Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	1100	873,154		3.06	3.39	787,773		1.00	0.0	0.0	0.0%	0.0%	0.0%	7.88
3	1114R	1,453		3.05	3.36	1,321		0.00	277.6	277.6	97.1%	37.7%	37.7%	0.01
3	1128	79,943		3.04	2.71	*705*		0.00	0.2	277.8	0.1%	0.0%	37.8%	0.01
3	1142R	3,114		3.08	3.67	2,616		0.00	-0.6	277.2	-0.2%	-0.1%	37.7%	0.03
3	1156R2	198,819		3.08	3.30	185,625		0.24	-57.3	219.9	-20.0%	-7.8%	29.9%	1.86
3	1170R2	252,185		3.10	3.38	230,976		0.29	-13.7	206.2	-4.8%	-1.9%	28.0%	2.31
3	1184R2	422,545		3.06	3.03	426,320		0.54	-57.2	149.0	-20.0%	-7.8%	20.2%	4.26
3	1198	471,169	E (Bare	3.06	3.14	459,564	E (Barely	0.58	-9.4	139.5	-3.3%	-1.3%	19.0%	4.60
4	1101	883,590		3.06	3.68	734,142		1.00	0.0	0.0	0.0%	0.0%	0.0%	7.34
4	1115	31,630		3.05	3.05	31,568		0.04	250.8	250.8	93.1%	34.9%	34.9%	0.32
4	1129R	3,419		3.05	2.60	4,025		0.01	9.6	260.4	3.5%	1.3%	36.3%	0.04
4	1143R	500	U	3.10	3.25	477	U	0.00	1.2	261.6	0.4%	0.2%	36.4%	0.01
4	1157R	834		3.09	3.04	848		0.00	-0.1	261.5	0.0%	0.0%	36.4%	0.01
4	1171	37,404		3.10	3.31	35,011		0.05	-10.5	251.0	-3.9%	-1.5%	35.0%	0.35
4	1185	54,977		3.08	3.01	56,327		0.08	-6.3	244.6	-2.3%	-0.9%	34.1%	0.56
4	1199R	440,073		3.06	4.46	302,129		0.38	-70.5	174.1	-24.7%	-9.6%	24.5%	3.02

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Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
5	7/15/98 8:45	0.0	4B-R14-T0-5	366	TSF Sludg	91.5	10	10	366.0	4.0
5	7/15/98 9:15	0.5	4B-R14-T30MIN-5	366	TSF Sludg	91.5	10	20	356.0	3.9
5	7/15/98 10:45	2.0	4B-R14-T2HR-5	366	TSF Sludg	91.5	10	30	346.0	3.8
5	7/15/98 12:45	4.0	4B-R14-T4HR-5	366	TSF Sludg	91.5	10	40	336.0	3.7
5	7/15/98 14:45	6.0	4B-R14-T6HR-5A	366	TSF Sludg	91.5	20	60	326.0	3.6
5	7/16/98 7:00	22.2	4B-R14-T20HR-5	366	TSF Sludg	91.5	10	70	306.0	3.3
5	7/16/98 8:45	24.0	4B-R14-T24HR-5	366	TSF Sludg	91.5	10	80	296.0	3.2
5	7/20/98 8:45	120.0	4B-R14-T120HR-5	366	TSF Sludg	91.5	10	90	286.0	3.1
6	7/15/98 8:45	0.0	4B-R14-T0-6	365	TSF Sludg	91.3	10	10	365.0	4.0
6	7/15/98 9:15	0.5	4B-R14-T30MIN-6	365	TSF Sludg	91.3	10	20	355.0	3.9
6	7/15/98 10:45	2.0	4B-R14-T2HR-6	365	TSF Sludg	91.3	10	30	345.0	3.8
6	7/15/98 12:45	4.0	4B-R14-T4HR-6	365	TSF Sludg	91.3	10	40	335.0	3.7
6	7/15/98 14:45	6.0	4B-R14-T6HR-6	365	TSF Sludg	91.3	10	50	325.0	3.6
6	7/16/98 7:00	22.2	4B-R14-T20HR-6A	365	TSF Sludg	91.3	20	70	315.0	3.5
6	7/16/98 8:45	24.0	4B-R14-T24HR-6	365	TSF Sludg	91.3	10	80	295.0	3.2
6	7/20/98 8:45	120.0	4B-R14-T120HR-6	365	TSF Sludg	91.3	10	90	285.0	3.1

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	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	30976	0	0	0	0	6.73
5	14641.6	30976	17	801	13697	6151	6151	67	137.0	6.24
5	14641.6	13697	36	401	14356	-228	5923	65	143.6	6.4
5	14641.6	14356	35	401	14035	108	6031	66	140.4	6.46
5	14641.6	14035	39	401	15519	-484	5548	61	310.4	6.74
5	14641.6	15519	32	401	12792	834	6382	70	127.9	6.82
5	14641.6	12792	31	401	12471	95	6477	71	124.7	6.83
5	14641.6	12471	43	161	6987	1568	8045	88	69.9	7.14
6	0	0	NA	NA	30979	0	0	0	0	6.63
6	14602	30979	29	801	23549	2638	2638	29	235.5	6.29
6	14602	23549	53	401	21373	751	3388	37	213.7	6.47
6	14602	21373	49	401	19609	591	3980	44	196.1	6.53
6	14602	19609	41	401	16281	1082	5061	55	162.8	6.72
6	14602	16281	29	401	11509	1503	6564	72	230.2	6.83
6	14602	11509	26	401	10266	367	6931	76	102.7	6.84
6	14602	10266	18	161	2946	2086	9017	99	29.5	7.15

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Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Labortory Research Book												
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	1102	904,795		3.08	3.76	741,037		1.00	0.0	0.0	0.0%	0.0%	0.0%	7.41
5	1116R	500	U	3.07	2.88	532	U	0.00	263.6	263.6	97.2%	36.6%	36.6%	0.01
5	1130R	500	U	3.06	3.34	458	U	0.00	0.0	263.6	0.0%	0.0%	36.6%	0.00
5	1144R	500	U	3.10	3.61	429	U	0.00	0.0	263.7	0.0%	0.0%	36.6%	0.00
5	1158R	500	U	3.11	3.27	476	U	0.00	0.0	263.6	0.0%	0.0%	36.6%	0.01
5	1172R	500	U	3.09	3.32	466	U	0.00	0.0	263.6	0.0%	0.0%	36.6%	0.00
5	1186R	500	U	3.08	3.01	511	U	0.00	0.0	263.6	0.0%	0.0%	36.6%	0.01
5	1200	0	U	3.06	4.34	1	U	0.00	0.1	263.8	0.1%	0.0%	36.7%	0.00
6	1103	886,009		3.07	3.56	765,114		1.00	0.0	0.0	0.0%	0.0%	0.0%	7.65
6	1117	10,434	U	3.06	3.42	9,326	U	0.01	268.3	268.3	96.1%	36.6%	36.6%	0.09
6	1131R	500	U	3.05	3.66	417	U	0.00	3.1	271.4	1.1%	0.4%	37.0%	0.00
6	1145R	500	U	3.10	3.76	412	U		0	271.4	0.0%	0.0%	37.0%	0.00
6	1159R	500	U	3.13	3.28	478	U		0	271.4	0.0%	0.0%	37.0%	0.00
6	1173R	500	U	3.10	3.59	432	U		0	271.4	0.0%	0.0%	37.0%	0.01
6	1187R	500	U	3.09	3.34	464	U	0.00	0.0	271.4	0.0%	0.0%	37.0%	0.00
6	1201	0	U	3.08	4.55	1	U	0.00	0.1	271.5	0.0%	0.0%	37.0%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

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Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4B-R14	For additional comments, RMAL Laboratory Research Book								Exp.	4B-R14	For additional comments, RMAL Laboratory Research Book												Exp.	4B-R14	For additional comments, RMAL Laboratory R			
											MnO4- Calib. Slope:		0.046	STOCK SOLN ABS:	NA	DF:	NA	Conc (p	NA										
											Calibration Date: 5/5/98																			
							Sample Data				KMnO4					pH Data														
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	%Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples												DUPLICATES									DUPLICATES				
1	7/15/98 8:45	0.0	4B-R14-T0-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.05	1104	1,402,048		3.07	3.52	1,223,545		1.5%	1232659.99	12889.92
2	7/15/98 9:15	0.5	4B-R14-T30MIN-2B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.2	1118	1,313,300		3.07	3.16	1,273,302		-5.5%	1240290.19	46685.37
3	7/15/98 10:45	2.0	4B-R14-T2HR-3B	363	TSF Sludg	90.4	10	NA	NA	NA	4792.9	NA	16	201	3296	6.52	1132R	694		3.06	3.01	705		0.0%	704.82	0.00
4	7/15/98 12:45	4.0	4B-R14-T4HR-4B	367	TSF Sludg	91.4	10	NA	NA	NA	4844.7	NA	16	201	3276	6.49	1146R	455	U	3.11	2.99	474	U	0.7%	475.21	2.38
5	7/15/98 14:45	6.0	4B-R14-T6HR-5B	366	TSF Sludg	91.5	10	NA	NA	NA	14641.6	NA	39	401	15479	6.74	1160R	500	U	3.13	3.00	523	U	-9.6%	499.73	33.05
6	7/16/98 7:00	22.2	4B-R14-T20HR-6B	365	TSF Sludg	91.3	10	NA	NA	NA	14602	NA	29	401	11469	6.83	1174R	500	U	3.11	3.03	513	U	-18.8%	472.12	57.29
1	7/16/98 8:45	24.0	4B-R14-T24HR-1B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.07	1188	1,243,627		3.08	3.14	1,220,972		-2.5%	1206048.00	21105.89
2	7/20/98 8:45	120.0	4B-R14-T120HR-2B	360	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.23	1202R	1,482,484		3.04	3.13	1,437,933				
	Extraction of the Remaining Reactor Contents																									
1	7/20/98 8:45	120.0	4B-R14-F1	360	GW Only	0.0					NA	NA	NA	NA	NA	NT	1234	1,013,567		451.5	265	458				
2	7/20/98 8:45	120.0	4B-R14-F2	360	GW Only	0.0					NA	NA	NA	NA	NA	NT	1235	1,036,763		421.2	263	437				
3	7/20/98 8:45	120.0	4B-R14-F3	363	TSF Sludg	90.4					NA	NA	NA	NA	NA	NT	1236R	361,488		419.7	362	152				
4	7/20/98 8:45	120.0	4B-R14-F4	367	TSF Sludg	91.4					NA	NA	NA	NA	NA	NT	1237R	246,876		422.7	368	104				
5	7/20/98 8:45	120.0	4B-R14-F5	366	TSF Sludg	91.5					NA	NA	NA	NA	NA	NT	1238R	0		412.1	377	0				
6	7/20/98 8:45	120.0	4B-R14-F6	365	TSF Sludg	91.3					NA	NA	NA	NA	NA	NT	1239R	0		421.2	370	0				
	Extraction of the Charcoal Beds																									
1	7/20/98 8:45		4B-R14-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1210R	232,770		5.13	0.10	1.1931				
1	7/20/98 8:45		4B-R14-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1211R	0		5.16	0.04	0.0000				
2	7/20/98 8:45		4B-R14-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1212R	31,572		5.02	0.10	0.1585				
2	7/20/98 8:45		4B-R14-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1213R	0		5.16	0.05	0.0000				
3	7/20/98 8:45		4B-R14-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1214R	140,193		5.17	0.10	0.7245				
3	7/20/98 8:45		4B-R14-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1215R	40		5.17	0.04	0.0002				
4	7/20/98 8:45		4B-R14-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1216	1,155		5.18	0.09	0.0060				
4	7/20/98 8:45		4B-R14-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1217R	0		5.16	0.04	0.0000				
5	7/20/98 8:45		4B-R14-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1218R	34,238		5.18	0.10	0.1773				
5	7/20/98 8:45		4B-R14-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1219R	0		5.17	0.04	0.0000				
6	7/20/98 8:45		4B-R14-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1220R	18,288		5.21	0.10	0.0953				
6	7/20/98 8:45		4B-R14-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1221R	0		5.18	0.05	0.0000				

Additional Oxidant Information

Flask	Total MnO4- (mg)	Init Load mg/mL or mg/g	Consumed mg g@t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	3610	8.1	3610	8.1	
4	3649	8.1	3649	8.1	8.14
5	11028	24.6	6588	14.7	
6	10998	24.6	7353	16.5	15.60

Prepared by: S.R. Cline

LastUpdated: 11/1/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R15

For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	10,000	NO	1 & 3

Experiment Start Date: 6/22/98

Comments:
Immediately prior to T=0:
Due to crack in reaction vessel 4b-R15-4, sample transferred to new reaction vessel without stopcock assembly. (stopper only)

SPIKE SOLUTION PREPARATION

6/22/98

Prepared a 10 ppm TCE spiking solution in Tedlar bag using 2460.0 gm of sparged groundwater and and 40.0 mL of saturated TCE spiking solution.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
897	4B-R15-TB-A	6/23/98 7:30	8,816		5.13	4.89	9,245
898	4B-R15-TB-B	6/23/98 7:30	8,763		5.10	4.91	9,114

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
							Sample Data			
Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	vol (mL) aqueous aliquot	Cum Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio
1	6/24/98 8:45	0.0	4B-R15-T0-1A	**363.4**	GW Only	**0.0**	20	20	363.4	NA
1	6/24/98 9:15	0.5	4B-R15-T30MIN-1	363.4	GW Only	0	10	30	343.4	NA
1	6/24/98 10:45	2.0	4B-R15-T2HR-1	363.4	GW Only	0	10	40	333.4	NA
1	6/24/98 12:45	4.0	4B-R15-T4HR-1	363.4	GW Only	0	10	50	323.4	NA
1	6/24/98 14:45	6.0	4B-R15-T6HR-1	363.4	GW Only	0	10	60	313.4	NA
1	6/25/98 7:02	22.3	4B-R15-T20HR-1	363.4	GW Only	0	10	70	303.4	NA
1	6/25/98 8:45	24.0	4B-R15-T24HR-1A	363.4	GW Only	0	20	90	293.4	NA
2	6/24/98 8:45	0.0	4B-R15-T0-2	**359.8**	GW Only	**0.0**	10	10	359.8	NA
2	6/24/98 9:15	0.5	4B-R15-T30MIN-2A	359.8	GW Only	0	20	30	349.8	NA
2	6/24/98 10:45	2.0	4B-R15-T2HR-2	359.8	GW Only	0	10	40	329.8	NA
2	6/24/98 12:45	4.0	4B-R15-T4HR-2	359.8	GW Only	0	10	50	319.8	NA
2	6/24/98 14:45	6.0	4B-R15-T6HR-2	359.8	GW Only	0	10	60	309.8	NA
2	6/25/98 7:02	22.3	4B-R15-T20HR-2	359.8	GW Only	0	10	70	299.8	NA
2	6/25/98 8:45	24.0	4B-R15-T24HR-2	359.8	GW Only	0	10	80	289.8	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.97
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.93
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.05
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.98
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.95
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.96
1	0	0	NA	NA	NA	NA	NA	NA	NA	7.93
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.06
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.06
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.02
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
2	0	0	NA	NA	NA	NA	NA	NA	NA	8

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Fla	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
1	899	10,082		3.07	3.92	7,888		NA	NA	NA	NA	NA	NA	0.16
1	906	9,007		3.00	3.73	7,246		NA	NA	NA	NA	NA	NA	0.07
1	913	9,003		3.04	3.72	7,360		NA	NA	NA	NA	NA	NA	0.07
1	920	8,749		3.00	3.54	7,413		NA	NA	NA	NA	NA	NA	0.07
1	927	8,804		3.05	3.38	7,939		NA	NA	NA	NA	NA	NA	0.08
1	934	7,773		3.07	3.22	7,412		NA	NA	NA	NA	NA	NA	0.07
1	941	7,730		3.08	3.27	7,275		NA	NA	NA	NA	NA	NA	0.15
2	900	10,039		3.03	3.90	7,795		NA	NA	NA	NA	NA	NA	0.08
2	907	9,284		3.07	3.93	7,257		NA	NA	NA	NA	NA	NA	0.15
2	914	8,928		3.03	3.65	7,414		NA	NA	NA	NA	NA	NA	0.07
2	921	8,562		3.05	3.55	7,371		NA	NA	NA	NA	NA	NA	0.07
2	928	8,919		3.04	3.56	7,615		NA	NA	NA	NA	NA	NA	0.08
2	935	8,206		3.08	3.46	7,314		NA	NA	NA	NA	NA	NA	0.07
2	942	8,666		3.03	3.58	7,334		NA	NA	NA	NA	NA	NA	0.07

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
							Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	6/24/98 8:45	0.0	4B-R15-T0-3	**370.4**	TSF Sludg	**91.9**	10	10	370.4	4.0
3	6/24/98 9:15	0.5	4B-R15-T30MIN-3	370.4	TSF Sludg	91.9	10	20	360.4	3.9
3	6/24/98 10:45	2.0	4B-R15-T2HR-3A	370.4	TSF Sludg	91.9	20	40	350.4	3.8
3	6/24/98 12:45	4.0	4B-R15-T4HR-3	370.4	TSF Sludg	91.9	10	50	330.4	3.6
3	6/24/98 14:45	6.0	4B-R15-T0-1A	370.4	TSF Sludg	91.9	10	60	320.4	3.5
3	6/25/98 7:02	22.3	4B-R15-T20HR-3	370.4	TSF Sludg	91.9	10	70	310.4	3.4
3	6/25/98 8:45	24.0	4B-R15-T24HR-3	370.4	TSF Sludg	91.9	10	80	300.4	3.3
4	6/24/98 8:45	0.0	4B-R15-T0-4	**365.2**	TSF Sludg	**91.2**	10	10	365.2	4.0
4	6/24/98 9:15	0.5	4B-R15-T30MIN-4	365.2	TSF Sludg	91.2	10	20	355.2	3.9
4	6/24/98 10:45	2.0	4B-R15-T2HR-4	365.2	TSF Sludg	91.2	10	30	345.2	3.8
4	6/24/98 12:45	4.0	4B-R15-T4HR-4A	365.2	TSF Sludg	91.2	20	50	335.2	3.7
4	6/24/98 14:45	6.0	4B-R15-T6HR-4	365.2	TSF Sludg	91.2	10	60	315.2	3.5
4	6/25/98 7:02	22.3	4B-R15-T20HR-4	365.2	TSF Sludg	91.2	10	70	305.2	3.3
4	6/25/98 8:45	24.0	4B-R15-T24HR-4	365.2	TSF Sludg	91.2	10	80	295.2	3.2

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
	KMnO4	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Added	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	(mg)	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
3	0	0	NA	NA	10219	0	0	0	0	6.6
3	**4890**	10219	17.9	401	7178	1096	1096	12	71.8	6.84
3	4890	7178	22.3	201	4482	945	2041	22	89.6	7.06
3	4890	4482	15.9	201	3196	425	2466	27	32.0	7.12
3	4890	3196	23.3	101	2353	270	2736	30	23.5	7.14
3	4890	2353	35.2	9	317	632	3368	37	3.2	7.24
3	4890	317	48.1	4	192	37	3405	37	1.9	7.4
4	0	0	NA	NA	10220	0	0	0	0	6.67
4	**4820**	10220	7.0	401	2807	2633	2633	29	28.1	6.94
4	4820	2807	15.8	201	3176	-127	2506	27	31.8	7.13
4	4820	3176	13.5	201	2714	155	2661	29	54.3	7.21
4	4820	2714	27.4	101	2767	-17	2644	29	27.7	7.24
4	4820	2767	13.0	81	1053	523	3167	35	10.5	7.3
4	4820	1053	22.6	41	927	37	3204	35	9.3	7.39

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Fla	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
3	901R	5,303		3.03	3.45	4,663		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.05
3	908	16		3.05	3.77	13		0.00	1.7	1.7	97.0%	57.7%	57.7%	0.00
3	915	7		3.06	3.82	5		0.00	0.0	1.7	0.2%	0.1%	57.8%	0.00
3	922	10		3.08	3.39	9		0.00	0.0	1.7	-0.1%	0.0%	57.8%	0.00
3	929	6	U	3.07	3.63	5	U	0.00	0.0	1.7	0.1%	0.0%	57.8%	0.00
3	936	6		3.08	3.87	5		0.00	0.0	1.7	0.0%	0.0%	57.8%	0.00
3	943	9		3.04	3.34	8		0.00	0.0	1.7	-0.1%	0.0%	57.8%	0.00
4	902R	4,752		3.06	3.75	3,880		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.04
4	909	11		3.06	4.16	8		0.00	1.4	1.4	97.1%	48.0%	48.0%	0.00
4	916	0		3.07	3.86	1		0.00	0.0	1.4	0.2%	0.1%	48.1%	0.00
4	923	5	U	3.08	2.87	6	U	[illegible]	[illegible]	1.4	-0.1%	-0.1%	48.1%	0.00
4	930	0		3.05	3.87	1		[illegible]	[illegible]	1.4	0.1%	0.1%	48.1%	0.00
4	937	0		3.08	3.37	1		[illegible]	[illegible]	1.4	0.0%	0.0%	48.1%	0.00
4	944	6	U	3.07	3.71	5	U	0.00	0.0	1.4	-0.1%	0.0%	48.1%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	6/24/98 8:45	0.0	4B-R15-T0-5	**365.9**	TSF Sludg	**91.6**	10	10	365.9	4.0
5	6/24/98 9:15	0.5	4B-R15-T30MIN-5	365.9	TSF Sludg	91.6	10	20	355.9	3.9
5	6/24/98 10:45	2.0	4B-R15-T2HR-5	365.9	TSF Sludg	91.6	10	30	345.9	3.8
5	6/24/98 12:45	4.0	4B-R15-T4HR-5	365.9	TSF Sludg	91.6	10	40	335.9	3.7
5	6/24/98 14:45	6.0	4B-R15-T6HR-5A	365.9	TSF Sludg	91.6	20	60	325.9	3.6
5	6/25/98 7:02	22.3	4B-R15-T20HR-5	365.9	TSF Sludg	91.6	10	70	305.9	3.3
5	6/25/98 8:45	24.0	4B-R15-T24HR-5	365.9	TSF Sludg	91.6	10	80	295.9	3.2
6	6/24/98 8:45	0.0	4B-R15-T0-6	**370.1**	TSF Sludg	**91.8**	10	10	370.1	4.0
6	6/24/98 9:15	0.5	4B-R15-T30MIN-6	370.1	TSF Sludg	91.8	10	20	360.1	3.9
6	6/24/98 10:45	2.0	4B-R15-T2HR-6	370.1	TSF Sludg	91.8	10	30	350.1	3.8
6	6/24/98 12:45	4.0	4B-R15-T4HR-6	370.1	TSF Sludg	91.8	10	40	340.1	3.7
6	6/24/98 14:45	6.0	4B-R15-T6HR-6	370.1	TSF Sludg	91.8	10	50	330.1	3.6
6	6/25/98 7:02	22.3	4B-R15-T20HR-6A	370.1	TSF Sludg	91.8	20	70	320.1	3.5
6	6/25/98 8:45	24.0	4B-R15-T24HR-6	370.1	TSF Sludg	91.8	10	80	300.1	3.3
						91.8				

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:		NA	DF:	NA	Conc (ppm):	NA
	Calibration Date: 5/5/98									
	MnO4- Data									pH Dat
Reactor No.	KMnO4 Added (mg)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
5	0	0	NA	NA	30982	0	0	0	0	6.55
5	**14640**	30982	19.1	801	15299	5581	5581	61	153.0	7
5	14640	15299	37.0	401	14837	160	5741	63	148.4	7.21
5	14640	14837	33.8	401	13554	431	6172	67	135.5	7.28
5	14640	13554	30.8	401	12351	392	6564	72	247.0	7.33
5	14640	12351	31.7	401	12712	-110	6454	70	127.1	7.49
5	14640	12712	31.2	401	12511	59	6513	71	125.1	7.62
6	0	0	NA	NA	30955	0	0	0	0	6.56
6	**14800**	30955	19.0	801	15219	5666	5666	62	152.2	7
6	14800	15219	38.9	401	15599	-133	5533	60	156.0	7.22
6	14800	15599	39.3	401	15759	-55	5479	60	157.6	7.22
6	14800	15759	40.0	401	16040	-93	5386	59	160.4	7.27
6	14800	16040	37.3	401	14957	347	5733	62	299.1	7.4
6	14800	14957	37.3	401	14957	0	5733	62	149.6	7.56

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R15	For additional comments, RMAL Labortory Research Book											
	ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Fla	Aq.	mg TCE	Cum.	% of Init A	% of Total	Cum %	mg TCE
Reactor	GC #	Conc.		Volume	Volume	Conc.		C/Co	Oxidized	mg TCE	TCE Oxidi	TCE Oxidi	Total TCE	in Aliquot
No.		(ppb)		(mL)	(mL)	(ppb)			in Interval	Oxidized	In Interval	In Interval	Oxidized	
5	903R	5,014		3.07	3.75	4,103		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.04
5	910	0		3.09	4.33	1		0.00	1.5	1.5	97.2%	50.9%	50.9%	0.00
5	917	0		3.07	4.07	1				1.5	0.0%	0.0%	50.9%	0.00
5	924	5	U	3.10	3.80	4	U			1.5	-0.1%	0.0%	50.8%	0.00
5	931	0		3.08	3.81	1		0.00	0.0	1.5	0.1%	0.0%	50.9%	0.00
5	938	0		3.08	3.43	1		0.00	0.0	1.5	0.0%	0.0%	50.9%	0.00
5	945	0		3.11	3.76	1		0.00	0.0	1.5	0.0%	0.0%	50.9%	0.00
6	904R	4,495		3.08	3.35	4,130		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.04
6	911	0		3.09	4.02	1		0.00	1.5	1.5	97.3%	51.2%	51.2%	0.00
6	918	0		3.07	4.04	1		0.00	0.0	1.5	0.0%	0.0%	51.2%	0.00
6	925	0		3.09	3.85	1		0.00	0.0	1.5	0.0%	0.0%	51.2%	0.00
6	932	0		3.06	3.90	1		0.00	0.0	1.5	0.0%	0.0%	51.2%	0.00
6	939	0		3.09	3.50	1		0.00	0.0	1.5	0.0%	0.0%	51.2%	0.00
6	946	0		3.13	3.98	1		0.00	0.0	1.5	0.0%	0.0%	51.2%	0.00

Steven Robert Cline:
ND, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R15	For additional comments, RMAL Laboratory Research Book								MnO4- Calb. Slope:		0.046	STOCK SOLN ABS:	NA	DF:	NA	Conc (ppm):	NA							
											Calibration Date: 5/5/98															
							Sample Data				MnO4 Data							pH Data								
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual	KMnO4	Initial	Aliquot	Final	Final		ORNL	Extract	Flag	Hexane	Aqueous	Aqueous	Flag	%Diff	AVG	STDEV
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S	Added	MnO4-	MnO4-	Spec	MnO4-	pH	GC #	Conc.		Volume	Volume	Conc.			(ppb)	(ppb)
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio	(mg)	(mg/L)	(mg/L)	DF	(mg/L)			(ppb)		(mL)	(mL)	(ppb)				
	Duplicate VOC Samples												DUPLICATES									DUPLICATES				
1	6/24/98 8:45	0.0	4B-R15-T0-1B	363.4	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.98	905	7,661		3.05	2.96	7,911		-0.3%	7899.34	16.47
2	6/24/98 9:15	0.5	4B-R15-T30MIN-2B	359.8	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	8.06	912	9,165		3.09	3.83	7,398		-1.9%	7327.91	99.70
3	6/24/98 10:45	2.0	4B-R15-T2HR-3B	370.4	TSF Sludg	91.9	10	NA	NA	NA	4890	NA	22.4	201	4502	7.03	919	6		3.06	3.46	6		-8.3%	5.52	0.31
4	6/24/98 12:45	4.0	4B-R15-T4HR-4B	365.2	TSF Sludg	91.2	10	NA	NA	NA	4820	NA	13.6	201	2734	7.22	926	6	U	3.10	3.15	6	U	2.2%	5.69	0.09
5	6/24/98 14:45	6.0	4B-R15-T6HR-5B	365.9	TSF Sludg	91.6	10	NA	NA	NA	14640	NA	30.9	401	12391	7.32	933	0		3.07	2.99	1		0.0%	1.00	0.00
6	6/25/98 7:02	22.3	4B-R15-T20HR-6B	370.1	TSF Sludg	91.8	10	NA	NA	NA	14800	NA	37.2	401	14917	7.4	940	0		3.09	3.16	1		0.0%	1.00	0.00
1	6/25/98 8:45	24.0	4B-R15-T24HR-1B	363.4	GW Only	0	10	NA	NA	NA	0	NA	NA	NA	NA	7.92	947	7,376		3.10	3.16	7,240		0.5%	7257.86	24.56
	Extraction of the Remaining Reactor Contents																									
1																						soil&gw TCE (mg)				
2																						mass (g)				
3	6/25/98 8:45	24.0	4B-R15-F3	370.4	TSF Sludg	91.9					NA	NA	NA	NA	NA	NT	958	2,104		438.8	376.2	(sludge&GW) 0.9230				
4	6/25/98 8:45	24.0	4B-R15-F4	365.2	TSF Sludg	91.2					NA	NA	NA	NA	NA	NT	959	379		432.6	361.2	0.1641				
5	6/25/98 8:45	24.0	4B-R15-F5	365.9	TSF Sludg	91.6					NA	NA	NA	NA	NA	NT	960	100	U	425.2	379	0.0425	U			
6	6/25/98 8:45	24.0	4B-R15-F6	370.1	TSF Sludg	91.8					NA	NA	NA	NA	NA	NT	961	100	U	410.2	382.7	0.0410	U			
	Extraction of the Charcoal Beds																					carbon TCE (mg)				
1	6/25/98 8:45		4B-R15-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	948	21		5.12	0.09	0.0001				
1	6/25/98 8:45		4B-R15-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	949	0		5.15	0.05	0.0000				
2	6/25/98 8:45		4B-R15-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	950	15		5.18	0.10	0.0001				
2	6/25/98 8:45		4B-R15-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	951	0		5.19	0.04	0.0000				
3	6/25/98 8:45		4B-R15-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	952	0		5.18	0.09	0.0000				
3	6/25/98 8:45		4B-R15-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	953	0		5.17	0.04	0.0000				
4	NA		4B-R15-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	NO SAMPLE					NA				
4	NA		4B-R15-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	NO SAMPLE					NA				
5	6/25/98 8:45		4B-R15-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	954	0		5.18	0.09	0.0000				
5	6/25/98 8:45		4B-R15-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	955	0		5.17	0.05	0.0000				
6	6/25/98 8:45		4B-R15-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	956	0		5.16	0.10	0.0000				
6	6/25/98 8:45		4B-R15-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	957	0		5.16	0.04	0.0000				

Steven Robert Cline
ND, BUT ENTERED AS 1 PPB
FOR PLOTTING LOG SCALE

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	3683	8.1	3614	8.0	
4	3630	8.1	3301	7.4	7.69
5	11026	24.6	6574	14.7	
6	11147	24.7	5761	12.7	13.72

Prepared by: S.R. Cline

LastUpdated: 11/3/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Experiment: 4b-R16 For additional comments, RMAL Labortory Research Book

Solid Media	Initial TCE (ppb)	Co-Contaminant?	MnO4- Concs. (%)
Sludge	100,000	NO	.01&.1

Experiment Start Date: 7/6/98

Comments:

SPIKE SOLUTION PREPARATION

7/6/98

Prepared a 100 ppm TCE spiking solution in Tedlar bag using 2100gm of sparged groundwater and 400mL of saturated (1100 ppm) TCE solution. Placed bag in incubator set at 12 C.

Analysis of spiking solution prepared on 7-6-98 found 80ppm TCE. 25uL of pure-phase TCE added to solution. Placed bag in incubator set at 12 C.

GC Analysis of Spike Solution

ORNL GC #	Sample Name	Sample Time	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)
962	4B-R16-TB-A	7/8/98 7:40	90,127		5.10	5.00	91,984
963	4B-R16-TB-B	7/8/98 7:40	85,604		5.10	4.91	88,981

Prepared by: S.R. Cline

LastUpdated: 10/22/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
1	7/9/98 8:45	0.0	4B-R16-T0-1A	**364**	GW Only	**0.0**	20	20	364.0	NA
1	7/9/98 9:15	0.5	4B-R16-T30MIN-1	364	GW Only	0	10	30	344.0	NA
1	7/9/98 10:45	2.0	4B-R16-T2HR-1	364	GW Only	0	10	40	334.0	NA
1	7/9/98 12:45	4.0	4B-R16-T4HR-1	364	GW Only	0	10	50	324.0	NA
1	7/9/98 14:45	6.0	4B-R16-T6HR-1	364	GW Only	0	10	60	314.0	NA
1	7/10/98 6:55	22.2	4B-R16-T20HR-1	364	GW Only	0	10	70	304.0	NA
1	7/10/98 8:45	24.0	4B-R16-T24HR-1A	364	GW Only	0	20	90	294.0	NA
2	7/9/98 8:45	0.0	4B-R16-T0-2	**362**	GW Only	**0.0**	10	10	362.0	NA
2	7/9/98 9:15	0.5	4B-R16-T30MIN-2A	362	GW Only	0	20	30	352.0	NA
2	7/9/98 10:45	2.0	4B-R16-T2HR-2	362	GW Only	0	10	40	332.0	NA
2	7/9/98 12:45	4.0	4B-R16-T4HR-2	362	GW Only	0	10	50	322.0	NA
2	7/9/98 14:45	6.0	4B-R16-T6HR-2	362	GW Only	0	10	60	312.0	NA
2	7/10/98 6:55	22.2	4B-R16-T20HR-2	362	GW Only	0	10	70	302.0	NA
2	7/10/98 8:45	24.0	4B-R16-T24HR-2	362	GW Only	0	10	80	292.0	NA

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCKConc.(ppm):		49.6	DF:	800	Conc (ppm):	39680
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock MnC	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (mL	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
1	0	0	NA	NA	NA	NA	NA	NA	NA	8
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.01
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.03
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.07
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.04
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.03
1	0	0	NA	NA	NA	NA	NA	NA	NA	8.04
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.09
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.09
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.1
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.14
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.11
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.12
2	0	0	NA	NA	NA	NA	NA	NA	NA	8.12

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Fla	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
1	964	71,894		3.02	2.98	72,767		NA	NA	NA	NA	NA	NA	1.46
1	971	67,402		3.06	3.43	60,083		NA	NA	NA	NA	NA	NA	0.60
1	978	70,194		3.09	3.45	62,850		NA	NA	NA	NA	NA	NA	0.63
1	985	73,547		3.05	3.71	60,430		NA	NA	NA	NA	NA	NA	0.60
1	992	65,697		3.10	3.43	59,388		NA	NA	NA	NA	NA	NA	0.59
1	999	69,739		3.09	3.71	58,016		NA	NA	NA	NA	NA	NA	0.58
1	1006	64,626		3.08	3.49	56,963		NA	NA	NA	NA	NA	NA	1.14
2	965	78,313		3.04	3.39	70,214		NA	NA	NA	NA	NA	NA	0.70
2	972	75,981		3.05	3.59	64,610		NA	NA	NA	NA	NA	NA	1.29
2	979	68,810		3.09	3.33	63,920		NA	NA	NA	NA	NA	NA	0.64
2	986	68,911		3.06	3.44	61,286		NA	NA	NA	NA	NA	NA	0.61
2	993	70,226		3.07	3.02	71,452		NA	NA	NA	NA	NA	NA	0.71
2	1000	73,708		3.05	3.43	65,452		NA	NA	NA	NA	NA	NA	0.65
2	1007	51,683		3.06	2.79	56,772		NA	NA	NA	NA	NA	NA	0.57

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
3	7/9/98 8:45	0.0	4B-R16-T0-3	**365**	TSF Sludg	**92.0**	10	10	365.0	4.0
3	7/9/98 9:15	0.5	4B-R16-T30MIN-3	365	TSF Sludg	92	10	20	355.9	3.9
3	7/9/98 10:45	2.0	4B-R16-T2HR-3A	365	TSF Sludg	92	20	40	345.9	3.8
3	7/9/98 12:45	4.0	4B-R16-T4HR-3	365	TSF Sludg	92	10	50	325.9	3.5
3	7/9/98 14:45	6.0	4B-R16-T0-1A	365	TSF Sludg	92	10	60	315.9	3.4
3	7/10/98 6:55	22.2	4B-R16-T20HR-3	365	TSF Sludg	92	10	70	305.9	3.3
3	7/10/98 8:45	24.0	4B-R16-T24HR-3	365	TSF Sludg	92	10	80	295.9	3.2
4	7/9/98 8:45	0.0	4B-R16-T0-4	**366**	TSF Sludg	**91.5**	10	10	366.0	4.0
4	7/9/98 9:15	0.5	4B-R16-T30MIN-4	366	TSF Sludg	91.5	10	20	356.9	3.9
4	7/9/98 10:45	2.0	4B-R16-T2HR-4	366	TSF Sludg	91.5	10	30	346.9	3.8
4	7/9/98 12:45	4.0	4B-R16-T4HR-4A	366	TSF Sludg	91.5	20	50	336.9	3.7
4	7/9/98 14:45	6.0	4B-R16-T6HR-4	366	TSF Sludg	91.5	10	60	316.9	3.5
4	7/10/98 6:55	22.2	4B-R16-T20HR-4	366	TSF Sludg	91.5	10	70	306.9	3.4
4	7/10/98 8:45	24.0	4B-R16-T24HR-4	366	TSF Sludg	91.5	10	80	296.9	3.2

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCKConc.(ppm):		49.6	DF:	800	Conc (ppm):	39680
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
Reactor No.	Volume Stock MnO Added (mL	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	mg MnO4 Consumed in Interval	Cum. mg MnO4 Consumed	Cum mg MnO4 per gram	mg MnO4- in Aliquot	pH
3	0	0	NA	NA	101.8	0.0	0.0	0.0	0	6.56
3	0.913	101.8	1.31	1	1.3	35.8	35.8	0.4	0.0	6.6
3	0.913	1.3	1.52	1	1.5	-0.1	35.7	0.4	0.0	6.61
3	0.913	1.5	1.81	1	1.8	-0.1	35.6	0.4	0.0	6.59
3	0.913	1.8	1.91	1	1.9	0.0	35.6	0.4	0.0	6.6
3	0.913	1.9	2.52	1	2.5	-0.2	35.4	0.4	0.0	6.62
3	0.913	2.5	2.63	1	2.6	0.0	35.3	0.4	0.0	6.63
4	0	0	NA	NA	101.7	0.0	0.0	0.0	0	6.53
4	0.915	101.7	1.80	1	1.8	35.7	35.7	0.4	0.0	6.63
4	0.915	1.8	2.14	1	2.1	-0.1	35.5	0.4	0.0	6.65
4	0.915	2.1	2.20	1	2.2	0.0	35.5	0.4	0.0	6.62
4	0.915	2.2	2.36	1	2.4	-0.1	35.5	0.4	0.0	6.63
4	0.915	2.4	3.06	1	3.1	-0.2	35.3	0.4	0.0	6.63
4	0.915	3.1	3.26	1	3.3	-0.1	35.2	0.4	0.0	6.64

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Fla	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
3	966	59,709		3.06	3.57	51,189		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.51
3	973R	54,657		3.07	3.27	51,321		1.00	0.0	0.0	-0.3%	-0.2%	-0.2%	0.51
3	980R	51,558		3.08	3.12	50,942		1.00	0.1	0.1	0.7%	0.5%	0.3%	1.02
3	987R	57,811		3.08	3.56	49,941		0.98	0.3	0.4	1.7%	1.3%	1.6%	0.50
3	994R	56,651		3.08	3.41	51,149		1.00	-0.4	0.0	-2.0%	-1.5%	0.1%	0.51
3	1001R	55,055		3.04	3.26	51,422		1.00	-0.1	-0.1	-0.4%	-0.3%	-0.2%	0.51
3	1008R	55,704		3.07	3.45	49,617		0.97	0.5	0.5	2.9%	2.0%	1.8%	0.50
4	967	50,595		3.06	3.42	45,270		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.45
4	974R	50,987		3.07	3.65	42,876		0.95	0.9	0.9	5.2%	3.3%	3.3%	0.43
4	981R	50,897		3.09	3.41	46,166		1.02	-1.1	-0.3	-6.9%	-4.4%	-1.1%	0.46
4	988R	45,824		3.08	2.96	47,782		1.06	-0.5	-0.8	-3.3%	-2.1%	-3.2%	0.96
4	995R	39,910	E	3.09	3.61	34,083	E	0.75	4.3	3.5	26.2%	16.6%	13.4%	0.34
4	1002R	52,181		3.06	3.25	49,218		1.09	-4.6	-1.1	-28.0%	-17.8%	-4.3%	0.49
4	1009R	53,564		3.07	3.38	48,628		1.07	0.2	-1.0	1.1%	0.7%	-3.7%	0.49

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	[redacted]						Sample Data			
		RXN		Volume		Solid	vol (mL)	Cum	Actual	Actual
Reactor	Sample	Time	Sample	GW Used	Media	Mass	aqueous	Aliquot	Vol at	L/S
No.	Time	(hrs)	Name	(mL)	Type	(grams)	aliquot	Vol (mL)	Sampling	Ratio
5	7/9/98 8:45	0.0	4B-R16-T0-5	**366**	TSF Sludg	**91.2**	10	10	366.0	4.0
5	7/9/98 9:15	0.5	4B-R16-T30MIN-5	366	TSF Sludg	91.2	10	20	365.2	4.0
5	7/9/98 10:45	2.0	4B-R16-T2HR-5	366	TSF Sludg	91.2	10	30	355.2	3.9
5	7/9/98 12:45	4.0	4B-R16-T4HR-5	366	TSF Sludg	91.2	10	40	345.2	3.8
5	7/9/98 14:45	6.0	4B-R16-T6HR-5A	366	TSF Sludg	91.2	20	60	335.2	3.7
5	7/10/98 6:55	22.2	4B-R16-T20HR-5	366	TSF Sludg	91.2	10	70	315.2	3.5
5	7/10/98 8:45	24.0	4B-R16-T24HR-5	366	TSF Sludg	91.2	10	80	305.2	3.3
6	7/9/98 8:45	0.0	4B-R16-T0-6	**360**	TSF Sludg	**90.1**	10	10	360.0	4.0
6	7/9/98 9:15	0.5	4B-R16-T30MIN-6	360	TSF Sludg	90.1	10	20	359.0	4.0
6	7/9/98 10:45	2.0	4B-R16-T2HR-6	360	TSF Sludg	90.1	10	30	349.0	3.9
6	7/9/98 12:45	4.0	4B-R16-T4HR-6	360	TSF Sludg	90.1	10	40	339.0	3.8
6	7/9/98 14:45	6.0	4B-R16-T6HR-6	360	TSF Sludg	90.1	10	50	329.0	3.7
6	7/10/98 6:55	22.2	4B-R16-T20HR-6A	360	TSF Sludg	90.1	20	70	319.0	3.5
6	7/10/98 8:45	24.0	4B-R16-T24HR-6	360	TSF Sludg	90.1	10	80	299.0	3.3

Prepared by: S.R. Cline

LastUpdated: 10/23/98

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book							
	MnO4- Calb. Slope:		0.046	STOCKConc.(ppm):		49.6	DF:	800	Conc (ppm):	39680
	Calibration Date: 5/5/98									
	MnO4- Data									pH Data
	Volume	Initial	Aliquot	Final	Final	mg MnO4	Cum.	Cum	mg MnO4-	
Reactor	Stock MnO	MnO4-	MnO4-	Spec	MnO4-	Consumed	mg MnO4	mg MnO4	in Aliquot	pH
No.	Added (mL	(mg/L)	(mg/L)	DF	(mg/L)	in Interval	Consumed	per gram		
5	0	0	NA	NA	994.3	0.0	0.0	0.0	0	6.57
5	9.15	994.3	0.3	1	0.3	363.0	363.0	4.0	0.0	6.74
5	9.15	0.3	0.5	1	0.5	-0.1	362.9	4.0	0.0	6.82
5	9.15	0.5	0.6	1	0.6	0.0	362.8	4.0	0.0	6.87
5	9.15	0.6	0.8	1	0.8	-0.1	362.8	4.0	0.0	6.87
5	9.15	0.8	1.7	1	1.7	-0.3	362.5	4.0	0.0	6.9
5	9.15	1.7	2.0	1	2.0	-0.1	362.4	4.0	0.0	6.9
6	0	0	NA	NA	994.76	0.0	0.0	0.0	0	6.53
6	9	994.8	0.6	1	0.6	356.9	356.9	4.0	0.0	6.72
6	9	0.6	1.0	1	1.0	-0.1	356.8	4.0	0.0	6.79
6	9	1.0	1.1	1	1.1	0.0	356.7	4.0	0.0	6.84
6	9	1.1	1.3	1	1.3	-0.1	356.7	4.0	0.0	6.86
6	9	1.3	2.1	1	2.1	-0.3	356.4	4.0	0.0	6.91
6	9	2.1	2.4	1	2.4	-0.1	356.3	4.0	0.0	6.88

Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

	Exp.	4b-R16	For additional comments, RMAL Labortory Research Book											
Reactor No.	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Fla	Aq. C/Co	mg TCE Oxidized in Interval	Cum. mg TCE Oxidized	% of Init A TCE Oxidi In Interval	% of Total TCE Oxidi In Interval	Cum % Total TCE Oxidized	mg TCE in Aliquot
5	968	56,462		3.07	3.68	47,092		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.47
5	975R	35,776		3.06	3.54	30,962		0.66	5.9	5.9	34.2%	22.5%	22.5%	0.31
5	982R	33,913		3.08	3.24	32,217		0.68	-0.4	5.4	-2.6%	-1.7%	20.8%	0.32
5	989R	38,101		3.09	3.49	33,689		0.72	-0.5	4.9	-2.9%	-1.9%	18.9%	0.34
5	996R	36,597		3.09	3.15	35,900		0.76	-0.7	4.2	-4.3%	-2.8%	16.0%	0.72
5	1003R	41,548		3.05	3.42	37,053		0.79	-0.4	3.8	-2.1%	-1.4%	14.6%	0.37
5	1010R	39,443		3.08	3.37	36,106		0.77	0.3	4.1	1.7%	1.1%	15.7%	0.36
6	969	54,332		3.07	3.60	46,311		1.00	0.0	0.0	0.0%	0.0%	0.0%	0.46
6	976R	41,184		3.08	3.70	34,236		0.74	4.3	4.3	26.0%	16.8%	16.8%	0.34
6	983R	38,406		3.09	3.79	31,266		0.68	1.0	5.4	6.2%	4.0%	20.9%	0.31
6	990R	42,635		3.10	3.51	37,618		0.81	-2.2	3.2	-12.9%	-8.4%	12.5%	0.38
6	997R	40,482		3.10	3.09	40,541		0.88	-1.0	2.3	-5.8%	-3.7%	8.8%	0.41
6	1004R	40,948		3.07	3.00	41,816		0.90	-0.4	1.8	-2.4%	-1.6%	7.2%	0.84
6	1011R	49,028		3.09	3.55	42,625		0.92	-0.2	1.6	-1.5%	-0.9%	6.2%	0.43

Prepared by: S.R. Cline

LastUpdated: 10/23/98

Exp. 4b-R16 For additional comments, RMAL Labortory Research Book

MnO4- Calib. Slope: 0.046 STOCKConc (ppm): 49.6 DF: 800 Conc (ppm): 39680

Calibration Date: 5/5/98

Reactor No.	Sample Time	RXN Time (hrs)	Sample Name	Volume GW Used (mL)	Media Type	Solid Mass (grams)	Sample Data: vol (mL) aqueous aliquot	Curn Aliquot Vol (mL)	Actual Vol at Sampling	Actual L/S Ratio	Stock Mn Volume Added (mL)	Initial MnO4- (mg/L)	Aliquot MnO4- (mg/L)	Final Spec DF	Final MnO4- (mg/L)	pH	ORNL GC #	Extract Conc. (ppb)	Flag	Hexane Volume (mL)	Aqueous Volume (mL)	Aqueous Conc. (ppb)	Flag	% Diff	AVG (ppb)	STDEV (ppb)
	Duplicate VOC Samples																									
1	7/9/98 8:45	0.0	4B-R16-T0-1B	364	GW Only	0	10	NA		NA	0	NA	NA	NA	NA	8.01	970	81,690		3.05	3.61	69,148		5.0%	70957.49	2558.65
2	7/9/98 9:15	0.5	4B-R16-T30MIN-2B	362	GW Only	0	10	NA		NA	0	NA	NA	NA	NA	8.09	977	65,326		3.08	3.05	65,845		-1.9%	65227.51	873.24
3	7/9/98 10:45	2.0	4B-R16-T2HR-3B	365	TSF Sludg	92.0	10	NA		NA	0.913	NA	1.5	1	1.5	6.62	984R	48,393		3.09	3.06	48,826		4.2%	49884.02	1496.46
4	7/9/98 12:45	4.0	4B-R16-T4HR-4B	366	TSF Sludg	91.5	10	NA		NA	0.915	NA	2.2	1	2.2	6.62	991	36,157	E	3.10	3.22	34,825	E	27.1%	41303.33	9161.75
5	7/9/98 14:45	6.0	4B-R16-T6HR-5B	366	TSF Sludg	91.2	10	NA		NA	9.15	NA	0.8	1	0.8	6.88	998R	35,543		3.09	3.19	34,465		4.0%	35182.61	1014.21
6	7/10/98 6:55	22.2	4B-R16-T20HR-6B	360	TSF Sludg	90.1	10	NA		NA	9	NA	2.2	1	2.2	6.91	1005R	46,641		3.07	3.46	41,400		1.0%	41608.03	293.69
1	7/10/98 8:45	24.0	4B-R16-T24HR-1	364	GW Only	0	10	NA		NA	0	NA	NA	NA	NA	8.04	1012	58,799		3.07	2.97	60,965		-7.0%	58963.98	2830.38
	Extraction of the Remaining Reactor Contents																				soil gw (g)	TCE (mg)				
1																										
2																										
3	7/10/98 8:45	24.0	4B-R16-F3	365	TSF Sludg	92					NA	NA	NA	NA	NA	NT	1025R	50,572		412.879	368	20.8800				
4	7/10/98 8:45	24.0	4B-R16-F4	366	TSF Sludg	91.3					NA	NA	NA	NA	NA	NT	1026R	45,850		442.273	370.6	20.2782				
5	7/10/98 8:45	24.0	4B-R16-F5	366	TSF Sludg	91.2					NA	NA	NA	NA	NA	NT	1027R	40,903		417.576	378.9	17.0801				
6	7/10/98 8:45	24.0	4B-R16-F6	360	TSF Sludg	90.1					NA	NA	NA	NA	NA	NT	1028R	46,497		415.909	370.9	19.3386				
	Extraction of the Charcoal Beds																				carbon (g)	TCE (mg)				
1	7/10/98 8:45		4B-R16-CHAR-1A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1013	224		5.08	0.10	0.0011				
1	7/10/98 8:45		4B-R16-CHAR-1B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1014	0		5.15	0.04	0.0000				
2	7/10/98 8:45		4B-R16-CHAR-2A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1015	161		5.19	0.10	0.0008				
2	7/10/98 8:45		4B-R16-CHAR-2B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1016	0		5.21	0.04	0.0000				
3	7/10/98 8:45		4B-R16-CHAR-3A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1017	0		5.20	0.10	0.0000				
3	7/10/98 8:45		4B-R16-CHAR-3B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1018	0		5.20	0.04	0.0000				
4	7/10/98 8:45		4B-R16-CHAR-4A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1019	226		5.20	0.10	0.0012				
4	7/10/98 8:45		4B-R16-CHAR-4B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1020	0		5.24	0.05	0.0000				
5	7/10/98 8:45		4B-R16-CHAR-5A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1021	846		5.19	0.10	0.0044				
5	7/10/98 8:45		4B-R16-CHAR-5B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1022	0		5.19	0.06	0.0000				
6	7/10/98 8:45		4B-R16-CHAR-6A		Charcoal	NA					NA	NA	NA	NA	NA	NT	1023	384		5.19	0.10	0.0020				
6	7/10/98 8:45		4B-R16-CHAR-6B		Charcoal	NA					NA	NA	NA	NA	NA	NT	1024	0		5.18	0.05	0.0000				

Additional Oxidant Information

Flask	Initial MnO4- (mg)	Init Load mg/mL or	Consumed mg @t=24 hrs	Consumed mg/mL or mg/g	AVG (mg/g)
1	0.0	0.000	NA	NA	NA
2	0.0	0.000	NA	NA	NA
3	36.2	0.08	35.3	0.08	
4	36.3	0.08	35.1	0.08	0.08
5	363.1	0.80	362.4	0.79	
6	357.1	0.80	356.3	0.79	0.79

APPENDIX D: COST AND SCHEDULE SUMMARY

The experiment start dates for those experiments that were both conducted *and* presented in this report are presented in Table D1

Table D1. ORNL Experiment Start Dates.

Task 2 Experiments	
Exp. 2B-1	2/17/98
Exp. 2B-3	4/8/98
Exp. 2A-3B	5/12/98
Task 3 Experiments	
DISSOLVED PLUME OXIDANT DEMAND	
Exp. Repeated 3a-R1	6/10/98
Exp. Repeated 3a-R2	6/22/98
Exp. Repeated 3a-R3	6/25/98
HOT SPOT OXIDANT DEMAND	
Exp. 3b-R1	5/5/98
Exp. 3b-R2	5/7/98
Exp. 3b-R3	5/7/98
Exp. 3b-R4	5/7/98
Task 4 Experiments	
DISSOLVED PLUME DEGRADATION RATE WORK	
Exp. 4a-R1	5/20/98
Exp. 4a-R2	5/28/98
Exp. 4a-R3	6/1/98
Exp. 4a-R5	6/15/98
Exp. 4a-R7	7/7/98
Exp. 4a-R4	7/14/98
Exp. 4a-R6	8/17/98
Exp. 4a-R8	8/24/98
HOT SPOT GROUNDWATER DEGRADATION RATE WORK	
Exp. 4b-R3	7/29/98
Exp. 4b-R4	7/29/98
Exp. 4b-R1	8/10/98
Exp. 4b-R7	8/12/98
Exp. 4b-R8	8/12/98
Exp. 4b-R2	8/13/98
Exp. 4b-R5	8/26/98
Exp. 4b-R6	8/31/98
HOT SPOT SLUDGE DEGRADATION RATE WORK	
Exp. 4b-R11	6/9/98
Exp. 4b-R12	6/16/98
Exp. 4b-R15	6/22/98
Exp. 4b-R16	7/6/98
Exp. 4b-R13	7/14/98
Exp. 4b-R14	7/14/98
Exp. 2B-3B (Matrix Spike Exp)	9/14/98

The period during which each SOW task was performed is presented in Figure D1.

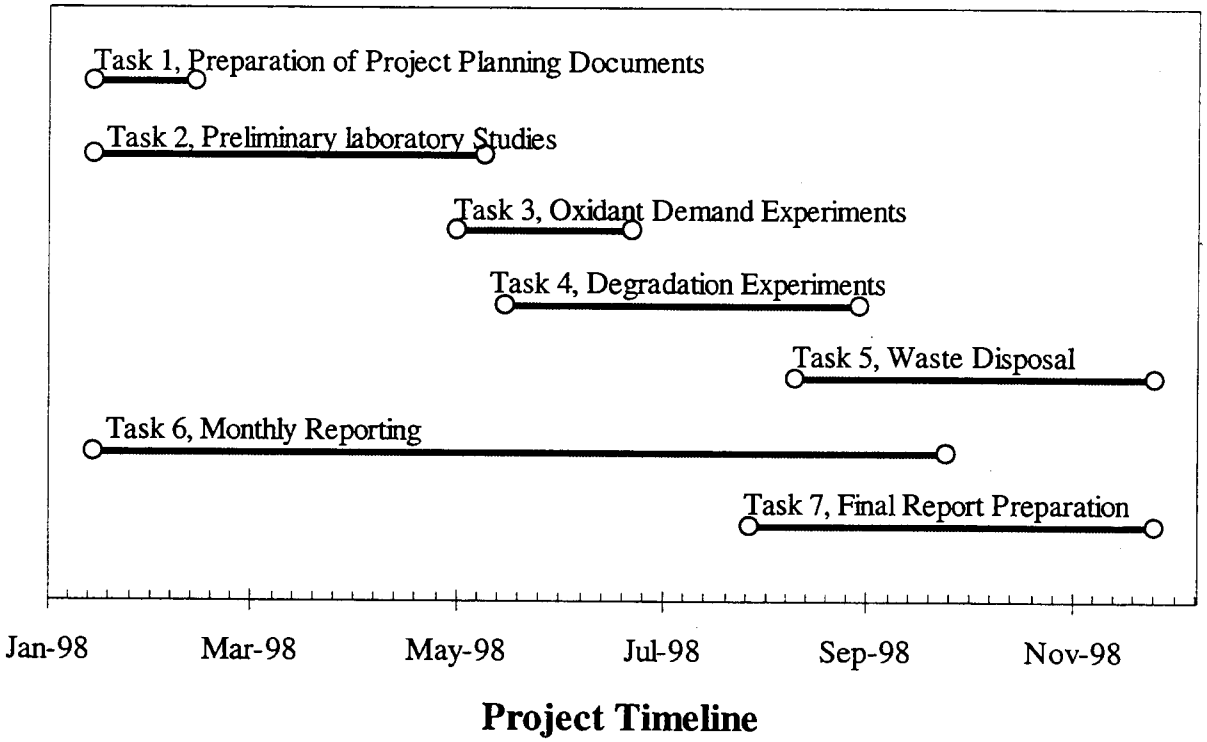

Figure D1. Project Timeline for the Laboratory Evaluation of In Situ Chemical Oxidation (ISCO) to Remediate the INEEL TAN Site.

The final cost summary for the treatability study is presented in Table D2. An additional $15K of funding was allocated to the project to continue report writing and handling of review comments. (The total budget value in Table D2 reflects this new funding allocation.)

Table D2. Cost Summary for the ISCO Treatability Study.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98	$382	$18,081	$0	$10,923	$382	$29,004	$29,386	$18,463	$10,923
Jun-98	$2,108	$14,366	$0	$23,310	$2,108	$37,676	$39,784	$16,474	$23,310
Jul-98	$2,473	$18,532	$0	$25,748	$2,473	$44,280	$46,753	$21,005	$25,748
Aug-98	$1,044	$18,479	$0	$0	$1,044	$18,479	$19,523	$19,523	$0
Sep-98	$707	$21,883	$17,278	$0	$17,985	$21,883	$39,868	$22,590	$17,278
Oct-98	$0	$1,233	-$1,292	$0	-$1,292	$1,233	-$59	$1,233	-$1,292
Total	**$27,713**	**$144,737**	**$15,986**	**$64,204**	**$43,699**	**$208,941**	**$252,640**	**$172,450**	**$80,190**

GRAND TOTAL (Thru Oct. 98)	**$252,640**
TOTAL FUNDS REMAINING	**$13,944**

Total Budget:	$266,584

APPENDIX E: MONTHLY PROGRESS REPORTS

Monthly Report: January

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

Funds were received at ORNL on January 14, 1998. The January cost report is presented in Table E1.1, in which the project costs are broken down in a variety of ways.

Technical Progress

This section describes the progress made in the remaining days of the January business month after receipt of funding (1/14/98). An environmental, safety, health, and quality (ESH&Q) evaluation was submitted for the project and approved. A request to perform the actual EPA Treatability Study with the INEEL media was prepared, submitted to, and approved by the ORNL Office of Environmental Protection. A Project Review Summary (PRS) was prepared and approved for NEPA compliance. The project activities are covered by an existing NEPA categorical exclusion (2017X) for work involving such bench-scale laboratory activities. A draft (>80% complete) test plan for the project was submitted to INEEL for initial review. Completion of this test plan is all that is necessary to fulfill the requirements of Task 1 in the project SOW.

Product research was conducted to select the incubator/shaker for the Tasks 3 and 4 studies. A requisition has been submitted to New Brunswick Scientific for the purchase of two (2) incubators, with an expected delivery date of 2/27/98. Numerous other materials and laboratory supplies (vials, VOC standards, etc.) have been ordered in preparation of the upcoming work.

In the laboratory, several preliminary experiments have been conducted to assist in the selection of an appropriate reactor for the Task 4 TCE degradation work. Of the most significance, an experiment (Exp 2a-2 in the current testplan) was conducted to evaluate the ability of glass reactors sealed with a ground glass stopper to hold TCE solutions (100 mg/L) for a 24 hr period without significant losses due to volatilization. The glass stoppers were equipped with activated carbon tubes, which were vented to the atmosphere. (With this configuration, a reactor cannot be pressurized as a result of the treatment experiments that will be conducted in Task 4.) Duplicate samples of the solution were collected from each reactor at Time =0, 4, and 24 hours. The carbon filters were also extracted with hexane at the end of the 24 hour test period.

Mass balance calculations were performed on each of the four (4) test reactors. The most promising results were obtained when the bottom of the carbon tube was covered with a thin Parafilm covering (which will rupture if a pressurization were to occur). For this reactor, 98.5% of the recovered TCE remained in spike solution following the test. Similar, 1.2% and 0.3% of the recovered TCE was removed from the system via the aliquot samples and carbon filters, respectively. Furthermore, total TCE recovery from the reactor was between 82% and 107% of the initial TCE mass in the reactor. The wide recovery range is unfortunately a result of a large discrepancy between the duplicate TCE samples collected at time=0. However, another test

reactor with <2% difference between duplicate that was evaluated yielded a total TCE recovery between 97% and 99.1%. More details of this experiment will be submitted later.

Technical Problems and Proposed Resolutions

The majority of the effort this month was devoted to administrative issues and material acquisition. Our current G.C. configuration is working very well in regard to overall performance and TCE resolution; however, it is not currently optimized for resolving the cis- and trans-1,2 DCE compounds. Work will continue to refine the configuration (temperature program, columns, flowrates, etc.).

Table E1.1. Cost Report, Through January 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98									
Mar-98									
Apr-98									
May-98									
Jun-98									
Jul-98									
Aug-98									
Sep-98									
Oct-98									
Total	**$0**	**$7,412**	**$0**	**$0**	**$0**	**$7,412**	**$7,412**	**$7,412**	**$0**

GRAND TOTAL (Thru Oct. 98)	**$7,412**
TOTAL FUNDS REMAINING	**$244,172**

Total Budget:	$251,584

Monthly Report: February

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The February cost report is presented in Table E1.2, in which the project costs are broken down in a variety of ways. The material costs are associated with miscellaneous supplies for the laboratory work and for the purchase of items needed in the development of the reactors to be used for the Task 4 experiments.

Technical Progress

This section describes the progress made during the February business month.

The TSF-05 and TAN-40 groundwater, basalt, and sediment samples were received on 2/11/98, and the eleven coolers used for shipping have been returned to INEEL as requested. The TSF-05 sludge was received at ORNL on 2/27/98. Information regarding the receipt of these materials have been submitted to ORNL Office of Environmental Compliance, as required by the regulations controlling EPA treatability studies. The analytical data for the TSF-05 sludge has not yet been received from INEEL, but ORNL has been notified that the results indicate the material to be less than 50 ppm PCBs.

The laboratory test plan continued to be prepared during the month. Changes and refinements to the test plan for the Task 3 and 4 activities were based on results and observations noted during the technique development work (Task 2) that is underway.

The most significant change to the testplan is a result of the hexane extraction experiment conducted for the reactive zone media at ESD. A summary of this experiment follows:

> The extraction experiment was performed to help determine what the most effective extraction period is for each medium being evaluated. The contaminant equilibration (of TAN-40 groundwater spiked at 1 mg/L TCE and soil) period was conducted at 12-15°C. Following equilibration, the hexane extraction was conducted at room temperature. Several aliquot samples were taken with time as the mixture was being extracted. Samples were taken of both the hexane and aqueous phases. The aqueous phase was further evaluated by determining the fraction of TCE present in both the liquid and solid phases at each time interval.
>
> Results obtained for extraction of sediment (Figure E1), crushed basalt, and groundwater alone were similar. Greater than 99.9% of the total TCE extracted after 2 hours is present in the hexane phase, and there is essentially no difference in TCE concentrations between the filtered and unfiltered aqueous samples for any media type evaluated after 2 hours. Extraction efficiency did not appear to increase between the 2 and 24 hr sampling periods, suggesting that a 2 hour extraction time is adequate.

Mass balances were also performed for each test case evaluated. Average TCE recoveries of 89%, 92%, and 92% were obtained for the samples containing sediment, crushed basalt, and groundwater only, respectively. The unrecovered TCE mass is not expected to exist as residual contamination on the solid phase since recoveries obtained for the groundwater only case were comparable. These mass balance computations are greatly controlled by the value obtained for the initial TCE concentration of the spiked groundwater. While duplicate analyses of the initial spike solution were in close agreement (avg= 932 ppb , sd=4 ppb), the potential for VOC losses certainly existed between the time these initial samples were collected and the time the vials were equilibrated (overnight) and finally transferred to the extraction bottles for the start of the extraction test.

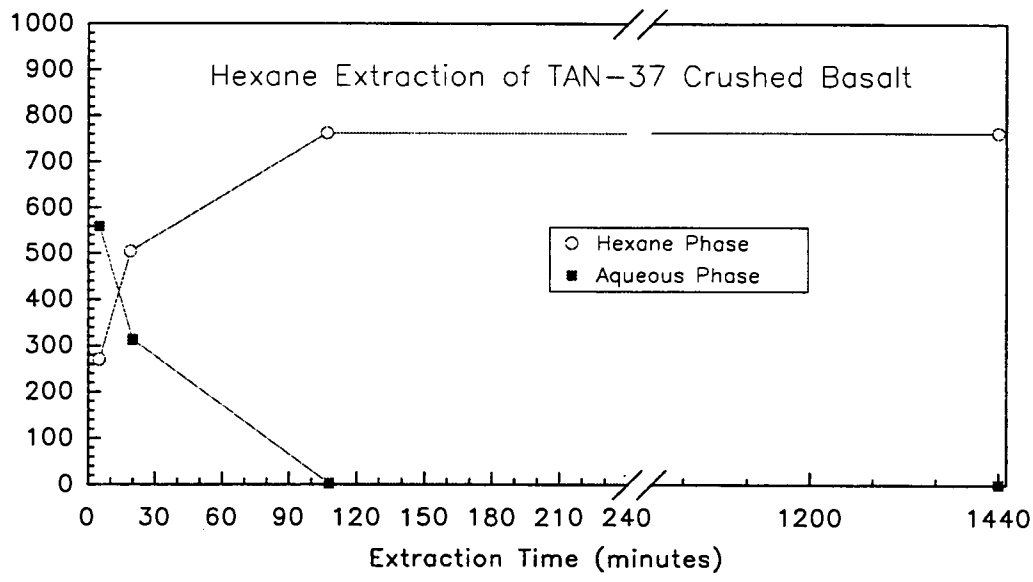

Figure E1. Results of Hexane Extraction Experiment for Crushed Basalt.

Notification had been received that refrigerated incubators were shipped from the vendor on 2/27/98, but they have not yet been received by ORNL.

Further development of the test reactors has continued this month. At this point, the required number of reactors needed for the Task 4 experiments have not been ordered. Instead, only a few setups have been acquired for testing to avoid unnecessary spending.

Spreadsheet templates were prepared this month by ESD to have consistency in the approach used to perform the data calculations and present the results of each upcoming experiment. Technical effort this month was also directed toward configuring the GC reports to meet the requirements set forth for the VOC data packages that will ultimately be submitted for the Task 4, TCE degradation studies. The Retention Time Window for TCE compound was determined with the current analytical setup.

Technical Problems and Proposed Resolutions

It was reported last month that our current G.C. configuration is not capable of resolving the vinyl chloride, cis DCE, and trans DCE compounds. This is no longer expected to be a problem. The ORNL staff has access to other instruments that will be able to detect and quantify these compounds when the Task 4 experiments dealing with the co-contaminants are performed. There are currently no major technical problems that must be resolved.

Table E1.2. Cost Report, Through February 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Total	**$2,105**	**$25,087**	**$0**	**$1,057**	**$2,105**	**$26,144**	**$28,249**	**$27,192**	**$1,057**

GRAND TOTAL (Thru Oct. 98)	**$28,249**
TOTAL FUNDS REMAINING	**$223,335**

Total Budget:	$251,584

Monthly Report: March

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The March cost report is presented in Table E1.3, in which the project costs are broken down in a variety of ways. The material costs this month were significant due to the acquisition of the refrigerated incubators for use in the Task 3 and 4 studies.

Technical Progress

This section describes the progress made during the March business month:

Staff at ORNL/RMAL performed pre-treatment TOC determinations on multiple samples of the TSF-05 sludge. Gross radionuclide activity determinations were also performed by RMAL for the RMAL. The analytical results are still being prepared.

Another test was conducted to assess the gas-tightness of the test reactors to be used in the Task 4 TCE oxidation work. The spike solution was equilibrated 18 hrs at 12 C before initial sampling occurred. A 90% mass balance was achieved. In these developmental experiments, we are conservatively opening up the vessel via collection of duplicate samples at each sampling interval. A better mass balance is anticipated in the Task 4 work: The frequency of duplicate collection during the Task 4 experiments is not as aggressive. Nonetheless, one more iteration of this experiment will be conducted using a slightly different sampling port configuration that has a Teflon stopcock.

Upon the request of INEEL, an additional lab experiment was prepared and setup to determine the oxidant dose needed in the field to reach the 5 ppb MCL limit for TCE. This work was conducted the first week of April, and the test findings have already been submitted to INEEL under separate cover.

The basalt equilibration study was also performed this month. In this test, TCE spiked TAN 40 groundwater was equilibrated with the crushed and aggregate basalt types for various time periods, with the maximum time period being 21 days. Control samples, in which media was not added to the test containers, were also carried through the experiment. Between 20-50% of the initial TCE was lost from the spiked groundwater, however, a larger proportion of the TCE lost appears to be attributed to volatilization losses from the test containers than from sorption by the basalt media. (Due to the long holding times involved, there were significant changes in TCE concentrations in the control samples.). There were also procedural problems as discussed in the next section, thus this experiment will likely be repeated.

Technical Problems and Proposed Resolutions

One of the new refrigerated incubators acquired last month did not function properly, due to a refrigerant leak. The vendor replaced the unit on April 17th, with the damaged unit being

returned at their expense. This problem has caused a slight schedule slip for the work being conducted at ORNL/RMAL on the TSF-05 sludge; however, the ESD portion of the work is still currently the critical path to project completion.

The testplan originally called for the collection of aqueous samples in disposable syringes and subsequent filtering prior to hexane extraction and TCE analysis. This was written into the procedures in order to discern TCE quantities associated with the particulate phase in the samples. Subsequent experimental data has shown that the 0.45 micron filters absorb 10-15% of the TCE that passes through them. Work is currently on-going to modify the testplan to eliminate this step, and work is being conducted to quantify how much solid phase is typically present on a spent filter to determine how much accuracy might be lost if the samples aren't filtered.

Table E1.3. Cost Report, Through March 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98									
May-98									
Jun-98									
Jul-98									
Aug-98									
Sep-98									
Oct-98									
Total	**$20,863**	**$40,753**	**$0**	**$1,958**	**$20,863**	**$42,711**	**$63,574**	**$61,616**	**$1,958**

GRAND TOTAL (Thru Oct. 98)	**$63,574**
TOTAL FUNDS REMAINING	**$188,010**

Total Budget:	$251,584

Monthly Report: April

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The April cost report is presented in Table E1.4, in which the project costs are broken down in a variety of ways. Please note that the RMAL portion of the work has began, costs will be increasing here next month. Also note that the all materials procured for the experimental work are being ordered at ESD to simplify purchasing logistics, but being used by both divisions working on the project.

A review of the current schedule was examined in April and submitted to INEEL for review. As a result, we are requesting that the period of performance be extended to September 30, 1998. Upon review of the costs incurred to date to predict the estimate at completion (EAC), additional budget is not being requested at this time.

Technical Progress

This section describes the progress made during the April business month:

The majority of the Task 3 oxidant consumption experiments were conducted this month. The laboratory data are still being reduced and interpreted. The Task 3a work with the reactive zone material, however, does not indicate a major loss of $MnO4^-$ as a result of the interaction with either the TAN-40 groundwater, basalt, or sediment matrixes. The greatest losses <20%) do appear to result from interaction with the finely crushed TAN-37 sediment material. In many circumstances, particularly for the 1% $MnO4^-$ loading, the error associated with sample dilution for $MnO4^-$ analyses appears to be greater than any observable losses of the oxidant via its consumption. In contrast, 4:1 L/S slurries of TSF-05 groundwater and sludge consumed all the initial $KMnO4^-$ in less than 30 minutes for both the 0.01 and 0.10% $MnO4^-$ loadings. Work with the TSF-05 sludge at higher oxidant loadings is in progress.

At the request of INEEL, a second experiment investigating the kinetics of TCE degradation was performed. In this experiment, three oxidant loadings (15, 65, and 100 mg/L $MnO4^-$) were reacted with 40 mL of TAN groundwater spiked with 1000 ppb TCE. The results are presented in Figure 1 (each loading was evaluated in duplicate). The rate of TCE degradation increases with increases in the initial oxidant loading. Twenty-four hours was the maximum reaction period evaluated. At that time, a residual of 20 ppb TCE remained in the samples having the 15 mg/L MnO4- loading, and an average residual of 7 ppb was reached for 65 mg/L loading. TCE was not detected in any of the samples with the 100 mg/L $MnO4^-$ loading after a reaction time of 4 hours. A residual $MnO4^-$ concentration was still present (≈90wt % of initial loading) in all samples at 24 hrs. More information regarding this experiment is available if it is needed.

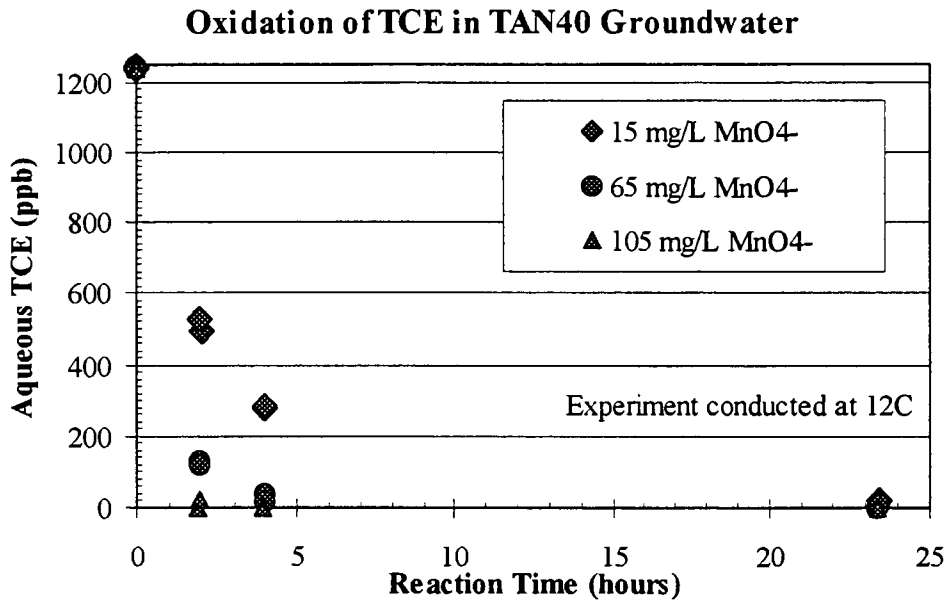

Figure E2. Results of TCE Kinetic Oxidation Study.

Needed supplies to test another configuration for the Task 4 reactors were received this month, and will be assessed during the week of May 11, 1998. The task 4 studies can be initiated after this work is completed.

The basalt equilibration experiment (Exp. 2c-1) was also initiated again this month as a result of the filtering problem encountered during the test last month. These samples are being analyzed via Purge and Trap/FID detector to better detect small changes in TCE concentrations with time that are anticipated.

The hexane extraction experiment on the TSF-05 sludge and groundwater was performed by ORNL/RMAL. As with the reactive zone materials evaluated previously at ORNL/ESD, a 2 hour extraction time is adequate for the sludge material.

Technical Problems and Proposed Resolutions

It was reported last month that one of the new refrigerated incubators did not work upon receipt. A new unit has been has been received and the other was returned to the vendor at their cost.

It was also reported last month that the 0.45 μm filters used prior to TCE analyses were adsorbing some quantities of TCE. A test was conducted this month to determine how much solid fraction is present in TAN40 groundwater or slurries of groundwater with basalt or sediment. In the worst case, a 10 mL aliquot of the crushed basalt contained less than 0.2% of the slurry's solid mass. Experiments are planned for May in which a comparison between TCE sampling via glass and plastic, disposable syringes will be performed to determine whether TCE adsorption is a problem here too.

Table E1.4. Cost Report, Through April 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98									
Jun-98									
Jul-98									
Aug-98									
Sep-98									
Oct-98									
Total	**$20,999**	**$52,163**	**$0**	**$4,223**	**$20,999**	**$56,386**	**$77,385**	**$73,162**	**$4,223**

GRAND TOTAL (Thru Oct. 98)	**$77,385**
TOTAL FUNDS REMAINING	**$174,199**

Total Budget:	$251,584

Monthly Report: May

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The May cost report is presented in Table E1.5, in which the project costs are broken down in a variety of ways.

Technical Progress

This section describes the progress made during the May business month:

TASK 3, Oxidant Consumption Work

All originally planned experimental test conditions were completed in May at both the ESD and CASD facilities, for the reactive zone and hot spot media, respectively. The data was recently transmitted to INEEL. While the anticipated results are supported by the data, the results for the reactive zone media were difficult to interpret due to difficulties in executing the test procedure. Thus, the reaction zone experiments (Task 3A) are being repeated using a modified step for oxidant spiking/injection, and the results at this point appear to be more informative and meaningful.

TASK 2, Development Work

The final reactor configuration (TASK 2a-3) was evaluated to assess its ability to maintain gas-tight conditions over time. The reactor, initially spiked at 100 ppb, maintained that TCE concentration when subjected to five (5) aliquot sampling events over a 24 hr period. The final design consists of a 500 mL flask, having a 42/29 standard taping opening. To both minimize and account for non-oxidative VOC losses that occur during aliquot sampling, the reactors are sealed with an adapter that maintains gas tight conditions during the reaction (Teflon Stopcock). Any VOC mass lost during sampling will be quantified via adsorption onto 6 mm diameter charcoal tubes extracted with hexane and analyzed along with the test samples.

This study also evaluated the effect of sampling via both glass and plastic, disposable syringes. Six aliquots were sampled using both techniques. The average TCE value obtain by sampling with the glass syringe was only 0.1% greater than the value obtained with the disposable syringes. The difference in TCE values between glass and plastic syringe sampling ranged between –4% to +4% for the six aliquots. Based upon this information, the use of the plastic disposable syringes will be continued in the Task 4 studies.

TASK 4, TCE Degradation Work

Significant modifications were made to the test procedure for the Task 4 work this month. These changes were made for numerous reasons: (1) to make the procedure both more thorough and easier to follow (2) to provide specifics regarding the use of the final test reactor (3) to eliminate/modify steps that caused problems in the Task 3 work.

TCE treatment experiments were initiated at both ESD and CASD this month. Six experiments have successfully been conducted to date. The preliminary data indicate both rapid and significant changes in TCE values as a result of oxidant additions. The control reactors appear to be maintaining their initial TCE concentrations well, and little TCE has been observed on the sampling port's charcoal tubes. In fact, there are two charcoal beds placed in series on each reactor, TCE has not yet been detected on the second bed. Formal results of the Task 4 work to date is currently planned to be presented in the June monthly report.

Technical Problems and Proposed Resolutions

TASK 3, Oxidant Consumption Work

As discussed above, ESD experienced problems achieving the desired oxidant concentrations in the test reactors. Often the final, measured oxidant concentration was greater than that computed using the laboratory gravimetric data. To fix this problem, a new calibration curve was prepared, and oxidant is now being adding via the use of stock MnO4- solutions as opposed to the addition of the solid KMnO4- crystals. This procedural modification was also written into the most current Task 4 degradation procedures. Calibration standards will also be titrated in the preparation of future MnO4- calibration curves to further ensure that the calibration data is correct.

TASK 4, TCE Degradation Work

At the start of the degradation work, CASD staff were experiencing problems achieving the desired initial spike concentrations. After a careful review of their laboratory approach used to execute the test procedure, slight changes have been made that have now resolved this situation. However, two experiments will have to be re-performed.

Table E1.5. Cost Report, Through May 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98	$382	$18,081	$0	$10,923	$382	$29,004	$29,386	$18,463	$10,923
Jun-98									
Jul-98									
Aug-98									
Sep-98									
Oct-98									
Total	**$21,381**	**$70,244**	**$0**	**$15,146**	**$21,381**	**$85,390**	**$106,771**	**$91,625**	**$15,146**

GRAND TOTAL (Thru Oct. 98)	**$106,771**
TOTAL FUNDS REMAINING	**$144,813**

Total Budget:	$251,584

Monthly Report: June

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The June cost report is presented in Table E1.6, in which the project costs are broken down in a variety of ways.

Technical Progress

This section describes the progress made during the June business month:

TASK 3, Oxidant Consumption Work

The consumption experiments using the reactive zone media (Task 3A) were repeated in June and the data has already been sent electronically to INEEL. The experiments were repeated using a modified step for oxidant spiking/injection.

TASK 4, TCE Degradation Work

Reactive Zone Media

Experimental data for one of the reactive zone media experiments are presented in Figures E3 and E4. In this experimental run, TAN40 groundwater only was spiked with TCE. The average TCE concentration of duplicate control reactors during the 6 sampling periods was 1,360 ppb (std dev= 48 ppb over the 24 hr period). Duplicate test reactors were subjected to oxidant loadings of 0.01 and 0.1% MnO_4^-. TCE degradation was rapid and significant. The related oxidant consumption data is presented in Figure E4. It is interesting to note that the "leveling" off of the TCE degradation rate (Figure E3) for the first 0.01% test reactor corresponds to the significantly larger consumption value in Figure E4. Work is on-going to provide both a tabular and additional graphical means to present the vast amount of data points (TCE, pH, MnO_4^-) generated during the course of one of these experiments.

TSF05 Sludge

Similarly, data for one of the TSF05 experiments are presented in Figures E5 and E6. TCE (100,000 ppb) in the TSF05 sludge/groundwater slurry is also quickly oxidized. However, a residual TCE concentration of approximately 100 ppb was still present after 24 hours. Although most of the oxidant was consumed for the 1% MnO_4^- oxidant loading, approximately 40% of the oxidant mass originally added for the 3% MnO_4^- loading is still present at 24 hours. As a result of this observation, some experiments involving the 1 and 3% loadings will be continued for periods greater than 24 hours to determine if TCE oxidation continues, albeit at a much slower rate than observed during the first few hours of reaction.

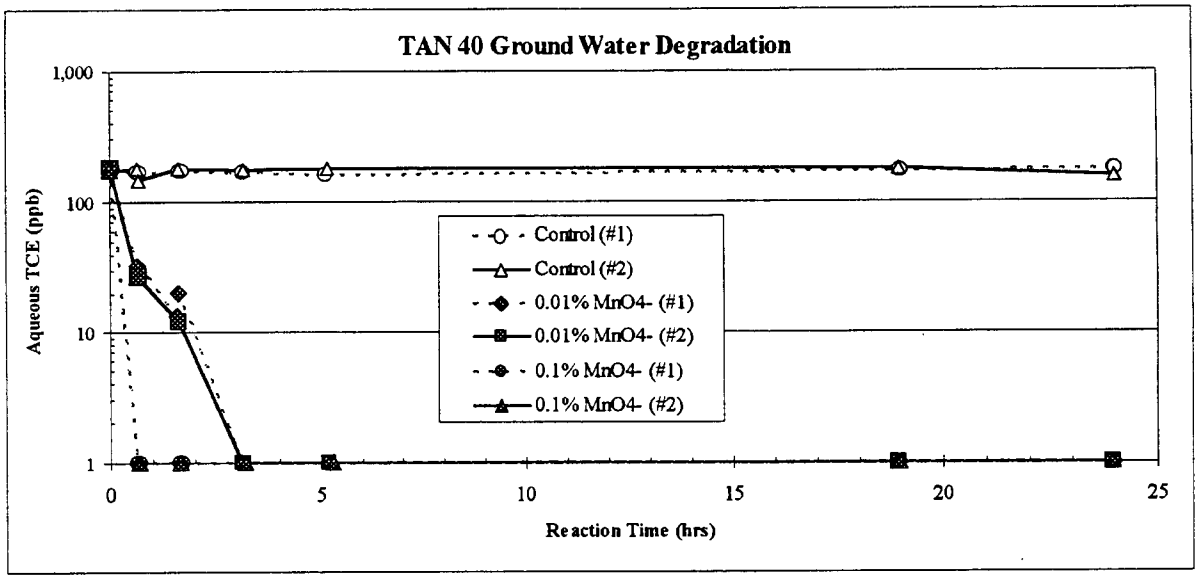

Figure E3, TAN-40 Groundwater TCE Oxidation

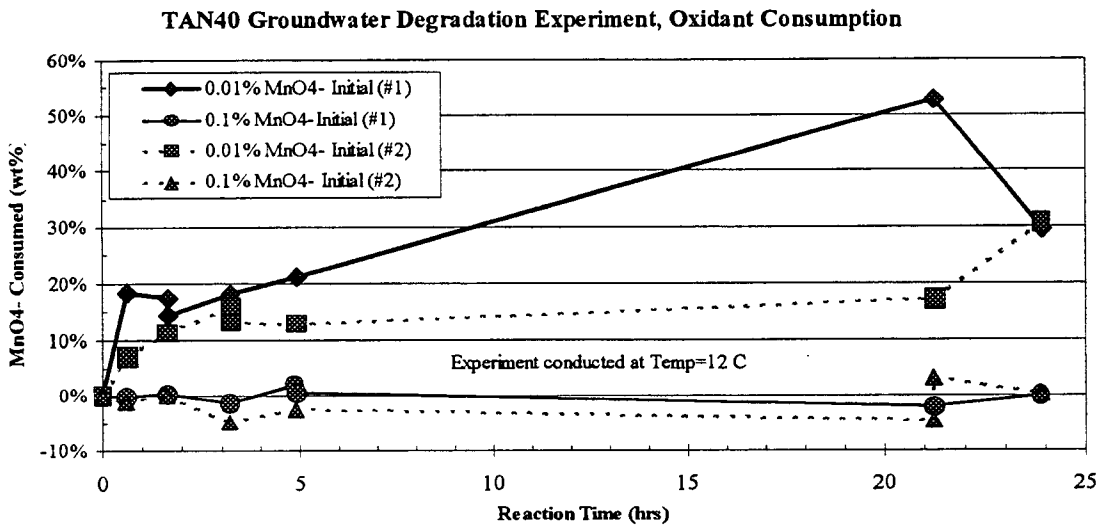

Figure E4, TAN-40 Groundwater, Oxidant Consumption

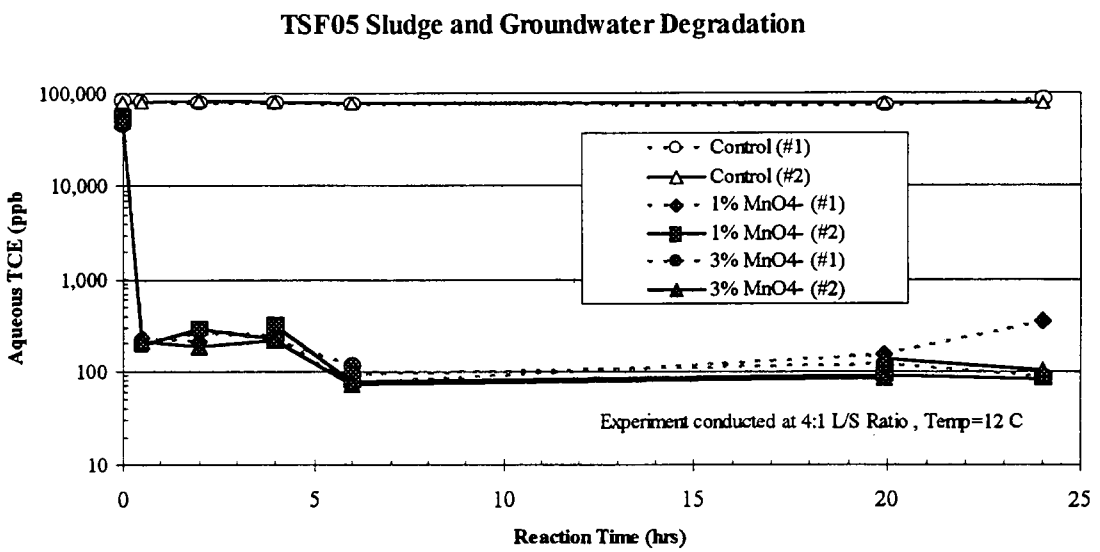

Figure E5, TSF-05 Sludge & Groundwater TCE Oxidation.

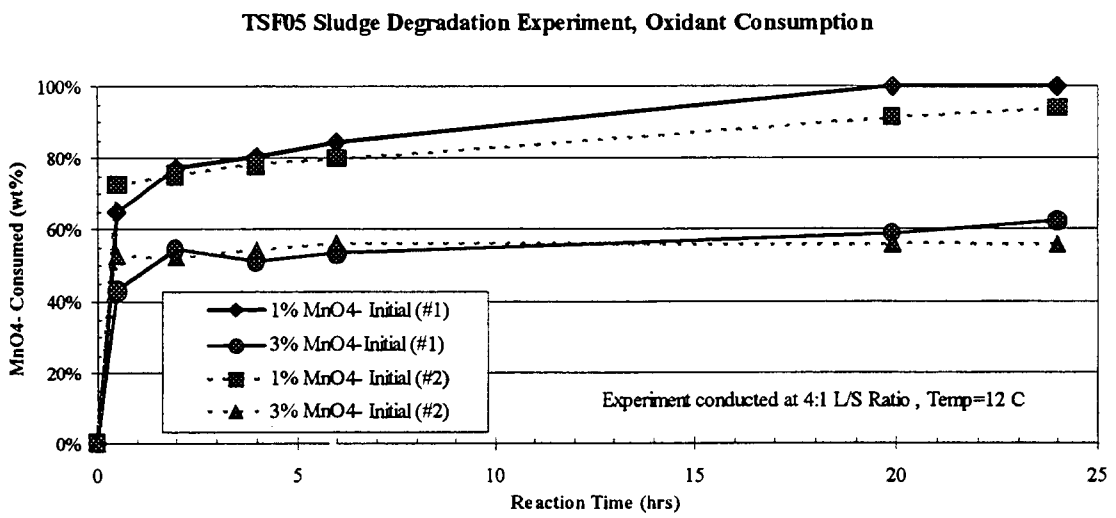

Figure E6, TSF-05 Sludge & Groundwater, Oxidant Consumption.

Technical Problems and Proposed Resolutions

Data from the repeated basalt equilibration study (Task 2c-1) are inconclusive. (The first attempt at this task was erroneous due to the discovery that the 0.45 micron membranes being used to filter the aqueous TCE samples adsorbed TCE.) In the repeated test, aqueous TCE was analyzed via the more sensitive purge and trap GC analysis. At any given time interval, differences among TCE concentrations in samples of TAN40 groundwater only, groundwater with aggregate basalt, and groundwater with crushed basalt were minimal and within one standard deviation. It is believed that instrument performance changed during the course of the 8 day test. A definitive and needed equilibration time for the aggregate basalt was not observed. As a result, ESD is currently planning to use a 24 hr equilibration period (as with the other media) during the Task 4a experiments with aggregate basalt.

Table E1.6. Cost Report, Through June 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98	$382	$18,081	$0	$10,923	$382	$29,004	$29,386	$18,463	$10,923
Jun-98	$2,108	$14,366	$0	$23,310	$2,108	$37,676	$39,784	$16,474	$23,310
Jul-98									
Aug-98									
Sep-98									
Oct-98									
Total	**$23,489**	**$84,610**	**$0**	**$38,456**	**$23,489**	**$123,066**	**$146,555**	**$108,099**	**$38,456**

GRAND TOTAL (Thru Oct. 98)	**$146,555**
TOTAL FUNDS REMAINING	**$105,029**

Total Budget:	$251,584

Monthly Report: July

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The July cost report is presented in Table E1.7, in which the project costs are broken down in a variety of ways.

Technical Progress

The conduct of the remaining Task 4 oxidation rate studies continued during the month of July. The hot spot groundwater studies listed in SOW Table 2.6 are being divided up between the ESD and RMAL research teams in order to expedite completion of the lab experiments. ESD will conduct the four (4) 10 mg/L initial TCE experiments listed in Table 2.6 (including the 2 co-contaminant experiments), and RMAL will conduct the 100 mg/L and DNAPL TCE experiments. Summary information regarding the experiments performed in July will be available soon. As observed in the Table 1 cost report, a great deal of the effort was expended in July on this project, with greater than 95% of that effort being dedicated to the actual conduct of the experiments.

Technical Problems and Proposed Resolutions

No additional technical problems were encountered during July.

Table E1.7. Cost Report, Through July 1998.

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98	$382	$18,081	$0	$10,923	$382	$29,004	$29,386	$18,463	$10,923
Jun-98	$2,108	$14,366	$0	$23,310	$2,108	$37,676	$39,784	$16,474	$23,310
Jul-98	$2,473	$18,532	$0	$25,748	$2,473	$44,280	$46,753	$21,005	$25,748
Aug-98									
Sep-98									
Oct-98									
Total	**$25,962**	**$103,142**	**$0**	**$64,204**	**$25,962**	**$167,346**	**$193,308**	**$129,104**	**$64,204**

GRAND TOTAL (Thru Oct. 98)	**$193,308**
TOTAL FUNDS REMAINING	**$58,276**

Total Budget:	$251,584

Monthly Report: August

Project: Laboratory Evaluation of In Situ Chemical Oxidation as a Technology for Groundwater Remediation at the INEEL TAN Site

Budget and Cost

The August cost report is presented in Table E1.8, in which the project costs are broken down in a variety of ways. Please note that no costs were incurred from the ORNL RMAL research team. This is due to the fact that their operating account was inadvertently closed in July. Their finance organization was not duly notified of the extension to the period of performance. The account has subsequently been re-opened, and the entire remaining balance in the RMAL account ($12.7 K) will be costed out in the September business month. Likewise, it is also anticipated that all $$ resources within the ESD operating account will also be expended during the September in the preparation of the final report.

Technical Progress

During the month of August, all Task 4 oxidation rate experiments were completed, including the co-contaminants experiments in which the TSF-05 groundwater was spiked with TCE, cis-1,2 DCE, trans-1,2 DCE, and 1,1 DCE. A great deal of effort was expended in optimizing instrument operation conditions in order to properly quantify these analytes. It was planned to also spike with vinyl chloride. Unfortunately, quantification of vinyl chloride via GC/ECD could not be accomplished. Vinyl chloride determination via purge & trap of aqueous samples could be accomplished, but was not feasible here due to the large number of VOC samples (70+) that are generated from each experiment. (ORNL/ESD GC instruments used for such purge and trap analyses are not equipped with automated sampling devices.)

Communication with INEEL this month focused upon the final desired format/outline of the ORNL final report. Actual preparation of the final report was initiated in August and will continue throughout the month of September.

At the request of INEEL, additional laboratory work is being conducted in September to perform a matrix spike study for each TAN site material to ascertain the actual % TCE recovery that can be achieved using the final laboratory procedure developed in order to perform the Task 4 oxidation rate studies. These matrix spike experiments are being conducted at 100-500 ppb so that dilutions prior to GC analysis will not be needed, thereby "removing" errors associated with the preparation of such dilutions from the matrix spike study. Results of these experiments will be added to the final report as soon as they are available.

Technical Problems and Proposed Resolutions

All experimental work is essentially complete. The primary task for ORNL is the complete the final report during the September business month.

Table E1.8. Cost Report, Through August 1998.

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Business Month	ESD-Total Matl	ESD-Total Effort	RMAL-Total Matl	RMAL-Total Effort	Total Material Cost	Total Effort Cost	Total Cost	TOTAL ESD	TOTAL RMAL
Jan-98	$0	$7,412	$0	$0	$0	$7,412	$7,412	$7,412	$0
Feb-98	$2,105	$17,675	$0	$1,057	$2,105	$18,732	$20,837	$19,780	$1,057
Mar-98	$18,758	$15,666	$0	$901	$18,758	$16,567	$35,325	$34,424	$901
Apr-98	$136	$11,410	$0	$2,265	$136	$13,675	$13,811	$11,546	$2,265
May-98	$382	$18,081	$0	$10,923	$382	$29,004	$29,386	$18,463	$10,923
Jun-98	$2,108	$14,366	$0	$23,310	$2,108	$37,676	$39,784	$16,474	$23,310
Jul-98	$2,473	$18,532	$0	$25,748	$2,473	$44,280	$46,753	$21,005	$25,748
Aug-98	$1,044	$18,479	$0	$0	$1,044	$18,479	$19,523	$19,523	$0
Sep-98									
Oct-98									
Total	**$27,006**	**$121,621**	**$0**	**$64,204**	**$27,006**	**$185,825**	**$212,831**	**$148,627**	**$64,204**

GRAND TOTAL (Thru Oct. 98)	**$212,831**
TOTAL FUNDS REMAINING	**$38,753**

Total Budget:	$251,584

INTERNAL DISTRIBUTION

1-2. S. R. Cline, 1505, MS-6035
3. Central Research Library
4. ESD Library
5. Laboratory Records, ORNL-RC

EXTERNAL DISTRIBUTION

6-7. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831