ORNL-2971

Vol. 8 3

CHEMISTRY—SEPARATION PROCESSES
FOR PLUTONIUM AND URANIUM

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BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL

Volume 8

Waste Treatment and Disposal

T. F. Connolly

Oak Ridge National Laboratory
operated by
Union Carbide Corporation

United States Atomic Energy Commission
Division of Technical Information

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PROCESSING OF NUCLEAR REACTOR FUELS – A BIBLIOGRAPHY

Introduction

This volume includes Section 8.0 of eight sections of a bibliography on nuclear reactor fuel reprocessing and waste disposal. The collection will be a unit, and cross references are made between volumes. The decimal coding of headings is designed for ease of cross referencing, filing, expansion, and for future use in an automatic microfilm viewer-printer now being developed.

Cutoff points are somewhat arbitrary: overlapping into the area of feed materials, for example, is kept to a minimum, even though fuel reprocessing and fuel refabrication can be a continuous operation. Continuous on-site reprocessing of aqueous reactor fuels is only lightly covered.

Section 1.0, Chemistry and Physics of Important Elements, contains many references to separation methods and conditions, particularly on a laboratory scale. Cross references to that section from Sections 2.0, 3.0, and 6.0 – to each of which it may be considered as peripheral – would be too numerous to be included and should be assumed for each element. Special tests or uses (e.g., as construction materials or reagents in standard processes) are treated in the appropriate sections.

The complete collection includes about 7000 abstracts, nearly all from Nuclear Science Abstracts, representing books, bibliographies, symposia, journals, and contractors' topical reports. Most of the material dates from the 1955 Geneva Conference to the present. A serious lack is material from progress reports, and a program for the detailed abstracting and indexing of progress reports is therefore under way at ORNL (with the helpful cooperation of the Cataloging Section of the AEC-DTI Extension).

TABLE OF CONTENTS

WASTE TREATMENT AND DISPOSAL 8.00

	Page
COSTS	8.01
DECAY STORAGE	8.04
HEAT PROBLEMS	8.06
PONDS	8.09
TANK STORAGE	8.09
General	8.09
Tank Design	8.10
DISPOSAL METHODS	8.12
FIXATION IN SOLID MEDIA	8.12
Clay	8.12
Other Soils	8.13
Cement	8.14
Ceramics	8.14
Ceneral	8.16
Glass	8.16
GASEOUS FISSION-PRODUCT DISPOSAL	8.18
INCINERATION	8.21
LAND, DISPOSAL ON	8.22
General	8.23
Ground-Water Contamination	8.25
Retention by Soils – General	8.27
Retention by Soils – Cs, Pu, Sr	8.29
In Salt formations	8.31
LIQUID WASTES	8.32
General	8.32
Monitoring	8.35
Treatment	8.36
WATER, DISPOSAL IN	8.39
Containers	8.39
General	8.40
Oceans	8.40
Rivers	8.43
PLANTS AND EQUIPMENT	8.43
RECOVERY OR REMOVAL OF MATERIALS	8.44
AL-CONTAINING WASTES	8.44
BIOLOGICAL	8.46
ELECTROLYTIC	8.47
FISSION PRODUCT REMOVAL	8.48
Cs and Sr	8.48
General	8.49
Ruthenium	8.50
ION EXCHANGE	8.51
IRRADIATION	8.54
PRECIPITATION	8.55
SOLVENT EXTRACTION	8.58
SURVEYS AND BIBLIOGRAPHIES	8.59
BIBLIOGRAPHIES	8.59
CHALK RIVER	8.60
EUROPE (AND OTHERS)	8.61
ORNL	8.62
PWR (SHIPPINGPORT)	8.63
U. S. – GENERAL	8.65
WASTE CHARACTERISTICS	8.71
FUTURE PROBLEMS	8.71
VOLUME REDUCTION	8.72
CALCINATION	8.73
CHEMICAL	8.76
ELECTROLYSIS	8.77
EVAPORATION AND DISTILLATION	8.78
SINTERING	8.82

WASTE TREATMENT AND DISPOSAL 8.00

See also, PLANTS AND EQUIPMENT,

and,

under PROCESS CHEMISTRY AND ENGINEERING, Special Processes (6.17),

and,

under FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL (Individual Elements)

and,

under HAZARDS AND PROTECTION, Legal Aspects (4.02.05).

COSTS 8.01

See also, under SURVEYS (GENERAL), COSTS (7.02).

3256
APPLICATION OF PRESENT WORTH TO WASTE-DISPOSAL ECONOMICS. W. J. George and L. R. Bacon (Wyandotte Chemicals Corp., Mich.). Nucleonics 17, No. 11, 173-4; 176; 178; 180(1959) Nov.

Calculations are presented for various methods of waste storage based on the assumptions: 50-yr lifetime of underground storage tanks, Purex-type waste, and 800 gal of waste per ton of spent fuel. The present worth of tank-storage costs, salt-cavity-storage costs, and combined tank-salt-cavity costs was calculated and a costs comparison of these three systems given. It is shown that either a combination tank-salt-cavity system or a salt-cavity system alone leads to lower costs for liquid waste storage than tank storage alone. (C.J.G.)

8222 UCRL-8609
California. Univ., Berkeley. Lawrence Radiation Lab.
COMPARATIVE COSTS OF SEA DISPOSAL AND LAND BURIAL FOR THE RADIOACTIVE WASTES OF THE LAWRENCE RADIATION LABORATORY. Elmer Nielsen. Jan. 21, 1959. 22p. Contract W-7405-eng-48. $4.80(ph), $2.70(mf) OTS.

A study has been made of comparative costs of disposal of radioactive wastes at sea and by burial, taking into account such factors as loading, storage, and transportation by various means. (auth)

European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
COST ESTIMATION FOR THE EXTRACTION PILOT PLANT. Technical Report No. 9. A. Redon. June 27, 1958. 7p. $1.80(ph), $1.80(mf) OTS.

The first approximation of the necessary investments in the extraction pilot plant which is outlined in Report No. 5 dated May 16, 1958, are presented. The pilot plant is planned for a room in the waste disposal facility. Detailed costs are listed, and a recommendation for additional amounts for an operating budget is included. (J.R.D.)

7237 TID-8017
Technical Information Service, AEC.
RADIOACTIVE WASTE DISPOSAL AT KNOLLS ATOMIC POWER LABORATORY. D. A. Manieri and W. H. Truran. Knolls Atomic Power Lab. Mar. 1958. 17p. $0.50(OTS).

One of Its Monograph Series "The Industrial Atom."

Disposal of radioactive wastes from KAPL is considered with respect to the three physical categories of waste—solid, liquid, and airborne—and the three environmental recipients—ground, surface water, and atmosphere. Solid waste-handling includes monitoring radiation levels, segregation, collection, processing, packaging, storing if necessary, and shipping to a remote burial ground at the Oak Ridge National Laboratory. Liquid waste is collected by controlled drain systems, monitored for radioactivity content, and stored if necessary or released to the Mohawk River. Exhaust air is cleaned before released and continuously monitored. The environment is monitored to assure safe and proper disposal of wastes. The cost of operations and the depreciation of facilities incurred by KAPL for disposing of radioactive contaminated waste is less than 0.7% per year of the total cost of the Laboratory. (auth)

8219 CF-57-10-129
Oak Ridge National Lab., Tenn.
PROPOSAL FOR INSTALLATION OF EQUIPMENT FOR TREATMENT OF ORNL HIGH LEVEL WASTE. I. R. Higgins. Oct. 24, 1957. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

It is proposed that neutralized ORNL storage tank supernate waste be used as a feed for a waste processing development facility. An electrolytic cell can be installed to remove nitrate and ruthenium from the wastes prior to discharge to the soil disposal pits. This eliminates the hazards of nitrate and ruthenium in the ORNL soil disposal pits. In addition, a continuous ion exchange unit can be installed to study the isolation of fission products from a portion of the waste stream. The total waste stream can be processed by the ion exchange if desired. A six to eight inch diameter continuous ion exchange contactor is considered sufficient to remove cesium, strontium, and rare earths from 5,000 to 10,000 gallons of waste per day. The estimated installed cost of such a unit is about $16,000. The labor and chemical operating cost at 100% overhead is estimated at $22.50 per day. Three types of electrolytic cells were considered. All of the cells remove about 90% of the ruthenium by plating on the cathode. It is expected that the degree of ruthenium removed may be increased by further laboratory development. The first cell type is the Ionics cell which converts $NaNO_3$ to NaOH and HNO_3 for recycle. The second is the nitrate reduction (or destruction) cell which produces caustic and ammonia gas, as studied by KAPL. The acid-base cell is favored because of a factor of 8 lower power consumption, and the nitric acid may be reused as well as sodium hydroxide. An acid-base cell with rectifier for 5,000 gallons per day of 0.3 M $NaNO_3$ waste is estimated at about $15,000. The operating cost with 100% overhead, including labor, electricity, and cell maintenance is estimated at $47.72 per day. Operations may be credited with $29 per day of caustic and $86 per day of nitric acid. If it is desired to isolate the ruthenium and not remove the nitrate, a simplified electrolytic cell may be used. Cell cost is estimated at ~80% of the acid-base cell and about one tenth the cost for a rectifier. About 90% of the ruthenium may be conveniently removed. Technetium is not considered a radioactive hazard, but recovery is considered because of its value and expected ease of recovery. Technetium is not scavenged and has a very great affinity for anion resin. At current prices it is estimated that 0.25 g per day of technetium is being discharged at ORNL, which at present prices is $7,000/day. (auth)

THE ECONOMICS AND HAZARD POTENTIAL OF WASTE DISPOSAL. E. D. Arnold. July 8, 1957. 19p. (CF-57-7-31)

The two most important considerations in the disposal of radioactive wastes are safety and economy. All other steps in the waste disposal complex must be tuned to accomplish these two goals. In general, the hazardous waste in the nuclear power complex affect the cost of the nuclear power reactor fuel cycle, the general environment since disposal must exclude radioactivity from the environment for over 500 yr, the costs and/or methods of waste treatment including fission product utilization, the methods of shipping, the location of chemical processing plants and waste disposal sites, the methods of disposal best suited for a particular type of waste or site location, and potential public damage and third-party liability.

9132

CHOOSING STORAGE TIME TO MINIMIZE PROCESSING COSTS. J. W. Ullmann and E. D. Arnold (Oak Ridge National Lab., Tenn.). Nucleonics 15, No. 6, 80-3(1957) June.

The cost of storing spent fuel is compared with processing, refabrication, and shielding costs to determine the optimum fuel cycle for hypothetical one-region and two-region reactors. Irradiation products, storage space required, decay time required, and thorium and U^{233} problems are considered. (T.R.H.)

Economics of Waste Disposal, H.R. Zeitlin, E.D. Arnold, J.W. Ullmann. Nucleonics 15, 1, Jan 1957 p 58-62.

Accumulated fission product activity may be greater than 3×10^{11} curies by year 2000; to dispose of it, it is estimated that cost of $1.60 to $64. per gal. will be permissible for predicted nuclear power economy.

UNIT COSTS AND ECONOMIC RELATIONSHIPS FOR CERTAIN RADIOACTIVE WASTE DISPOSAL STEPS. F. L. Culler, J. O. Blomeke, and W. G. Stockdale. May 1, 1957. p.455-75 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

The cost of several waste disposal systems is presented using tables, graphs, and schematic drawings. The systems discussed include evaporation and storage processes, and interim high level waste storage and shipment to possible ultimate disposal sites. Comparative costs between acid and neutralized waste storage are also given.

COMMENTS ON THE TRANSPORTATION OF IRRADIATED FUEL AND RADIOACTIVE WASTES FOR M. LOUIS ARMAND, EURATOM GROUP. F. L. Culler. May 6, 1957. 32p. (CF-57-5-24)

General considerations involving the transportation of irradiated fuel and radioactive wastes are reviewed. It is assumed that many reactors will supply feed to a few large multipurpose chemical plants which ultimately send radioactive waste to a few disposal sites. General economic considerations of irradiated fuel reprocessing, economic aspects of the nuclear economy complex, growth predictions of the nuclear power economy in the U. S., general requirements for the shipment of fuel and waste, regulations applicable to fuel shipment, and permissible radiation levels are discussed.

5826 AECU-3370

Oak Ridge National Lab., Tenn. and Burns and McDonnell Engineering Co., Kansas City, Mo.

PROCESS WASTE WATER TREATMENT PLANT. Preliminary Report. Feb. 1957. 52p. Contract W-7405-eng-26 and AT(40-1)-2008. $0.45(OTS).

A proposal is presented for the construction, at a cost of $180,000, of a plant to treat the low level radioactive liquid waste from the various laboratory processes. The proposed plant will reduce the radiation activity of that waste to a level that will not exceed the accepted standards for discharges into White Oak Creek and the Clinch River. (auth)

RADIOACTIVE WASTE ECONOMICS: OPTIMUM STORAGE TIME PRIOR TO SHIPPING TO DISPOSAL SITE. H. R. Zeitlin and J. W. Ullmann. Oct. 24, 1955. 20p. (CF-55-10-101)

Optimum cooling times were determined for 250 gal batches of waste (800 gal/ton) from fuel irradiated 400 days to 10,000 MWD/T. The conclusions that can be drawn are that as the storage cost increases it becomes economical to ship shorter cooled waste. As the shipping distance increases, it becomes economical to store waste longer. In the case of $0.30/gal/yr storage, for 200 miles shipment, essentially no storage should be provided beyond that required for surge in filling carriers. The above conclusions are based on 10,000 MWD/T fuel. For less highly irradiated material, the optima would shift in the direction of shorter cooling times.

STUDY OF WASTE FACILITIES. H. W. Stivers. June 30, 1955. Changed from OFFICIAL USE ONLY Nov. 26, 1956. 19p. (HW-37680)

The purpose of this report is to develop an economic selection of conventional reinforced concrete structures of various shapes to establish a design criteria for intermediate level radioactive liquid waste facilities. The vault and the cavern type of storage facilities could be economically supplemented with the present tanks or used separately to meet the demands of present and future intermediate level radioactive wastes. The bare tank costs of these facilities for intermediate level waste storage are, respectively, $0.08 and $0.065/gal less than present conservative circular tanks used for intermediate and high level waste storage. This represents a 60 to 50% cost saving potential. The design criteria and the general shape of the facilities reduce the construction materials and earthwork quantities to achieve these lower unit costs.

REACTOR WASTE PROCESSING COST ANALYSIS. Information Report. M. McEwen. Mar. 5, 1952. Decl. Mar. 9, 1957. 15p. (MLM-672)

Results are reported from a study of comparative costs of evaporation vs. coprecipitation methods (FeS process) for the concentration of liquid reactor wastes prior to burial. The costs shown for plant-scale operation of the coprecipitation method are based on laboratory studies. Data indicate the FeS process competes economically with evaporation when the percent of dissolved solids in the feed reaches the 1 to 3% value, and the economic advantage of the coprecipitation method becomes very pronounced in processing high-solid-content wastes.

23003

STATEMENT OF DR. FRANK R. BRUCE, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENN. p.2345-56 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

Assuming 33,000 Mw of nuclear power by 1970, 300,000 Mw by 1990, and 700,000 Mw by 2000, an attempt is made to evaluate the quantitative and economic aspects of fuel processing waste disposal. Based on the use of Al-clad U, stainless steel-clad UO_2, or Zr-clad UO_2 fuel elements, the present waste storage cost is near 0.02 mill per kw-hr. (D.E.B.)

COSTS 8.01

23005
FUTURE ESTIMATES AND ECONOMICS OF WASTE DISPOSAL. SUMMARY AND EVALUATION OF ENVIRONMENTAL FACTORS. James G. Terrill, Jr. (U. S. Public Health Service, Washington, D. C.). p.2395-2410 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

Over-all radiation in the environment will become more complex, and the radiation levels will generally tend to increase to a point where current health standards will be threatened. A controlling factor in the development of the atomic energy industry may be the economics of waste disposal methods necessary to meet these criteria. Thus, it is of great national importance that a firmer basis for the health standards be developed as rapidly as possible, and that economical and significant methods of analyses which can be related to these standards be developed and approved by appropriate professional organizations. (auth)

21682
WASTE MANAGEMENT SAVANNAH RIVER PLANT ATOMIC ENERGY COMMISSION. Robert J. Christl (E. I. Du Pont De Nemours and Co., Aiken, S. C.). p.826-41 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Physical handling and disposition of radioactive wastes are presented relative to monitoring and economic aspects. (C.J.G.)

21677
STATEMENT OF TRACERLAB, INC., ON WASTE MANAGEMENT OPERATIONS. Samuel S. Auchincloss (Tracerlab, Inc., [Richmond, Calif.]). p.702-7 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Disposal procedures for solid and liquid wastes are discussed in relation to cost and safety. (C.J.G.)

DECAY STORAGE 8.02

See also, under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Legal Aspects (4.02.05).

RADIOACTIVE WASTE DISPOSAL. A. N. Marei. Priroda 47, No. 12, 47-50(1958) Dec. (In Russian)

An analysis is made of methods for the deactivation of gases, aerosols, and water and various methods of waste storage which prevent dissipation of radioactive waste. (R.V.J.)

13909 CRCE-736
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
METHODS OF STORAGE OF SOLIDS CONTAINING FISSION PRODUCTS. L. C. Watson, H. K. Rae, R. W. Durham, E. J. Evans, and D. H. Charlesworth. June 1958. 60p. (AECL-649). $1.50(AECL).

The requirements of a site for the permanent storage

PROPOSED DEVELOPMENT PROGRAM FOR TREATMENT OF RADIOACTIVE WASTES FROM MERCHANT SHIP REACTORS. I. R. Higgins and W. J. Neill. Mar. 19, 1958. 6p. (CF-58-3-67)

A proposed development program is made for the treatment and disposal of radioactive wastes from Merchant Ship Reactors. Both ion exchange resin and filters are to be used for coolant system cleanup. The development program is concerned with methods of handling and packaging of the spent resin, filter cake, and rare gases for safe disposal.

14744 A/CONF.15/P/389
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE STORAGE OF HIGH LEVEL RADIOACTIVE WASTES. DESIGN AND OPERATING EXPERIENCE IN THE UNITED STATES. O. H. Pilkey, A. M. Platt, and C. A. Rohrmann. 31p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

In the atomic energy industry in the United States the processing of nuclear reactor fuel at many sites yields

DECAY STORAGE 8.02

hazardous fission product waste mixtures in the form of concentrated aqueous solutions which must be securely and permanently stored with maximum assurance against uncontrolled release to the environment. The present method, with which there has been about fourteen years of successful industrial experience, comprises storage underground in steel tanks encased in reinforced concrete. Until methods are developed with demonstrated and improved reliability and at substantially lower costs, it is expected that this storage technique will continue to be used for these large scale operations. Most of the wastes are maintained as alkaline solutions to permit the use of ordinary steel; however large-scale storage is also done in stainless steel with acid wastes. The chemical processing of nuclear fuel has been improved to the extent that the radioactive decay of the concentrated fission products generates heat sufficient to maintain the waste fluids at the boiling temperature for many years. Aside from the needs for extremely reliable design and construction, facilities must be provided for the removal of this heat. In some installations this heat is used to concentrate the wastes and thus achieve smaller volumes for storage. In such cases additional facilities are required to remove the radioactive particulate matter which may be entrained in the evolved steam. In other cases this particulate problem is avoided by cooling the liquid wastes to maintain temperatures below boiling or by returning the condensate to the tanks. Under such conditions the release of particulate matter in the vent gases is greatly minimized. In the large-scale storage of self-heating wastes there is the phenomenon of cyclic boiling. This is critical from the standpoints of release of radioactivity from vents and from the structural security of the tanks which are subjected to such pressure surges. The use of air circulators has completely eliminated this unusual industrial problem. These air circulators are simple in design and operation but must have the utmost reliability throughout the "boiling life" of the storage facilities. The severe conditions involving mass of material, temperature, intense radioactivity, boiling and the prolonged storage period require careful control of the materials delivered to the storage facilities. Possibilities of thermal decomposition and radiolysis which may yield corrosive or explosive gases must be recognized and avoided by analysis and control of process streams which may be diverted to waste storage. Proposals for the adoption of other storage methods must be critically evaluated to determine the extent to which the problems related to the these severe conditions are minimized. The progress that has been made in waste volume reduction is such that by selection of fuel composition and choice of separation process the cost of waste storage need not be a major element in the cost of the total fuel cycle for nuclear power production. (auth)

10859 KAPL-M-WHT-1
Knolls Atomic Power Lab., Schenectady, N. Y.
ELIMINATION OF SECOND STAGE HOLD-UP OF LABORATORY LIQUID WASTE TO THE MOHAWK RIVER.
W. H. Truran. Aug. 1956. 7p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Certain KAPL liquid wastes, formerly subjected to evaporation, have for the period of June 1955 through June 1956, been released to the Mohawk River. The release procedure has involved two stage hold up and analysis followed by dilution with sanitary sewer effluent and storm water flows within the KAPL site. A review of operating procedures and experience suggests eliminating the second stage hold up and sampling. No loss of control over amounts of radioactivity or toxic chemicals in sewer effluent would result. Reduction in operating and maintenance expense would be significant. (auth)

10939 CF-56-5-58
Oak Ridge National Lab., Tenn.
HRP-CP: DESIGN CALCULATIONS FOR THE ENTRAINMENT SEPARATORS (S-2 AND S-3) FOR THE HRT CORE PROCESSING PLANT. William L. Carter. May 4, 1956. 25p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70 (mf OTS).

There are two entrainment separators in the HRT chemical processing plant to minimize particulate carry-over in the vapor from the decay-storage vessels. One separator is provided for each decay-storage vessel and is located in the vapor line near its exit from the vessel. De-entrained droplets collect at the bottom of the separator and drain back to the decay-storage vessel. To effect entrainment separation each unit employs three principles: centrifugation, impingement and the use of large contact surface in the form of wire mesh. An additional feature of the unit is a small condenser coil located at the vapor exit. The purpose of this coil is to provide reflux for flushing the inside of the separator thereby removing any crust or collection of solid matter which might impair the efficiency of the unit. This feature will greatly reduce or eliminate plugging tendencies. Pertinent characteristics, performance and operating information are given. (auth)

DECAY STORAGE 8.02

7983 HW-24500
Hanford Works, Richland, Wash.
PROTECTION OF EXTERIOR BURIED WASTE LINES. Engineering Study No. 6. G. U. Udine. Sept. 24, 1952. Changed from OFFICIAL USE ONLY May 22, 1957. 43p. Contract [W-31-109-Eng-52]. $7.80(ph OTS); $3.30(mf OTS).

The protection of buried waste lines from radiochemical plants at Hanford is discussed. Methods in general use and methods presently used at Hanford are evaluated. Proposed types of waste line encasements, cathodic protection, and hazards from possible leaks in existing lines are discussed. A comparison of costs of existing and proposed methods is made and recommendations are given. (T.R.H.)

2413 NYO-4003
New York Operations Office. Health and Safety Div., AEC.
RADIATION FROM RADIUM BEARING SLUDGE STORAGE TOWERS. Eugene V. Barry. Apr. 1952. Changed from OFFICIAL USE ONLY Aug. 17, 1956. 16p. $3.30(ph OTS); $2.40(mf OTS).

Design data are presented for radium bearing sludge storage towers including information as to amount of radiation that could be expected from towers of different diameter through the concrete wall at points external to the tower. (auth)

3258
STORAGE OF RADIOACTIVE DECAY PRODUCTS IN POLAR ICE. Bernhard Philberth. German Patent DAS 1 043 535. Nov. 13, 1958. Atompraxis 5, 376(1959). (In German)

The storage of radioactive decay products in arctic or antarctic ice, which receives on its surface constant mass increment by precipitation from the atmosphere, is proposed. With consideration of the relatively large transmission time and decay time of the polar ice masses and the especially good physical behavior of the ice in this case, a simple and safe disposal of decay products is possible in this manner. (J.S.R.)

HEAT PROBLEMS 8.02.01

See also, under PROCESS CHEMISTRY AND ENGINEERING, HEAT TRANSFER (6.11).

9250 ORNL-2812
Oak Ridge National Lab., Tenn.
CALCULATION OF TEMPERATURE RISE IN DEEPLY BURIED RADIOACTIVE CYLINDERS. J. J. Perona and M. E. Whatley. Feb. 25, 1960. 43p. Contract W-7405-eng-26. OTS.

Temperatures were calculated relative to the storage of radioactive solid waste as a function of time and radial distance for radioactive solid cylinders in infinite solid media of "average soil," "average rock," and salt. A resistance at the cylinder—infinite medium boundary was included in the form of an air space. For the range of parameters used and within the practical limits of accuracy, the maximum temperature rise increased linearly with the heat generation rate. The fission product spectrum was not significant in the determination of the maximum temperature rise. Under the pessimistic storage conditions assumed, the storage of cylinders of a practical size appears feasible without excessive temperature rise. A maximum temperature rise of 1000°F would be produced with an initial heat generation rate of 1300 to 1600 Btu/hr-ft^3 for cylinders with a 5-in. radius, with 350 to 450 Btu/hr-ft^3 for a 10-in. radius, and with 175 to 210 Btu/hr-ft^3 for a 15-in. radius, assuming a thermal conductivity of the radioactive cylinder of 0.1 Btu/hr-ft-°F. (auth)

Oak Ridge National Lab., Tenn.
POWER REACTOR FUEL REPROCESSING PROCESS WASTES. W. L. Conger. June 19, 1959. 7p. Contract [W-7405-eng-26]. $1.80(ph), $1.80(mf) OTS.

Data on waste volumes and heat generation of several reactor fuels which may be reprocessed in the Power Reactor Fuel Reprocessing Pilot Plant at ORNL are tabulated. (auth)

9869 AEC-tr-3235
POLYTROPIC PRESSURE OF AIR DURING HUMIDIFICATION IN MINE SHAFTS. O. O. Kremnyov. Translated from Dopovidi Akad. Nauk Ukr. R.S.R., No. 1, 45-8(1958). 6p.

The analytical equation which describes the process of the polytropic compression of air during its humidification under the conditions existing in mine shafts is derived. The process of humidification is considered as an extraction heat disregarding the changes in properties of the air occurring as a result of a very slight increase in the weight of the water vapor it contains. (J.S.R.)

DECAY STORAGE 8.02

HEAT PROBLEMS 8.02.01

20626 ORNL-2769
Oak Ridge National Lab., Tenn.
SURVEY ON THE MEASUREMENT OF THERMAL CONDUCTIVITY OF SOLIDS PRODUCED BY EVAPORATION AND CALCINATION OF SYNTHETIC FUEL REPROCESSING SOLUTIONS. H. W. Godbee and J. T. Roberts. Aug. 25, 1959. 25p. Contract W-7405-eng-26. $0.75(OTS).

Simplified equations to calculate the maximum temperature rise in stored solid wastes are given. The need for thermal conductivity values of solid wastes is demonstrated using these equations. For 55-gal containers of a calcined TBP-25 waste in a granite cave the temperature would rise 694 to 3307°F depending on the decay prior to storage. A program is proposed for measuring the thermal conductivity of solids produced by evaporation and calcination of synthetic fuel reprocessing solutions. Thermal conductivity is defined and factors influencing the thermal conductivity of nonmetallic solids are considered. Particularly the effects of temperature and porosity on thermal conductivity are considered. Methods of measuring thermal conductivity are outlined. Criteria used in selecting an arrangement of apparatus for measuring thermal conductivity are enumerated. An apparatus for determining the thermal conductivity of solids produced by evaporation and calcination of synthetic fuel reprocessing solutions is described. (auth)

8413
REMARKS ON HEAT PROBLEMS IN THE LONG TERM STORAGE OF HIGH LEVEL RADIOACTIVE LIQUID WASTES. M. Weber (Chemical Research, Prague). Jaderna Energie 4, No. 2, 39-42(1958). (In Czech.)

5851
HEAT-CONDUCTION LOSSES IN REACTOR WASTE BASINS. Stanley H. Jury (Univ. of Tennessee, Knoxville). A.I.Ch.E. Journal 3, 143, 9M(1957) Mar.

The problem of heat loss from the bottom of an asphalt-lined waste disposal pit is considered. It is concluded that this heat loss is negligible compared to the rate of radio heat generation. The pool would have to be filled with insulation to prevent softening of the asphalt liner. (T.R.H.)

HEAT TRANSFER IN WASTE BASINS. S. H. Jury. Aug. 11, 1955. Decl. with deletions Mar. 11, 1957. 16p. (CF-55-8-76(Del.))

Estimates are made of the heat transfer in proposed out-of-door radioactive waste basins. Calculations are outlined, and complete numerical results are included in appendices.

20629
THERMAL CONSIDERATIONS IN THE STORAGE OF RADIOACTIVE WASTES IN SALT FORMATIONS. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-4. Robert S. Schechter and Earnest F. Gloyna (Univ. of Texas, Austin). New York, Engineers Joint Council, 1959. 26p. $0.50.

The thermal aspects of storing liquid radioactive wastes in deep underground storage sites are examined theoretically. The results indicate that the numerical answers are extremely sensitive to the values of the physical parameters and that the temperature increase is diminished if the waste is diluted, rather than partially filling the underground cavity. (auth)

2130 SCL-T-206
A SOIL TEMPERATURE PROBE WITH ELECTROTHERMAL COMPENSATION. (Pochvennyi termoshchup elektroteplovoi kompensatsii). D. P. Vasilishin. Translated by Marcel I. Weinreich (Sandia Corp.) from Meteorologi. i Gidrologi. 12, 44-5(1957). 6p.

Design characteristics are described of a soil temperature probe with electrothermal compensation. (C.H.)

3082
DECAY-HEAT COOLING REQUIREMENTS OF SPENT FUEL FROM EBR-2. C. H. Scheibelhut (Reactor Engineering Div., Argonne National Lab., Lemont, Ill.). Nucleonics 14, No. 12, 57-60, 62(1956) Dec.

Fuel elements will be removed from the EBR-2 reactor after they have served for three months and have achieved 2% burnup. After being removed from the core they will be stored 15 days in the reactor Na so that the initially intense heat from fission-product decay can be removed. Then the fuel subassembly will be transferred to a cell where the irradiated fuel will be removed for processing. (W.L.H.)

DECAY STORAGE 8.02

HEAT PROBLEMS 8.02.01

257
HEAT PROBLEMS IN THE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTES. E. A. Coppinger and R. E. Tomlinson (Hanford Atomic Products Operation, Richland, Wash.). Chem. Eng. Progr. 52, 417-21(1956) Oct.

The production of power by the fission of heavy elements gives rise to a new type of industrial waste—the radioisotope. This waste is unique in that it continuously generates heat by the decay of the fission products. This rate of heat generation is sufficient to create problems in the containment of these wastes and places practical limitations on the methods which may be employed. Up to the present time the only method demonstrated on a large scale is the semi-permanent storage of these wastes in buried tanks. Other disposal methods are in various stages of development but all suffer from severe limitations imposed by the self-heating characteristics of the wastes. The removal of cesium and strontium from the waste decreases markedly the time that the self-heating characteristic remains as a practical operating problem and paves the way for the eventual storage of the residual wastes by ion exchange in the soil in some arid, isolated location. (auth)

FISSION PRODUCT HEAT GENERATION TABLES. W. H. Swift and G. L. O'Neill. Apr. 10, 1956. 57p. (HW-42488)

The heat generation by the radioactive decay of fission products associated with one ton of irradiated U was calculated by the IBM-702 computer for several irradiation histories and for cooling times of 60 to 4000 days. Only those fission products of interest in separations plant waste storage were considered. These fission products are listed along with pertinent data.

10933 CF-56-3-138
Oak Ridge National Lab., Tenn.
HRP-CP: DESIGN OF CONDENSERS H-1 AND H-2 FOR HRT CHEMICAL PROCESSING PLANT. William L. Carter. Mar. 19, 1956. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

There are two condensers in the chemical plant low-pressure system which are used to dissipate heat from radioactive decay of fission products. One condenser is associated with each of the decay-storage vessels. Attenuation of β and γ radiation in the stored slurry of fuel solution and solids causes boiling and decomposition of D_2O. These vapors are passed through a recombiner for D_2 and O_2 recovery and then into the condenser from which the condensate is refluxed to the decay-storage vessel. The condenser is a conventional design of shell and tube heat exchanger. Some of the more pertinent data are summarized. (auth)

190 CF-55-10-101
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE ECONOMICS: OPTIMUM STORAGE TIME PRIOR TO SHIPPING TO DISPOSAL SITE. H. R. Zeitlin and J. W. Ullmann. Oct. 24, 1955. 20p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The economics of waste disposal by pit storage when the geological location of the pits does not coincide with the location of the processing plant are considered. Optimum cooling times before shipment were determined for 250-gallon batches of Purex-type waste. Three distances between processing and disposal sites, and three unit storage costs were considered. It was concluded that as the storage cost increases it becomes economical to ship shorter-cooled waste, and as the shipping distance increases, it becomes economical to store waste longer. In the case of $0.30/gal/yr storage, for 200 miles shipment, essentially no storage should be provided beyond that required for surge in filling carriers. For less highly irradiated material, the optima would shift in the direction of shorter cooling times. Data are tabulated and presented graphically. (C.H.)

FEASIBILITY OF BOILING IN UNDERGROUND TANKS, p. 25-7 of QUARTERLY PROGRESS REPORT FOR FEBRUARY 16-MAY 15, 1955. Decl. Feb. 23, 1957. 60p. (BNL-348)

Temperature distribution studies during breakdown using simulated wastes are given. The corrosion behavior of steel in simulated Purex wastes was investigated. Tables and charts are included.

13731 CF-55-8-76(Del.)
Oak Ridge National Lab., Tenn.
HEAT TRANSFER IN WASTE BASINS. S. H. Jury. Aug. 11, 1955. Decl. with deletions Mar. 11, 1957. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Estimates are made of the heat transfer in proposed out-of-door radioactive waste basins. Calculations are outlined, and complete numerical results are included in appendices. (B.J.H.)

DECAY STORAGE 8.02

HEAT PROBLEMS 8.02.01

1497 AERE-C/R-1294
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE COOLING OF UNDERGROUND FISSION WASTES. J. K. Perring. Nov. 9, 1953. Decl. Jan. 10, 1956. 12p.
A method suggested for the disposal of waste fission products involves their adsorption in clay and burial in deep bore-holes. Approximate calculations are given by which the temperature of the clay at any time can be found. The results are so arranged that answers can easily be obtained for any mixture of the more common fission products. (auth)

9756 KT-95
Massachusetts Inst. of Tech., Oak Ridge, Tenn. Engineering Practice School.
BUBBLE FORMATION IN INTERNALLY-HEATED AQUEOUS SOLUTIONS. W. H. Bowman and G. T. Parish. Nov. 15, 1950. Decl. Mar. 1, 1957. 19p. For Carbide and Carbon Chemicals Div. [K-25 Plant]. Contract [W-7405-eng-26, Subcontract 70]. $4.80(ph OTS); $2.70(mf OTS).
A study was made of the transient and steady state phenomena taking place in an internally heated liquid. Complete discussions are included on results and procedures. Photographs of the bubble formation are also included. (B.J.H.)

PONDS 8.02.02

1333 AECU-3481
Texas. Univ., Austin. Sanitary Engineering Labs.
DEVELOPMENT OF DESIGN CRITERIA FOR WASTE STABILIZATION PONDS. Final Report. E. R. Hermann and E. F. Gloyna. Mar. 1, 1957. 169p. Contract AT(11-1)-220. $1.00(OTS).
Waste stabilization ponds have been used for many years as primary, secondary, and even tertiary sewage treatment devices; however, data for their economical and efficient design and operation have been lacking. The problem of developing rational design criteria for stabilization ponds was attacked on a broad basis; information from prior and contemporary investigators was collected and studied, factors thought to be important in stabilization pond processes were investigated in laboratory models and in outdoor pilot plants, and data reported since 1950 on pond installations at 188 communities throughout the State of

13033 HW-41440
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RECOMMENDED LIMIT FOR RADIOACTIVE LIQUID DISPOSAL FROM HANFORD SEPARATIONS PLANTS TO SURFACE PONDS. H. V. Clukey. Feb. 16, 1956. 5p. $1.80(ph), $1.80(mf) OTS.
A control limit for the activity density of radioactive materials which may be permitted in large-volume waste waters discharged from the Hanford separations plants to open ponds is set forth. The limit 5×10^{-5} microcuries of beta emitters per cc of waste solution was recommended for use in operational control, at the same time providing a criterion for in-line monitoring facilities and alternate routing facilities for the time that the activity density exceeds control limit. (J.R.D.)

4400
CONCENTRATION OF RADIOACTIVITY IN OXIDATION PONDS. E. W. Steel and Earnest F. Gloyna (Univ. of Texas, Austin). Sewage and Ind. Wastes 27, 941-56(1955) Aug.

TANK STORAGE 8.02.03

GENERAL 8.02.03.01

20622 AECU-4271
Fluor Corp., Ltd., Los Angeles.
ECONOMIC STUDY AND REPORT, GROUP II CPP LIQUID WASTE STORAGE FACILITIES. STUDY NO. 8. STORAGE OF NEUTRALIZED WASTE LIQUID. Sept. 1, 1957. 60p. Includes Study No. 5: TYPES OF UNDERGROUND TANKS AND VAULTS. Aug. 30, 1957. 8p. $18.30(ph), $6.00(mf) OTS.
The estimated cost of providing facilities for cooled storage of 1,200,000 gallons of untreated acid waste from the Idaho Chemical Processing Plant is $2,868,890. The estimated cost of providing facilities for cooled storage of the equivalent amount of neutralized waste (1,960,000 gallons) is $2,732,585. However, this figure includes facilities for the transfer of acid from one existing acid waste tank to another or to the neutralizing facilities. For a direct comparison of costs to store the equivalent amount of untreated acid waste, the transfer facilities cost of $103,815 should be deducted resulting in a comparative over-all cost of $2,628,770. A comparison of costs shows an initial saving of $240,120 if neutralized waste facilities are installed. A summary

DECAY STORAGE 8.02

TANK STORAGE 8.02.03

GENERAL 8.02.03.01

of annual operating costs for each of the systems on a comparative basis is presented. The foregoing comparisons show that, while there is a saving of approximately $240,000 in the installation of facilities for neutralizing CPP waste liquids, the operating costs, particularly the cost of caustic, makes storage of neutralized wastes economically unattractive. (auth)

13034 √ HW-51026
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
LEAK DETECTION—UNDERGROUND STORAGE TANKS. W. A. Haney. June 20, 1957. 7p. Contract [W-31-109-Eng-52]. $1.80(ph), $1.80(mf) OTS.
Data are presented relating to the establishment of a leak detection system for radioactive waste storage tanks. The precision of the liquid level measurement for detecting a significant leak and the time interval desirable between measurements for active and static tanks were determined. The limits of predicted percolation rates through the soil, channeling of streams, etc. from a leaking tank and of escaping vapors from active tanks were established. Location of electrodes in the soil in the vicinity of the tank farms to best detect a leak was made. (J.E.D.)

THE RETENTION OF HIGH LEVEL RADIOACTIVE WASTES. A. M. Platt. May 1, 1957. p.389-406 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)
The report describes HAPO waste tank storage, SRP underground waste storage, Idaho Chemical Processing Plant Waste Tank Farm; Waste scavenging as practiced at HAPO, ground disposal at HAPO (cribs, etc.) and ORNL ground disposal.

OPERATIONAL CHARACTERISTICS OF SUBMERGED GAS-LIFT CIRCULATORS. M. W. Cook and E. D. Waters. Dec. 1, 1955. 130p. (HW-39432)
Performance tests have shown that totally submerged gas-lift circulators offer an economic and effective means for achieving mild liquid agitation in large tanks.

PRODUCTION OF ACIDITY IN STORED WASTE. L. L. Burger. Oct. 26, 1955. 3p. (HW-39658)
The contemplated use of air-lift pumps to promote liquid circulation in waste storage tanks has raised the question of N fixation in the air by the high radiation. This production of oxides of N, known to occur primarily in the gas phase rather than through dissolved N, would result in a continued rise in acidity in the waste solution with attendant corrosion problems. A parallel question concerns the neutralization produced by the CO_2 present in atmospheric air. N fixation in the air by radiation, highest in the case of Purex wastes, should contribute at most a few millimoles of acid per liter of solution per yr. An air rate of 5×10^{-6} cfm/l of waste would introduce acidity from the CO_2 present at a rate of 1.7 millimoles/l/yr, also an insignificant rate. More acidity may conceivably be produced by radiation decomposition of organic matter present.

187 TID-10142
Hanford Atomic Products Operation, Richland, Wash.
DECONTAMINATION OF BISMUTH PHOSPHATE PROCESS FIRST CYCLE WASTE SUPERNATANTS. R. E. Burns, H. S. Gile, and C. R. McMullen. Sept. 10, 1953. Decl. Oct. 2, 1956. 17p. Contract [W-31-109-Eng-52]. $0.30 (OTS).
First decontamination cycle wastes from the Hanford Atomic Products Operations Bismuth Phosphate Process are made alkaline and stored in large underground tanks. Settling of solids produced on making the wastes alkaline effects considerable decontamination but not enough that very large volumes of the supernatants can be discharged to ground. The effectiveness of tannic acid, Ca_2PO_4, CaC_2O_4, $Fe_4[FeCN_6]_3$, and Fe_2FeCN_6 as carrier precipitates, and CaC_2O_4, Attaclay, and Attapulgus clay as solid adsorbents for the decontamination of supernatants from aged first cycle wastes has been studied. Plutonium, fission-product, and gross salt content of supernatants from several waste tanks are given along with decontamination factors for Pu and fission products obtained when these supernatants were treated under varying conditions with the adsorbents and carrier precipitates noted above. (auth)

TANK DESIGN 8.02.03.02

13991 HW-57282
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DESIGN OF UNDERGROUND STORAGE TANKS FOR

DECAY STORAGE 8.02

TANK STORAGE 8.02.03

TANK DESIGN 8.02.03.02

RADIOACTIVE WASTES. E. Doud. [1959]. 25p. Contract W-31-109-Eng-52. $4.80(ph), $2.70(mf) OTS.

For presentation at the American Institute of Chemical Engineers at Atlantic City, N. J., March 17, 1959.

The design features of four types of storage tanks used at production plants are described. The design considerations for future tanks including heat generation and dissipation problems are discussed. (auth)

7736 HW-57274

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INSTABILITY OF STEEL BOTTOMS IN WASTE STORAGE TANKS. L. E. Brownell. Aug. 29, 1958. 26p. Contract [W-31-109-Eng-52]. $4.80(ph), $2.70(mf) OTS.

In June 1958 measurements on Hanford waste storage tank 113-SX showed an upward dishing of the tank bottom to a height of about 4 feet, followed by a return of the liner to a horizontal position later in the month. It was thought that vapor pressure between the steel liner and the concrete bottom caused the dishing, with a subsequent pressure release allowing the liner to return to a horizontal position. Suggestions for storage tank design changes are presented, as well as procedures for preparing 113-SX for reuse. In addition, procedures are suggested for filling other existing tanks in SX and Purex tank farms, and the reuse of empty tanks built before 1949. (J.R.D.)

5852

TANKS FOR 1000 YEARS: DESIGN CONSIDERATIONS OF STORAGE TANKS FOR RADIOACTIVE WASTE. Edgar E. Wilson. Chem. Eng. Progr. 53, 151M-2M(1957) Mar.

WELDABILITY TESTS OF FOUR HIGH STRENGTH STRUCTURAL STEELS. G. W. Riedeman. Aug. 9, 1955. 8p. (HW-37956)

As part of a design program for HAPO waste storage tanks, a study was made of possible fabrication materials. This study revealed that the steels which were tested can be welded without the benefit of preheat and/or postheat treatment for structural applications involving materials about one-half inch in thickness using low-hydrogen, iron-powder-coated electrodes.

1360

DESIGN CONSIDERATIONS OF STORAGE TANKS FOR RADIOACTIVE WASTES. Edgar E. Wilson (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Chem. Eng. Progr. 52, Symposium Ser. No. 19, 153-7(1956).

The basic considerations involved in designing facilities for the long-term storage of radioactive wastes at the Savannah River Plant are presented. The storage facilities initially installed consist of 750,000-gal., 75-ft-diam. carbon steel tanks surrounded by concrete housings forming annuli to permit accumulation, detection, and removed of leakage. The tanks were built in a pit, waterproofed, and covered with earth. In a subsequent installation the tank size was increased to 1,000,000 gal., but the tops of the concrete housings were located slightly above finished grade and the bottoms of the steel tanks at the groundwater level. (auth)

FIELD CORROSION TEST-SAE 1020 CARBON STEEL IN REDOX PROCESS WASTE SOLUTION TANK NO. 104, 241-S. N. Endow and K. L. Sanborn. Aug. 11, 1954. Decl. Jan. 6, 1956. 24p. (HW-32755)

Data collected in corrosion tests on SAE 1020 steel specimens exposed in the radioactive waste solution from the Redox plant indicate that the corrosion rates do not differ significantly under conditions of self-concentration of wastes, from those measured in similar solutions at temperatures less than boiling. This observation may be considered valid for Redox waste up to 250°F and may apply at temperatures somewhat above 300°F. The maximum temperature recorded for the waste solution in the tank in which the specimens were exposed was 250°F, although temperatures in excess of 300°F may have been attained during the test. One stressed specimen was included in the test for the purpose of evaluating possible effects of stress corrosion cracking, but no evidence of stress corrosion cracking was observed after 9 months exposure.

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01

See also, under PROCESS CHEMISTRY AND ENGINEERING,
RADIATION EFFECTS--Glass (6.15.04),
Other Solids (6.15.09),
SINTERING (6.18).

CLAY 8.03.01.01

PRELIMINARY TESTS ON CLAY SINTERS TO RETAIN REACTOR WASTES. J. M. Kerr (Oak Ridge National Lab., Tenn.). Am. Ceram. Soc. Bull. 38, 374-6(1959) July.

The primary object of this investigation was to study the fixation of radioisotopes by clays and other fine grained naturally occurring materials. By progressively decreasing the amount of clay added to a given amount of waste solution tagged to a given activity, the minimum amount of clay necessary to retain the activity was determined. Mixes which gave the best results consisted of 100 g of shale with fluxes, 50 g of phosphate slime, and 50 g of a processed attapulgite clay, each with 250 ml of a simulated waste solution. The waste solution used in these investigations consisted of 1.6 M $Al(NO_3)_3$, 0.16 M HNO_3, 0.02 M H_2SO_4, mixed fission products, and carriers. Relatively high activity levels in the simulated waste solution were used in several mixes and indications were that increased firing temperatures would be necessary to retain the higher activity. These relatively high-activity levels were in the range of 200,000 to 400,000 beta counts/min/ml. Flux additions were made to an attapulgite clay and aluminum nitrate solution mixture. Results show that various fluorides will materially reduce the fusion temperature. (auth)

1175

FIXATION OF FISSION PRODUCT WASTES FOR ULTIMATE DISPOSAL. J. R. Grover (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Chem. & Process Eng. 40, 263-7, 270(1959) Aug.

Details are given for fixing fission product wastes in montmorillorite clay. Descriptions are given of various pieces of equipment used in the process at the Hanford Works including remotely operated make-and-break joints and a disposal canister. (C.J.G.)

10483

EQUILIBRIUM STUDIES ON NATURAL ION-EXCHANGE MINERALS. II. CAESIUM, SODIUM AND AMMONIUM IONS. C. B. Amphlett and L. A. McDonald (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 6, 145-52(1958) Apr.

Isotherms and values of thermodynamic equilibrium constants were derived for exchange within the systems Cs^+-Na^+ and $Cs^+-NH_4^+$ upon lower greensand soil; solid phase activity coefficients were also calculated. The results are compared with those of other workers on pure clay minerals; as in the case of the Cs^+-Sr^{2+} exchange, it is found that the equilibrium is less favorable towards Cs than for pure montmorillonite, but more so than for attapulgite, confirming the intermediate position of the mixed-clay mineral in the case of the soil. (auth)

10564

DISPOSAL OF LONG-LIVED FISSION PRODUCTS. J. R. Grover (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Conf. 3, 80-5(1958) Jan.

A process for the permanent fixation of fission product Sr^{90} and Cs^{137} is described. The highly active ions are adsorbed on granulated montmorillonite clay and fixed by firing the clay to 1200°C. Details are given of a remotely controlled experimental pilot plant to test the process. (auth)

GRANULAR CLAY FOR ION EXCHANGE USE IN EFFLUENT DISPOSAL. J. R. Grover. Apr. 1957. 5p. (AERE-CE/M-200)

The results of studies for the disposal of long lived fission products in AERE silica bonded clay in regard to the breakthrough capacity, ultima e capacity, and friability is presented.

8302

ADSORPTION STUDIES ON CLAY MINERALS. VI. ALKALI IONS ON ATTAPULGITE. C. Neale Merriam, Jr., and Henry C. Thomas (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys. 24, 993-5(1956) May.

The exchange equilibria of the alkali ions Cs, K, Na, and Li on attapulgite have been studied at 30 and 75°C. Thermodynamic data for the systems have been calculated. Cesium is the most strongly adsorbed ion and the others follow in the order given. The specificity of the clay becomes lower at the higher temperature. (auth)

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01

CLAY 8.03.01.01

REACTOR EVALUATION QUARTERLY PROGRESS REPORT FOR JANUARY-MARCH 1957. R. J. Beeley, ed. June 15, 1957. 29p. (NAA-SR-1938)

Various methods of high-activity fission product waste disposal were considered; the present method of storage in large underground tanks can be considered only as a temporary expedient. Permanent methods of disposal must be found if an ever-growing waste-tank farm is to be prevented. Disposal in the ocean of liquid or packaged projectiles has too many uncertainties to warrant consideration. Permanent disposal in montmorillonite clay or in Al_2O_3 appears promising for land disposal and even ocean disposal. A number of permanent disposal methods are under development to obtain the objectives of maximum use and ultimate safe confinement at low cost. The problem of disposal, though serious, does not appear as insurmountable as is sometimes depicted.

2327 BNL-2388
Brookhaven National Lab., Upton, N. Y.
THE EVALUATION OF MONTMORILLONITE CLAY FOR THE PICKUP AND FIXATION OF M.F.P. ACTIVITY IN THE PRESENCE OF BORIC ACID. George P. Simon. Sept. 27, 1954. Decl. Dec. 5, 1955. 13p. $3.30(ph OTS); $2.40(mf OTS).

An attempt was made to evaluate the pickup of mixed fission product activity on montmorillonite clay from boric acid solutions (0.1M). The average decontamination factor observed for an eight liter run using a 30 g extruded clay column was 190. This decontamination factor shows no apparent sign of decreasing at the present time. The clay column effluent was further cleaned by using various organic cation and anion exchangers. It has been observed that an overall process decontamination factor of 0.5×10^4 may be realized with a clay-anion exchanger system. (auth)

8323
RADIOACTIVE CONCENTRATOR AND RADIATION SOURCE. L. P. Hatch (to U. S. Atomic Energy Commission). U. S. Patent 2,918,700. Dec. 29, 1959.

A method is presented for forming a permeable ion exchange bed using Montmorillonite clay to absorb and adsorb radioactive ions from liquid radioactive wastes. A paste is formed of clay, water, and a material that forms with clay a stable aggregate in the presence of water. The mixture is extruded into a volume of water to form clay rods. The rods may then be used to remove radioactive cations from liquid waste solutions. After use, the rods are removed from the solution and heated to a temperature of 750 to 1000°C to fix the radioactive cations in the clay.

22990
FIXATION OF RADIOACTIVE WASTES IN STABLE SOLIDS. L. P. Hatch (Brookhaven National Lab., Upton, N. Y.). p.1839-44 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

A process for ultimate waste disposal which involves the adsorption and fixation of fission products in natural clay minerals is described. The design of a proposed calciner plant is presented. (C.J.G.)

OTHER SOILS 8.03.01.02

10124 AERE-C/R-1686
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
FIXATION OF ACTIVITY IN SOLID FORM BY ABSORPTION ON SOILS. PART I. FIRING AND LEACHING TESTS. C. B. Amphlett and D. T. Warren. June 1956. 11p. (FPSD/P-15).

The absorption of radioactivity from waste solutions on soils, followed by firing at high temperatures, has been studied as an alternative to fixation processes involving clay minerals. Fixation on soil is as efficient as on clay. Two types of process have been investigated, one based on ion exchange, and one in which the soil is used as a base for manufacture of a ceramic product by mixing with the waste and firing. Both types of operation give high decontamination factors under suitable conditions, but the second enables a higher loading to be achieved and is applicable to a much wider variety of wastes. The engineering problems associated with large-scale operation are simpler in the first case, although there is no doubt that the second system can also be scaled up if desired. (auth)

THE POSSIBILITY OF SELF-FIXATION OF HIGHLY ACTIVE WASTES. C. B. Amphlett. Feb. 1956. 8p. (AERE-C/R-1862; FPSD/P-12)

This report summarizes the uses of siliceous minerals to absorb activity either by ion exchange or by firing to produce mixed silicates. It is concluded that ion-exchange

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01.01

Other Soils 8.03.01.02

methods are best suited to fairly pure active materials in solution, but that the alternative process offers promise for absorption and fixation in solid form of bulk highly active wastes containing large proportions of inactive contaminants and of acid. It may also be applicable to solid wastes and suspensions.

CEMENT 8.03.01.03

PRE QUARTERLY PROGRESS REPORT FOR APRIL-JUNE 1957. D. I. Sinizer, J. R. Foltz, K. L. Mattern, and E. E. Motta. Sept. 15, 1957. 50p. (NAA-SR-2030)

The liquid waste from the Pyroprocessing-Refabrication Experiment facility has been defined as follows: (1) Low level: $<10^{-4}$ μc/cc; (2) Medium Level; 10^{-4} to 1 μc/cc; (3) High level: >1 μc/cc. The low-level waste will be diluted with radioactively cold sewage to a level of $<10^{-6}$ μc/cc and sent to a disposal field. The medium-level waste will be used for mixing the concrete, which in turn will be used for the solid waste disposal. The surface intensity from a 55 gallon drum filled with "hot" concrete (made with liquid waste containing 1 μc/cc) is about 30 mr/hr. Since maximum surface intensities of 200 mr/hr are allowable solid waste may be canned in hot concrete in quantities sufficient to raise the surface intensity to 200 mr/hr. The high-level liquid waste will be run through a flocculation tank, filters, and a demineralizer. The effluent will be medium-level waste which can then be used as described above for mixing "hot" concrete for solid-waste disposal. (The information on waste disposal in the above report appears in its entirety in this abstract.)

6255 KLX-1377
Vitro Corp. of America, New York.
DISPOSAL OF RADIOACTIVE WASTES IN CEMENT. JOB 24-A. June 18, 1952. Decl. Dec. 5, 1955. 15p. Contract AT(30-1)-850. $0.15(OTS).

Based on the laboratory and pilot plant operations, the recommended procedure for the disposal of aqueous radioactive solutions in cement is as follows: A 55-gal drum is placed on a drum roller and is charged with approximately 25 gal of alkalized radioactive liquid waste. To this solution four 95 lb bags of Portland cement are added. The drum is then closed and rolled at 3 rpm for about 15 minutes with periodic venting to a hood to prevent excessive pressure build-up. The drum is removed from the roller and allowed to stand until the cement mixture has set, which usually takes place in about 4 hours. (auth)

CERAMICS 8.03.01.04

CERAMIC SPONGES FOR RADIOACTIVE WASTE DISPOSAL. C. W. Christenson (Los Alamos Scientific Lab., N. Mex.). J. Am. Water Works Assoc. 51, 388 (1959) Mar.

Porous clay bodies for radioactive waste disposal were investigated. Preliminary results indicate that some ceramics absorb from 50 to 200% of their weight. Ceramic sponges which had absorbed Sr-90 and Cs-137 were fired to 1300°C with subsequent water leaching. No appreciable radioactivity was found in the leach solutions. Since the method has shown promise, a full-scale investigation is planned. (J.R.D.)

5523 AERE-R-3056
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
STRONTIUM CERAMICS AND GLASSES. P. J. Jones. Sept. 1959. 16p. BIS.

Investigation of the leaching, volatilization, and enamel forming properties of glasses and ceramics are reported in the following systems: boron oxide–silicon oxide–sodium oxide–strontium oxide; aluminum oxide–silicon oxide–sodium oxide–strontium oxide; and strontium oxide–titanium(IV) oxide. (auth)

CERAMIC ASPECTS OF WASTE DISPOSAL AND SELF FUSION EXPERIMENTS. p.98-104 of METALLURGY DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 10, 1955. June 14, 1956. Decl. Apr. 26, 1957. 104p. (ORNL-2078(Del.))

Experiments are reported on the fixation of radioisotopes in various ceramic bodies. Experiments show that a mixture of Na_2CO_3 and limestone with shale is more effective in retaining radioisotopes than a mixture of limestone and shale alone. Of all the isotopes tested, the radioactive Cs-Ba mixture appears to be the most difficult to fix in a ceramic body. The degree of fixation required will depend to a large extent on the storage conditions. The amount of fixation is dependent upon the temperature used to fire bodies.

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01

CERAMICS 8.03.01.04

PACKAGING OF RADIOACTIVE WASTE IN CERAMIC BODIES. Lane Mitchell. Jan. 30, 1956. 24p. (CF-56-1-131)

A preliminary investigation was made of the adsorption and absorption of radioisotopes by porous ceramic slugs. Procedures for the tests are outlined, and results are summarized.

22996

DISPOSAL OF HIGH-LEVEL WASTES BY FIXATION IN FUSED CERAMICS. Rolf Eliassen and Morton I. Goldman (Massachusetts Inst. of Tech., Cambridge). p.1966-79 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

A study was conducted on the conversion of acid aluminum nitrate fission product wastes to relatively insoluble, high melting point glasses which can be stored safely in the ground. Of the vitreous ceramic systems, the systems $CaO-Al_2O_3-B_2O_3-SiO_2$ and $Na_2O-CaO-Al_2O_3-B_2O_3-SiO_2$ show the greatest promise. Advantages of various ceramic systems are given. (C.J.G.)

22997

THE USE OF CERAMIC SPONGES FOR ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. p.2000-3 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

The process involves the firing of a highly porous clay body to about 800°C. The body is then soaked in liquid waste, dried, resoaked and the cycle repeated as many as four or five times, after which the body is fired at a temperature of about 1300°C to permanently fix the radionuclides. It was found that some ceramics will absorb a Purex waste to about 50 wt. %. (C.J.G.)

14513 A/CONF.15/P/388

Massachusetts Inst. of Tech., Cambridge.

RETENTION OF FISSION PRODUCTS IN CERAMIC GLAZE-TYPE FUSIONS. M. I. Goldman, J. A. Servizi, R. S. Daniels, T. H. Y. Tebbutt, R. T. Burns, and R. A. Lauderdale. 12p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Archaeological evidence has indicated the stability of ceramic glazes. Results are presented of investigations directed toward the fixation of fission products from high-aluminum-content fuel reprocessing wastes in a highly stable fused ceramic from which the fission products cannot be leached by water. Cesium is the most readily leached of the non-volatile fission products and was used as the test element for evaluation of composition parameters in the ceramic glaze systems: $CaO:Na_2O:Al_2O_3:SiO_2:B_2O_3$ and $CaO:Al_2O_3:SiO_2:B_2O_3$. The process advantage lies in the fact that aluminum (normally an interfering ion in many proposed waste treatment processes) is a necessary constituent of the solid product formed. The ceramic glaze can, in fact, be produced from the calcined product formed in the fluidized bed process employed at the Idaho Chemical Processing Plant. It is well known that fission products are easily leached from the latter. A new leaching test, which involves refluxing the product in distilled water, has been developed and adopted as a more sensitive indication of the retention of fission products in the ceramic. Volatility of fission products has been determined as a function of ceramic composition parameters and firing conditions with the objective of minimizing their evolution during the firing process. Radiation stability of various ceramic products has been investigated. Estimates of heat production and heat transfer characteristics have been used to develop conceptual process and storage facility designs. Extension of this process to wastes from processing of zirconium and stainless steel clad and alloyed fuel elements is discussed. (auth)

FIXATION OF HIGHLY ACTIVE WASTES IN SOLID FORM. C. B. Amphlett. Sept. 25, 1956. 17p. (UK/C/5/19)

Radioactive species in waste solutions may be fixed by mixing with suitable siliceous materials (e.g. soils, clays, or natural silicate minerals) and firing to high temperatures to produce a ceramic which suffers very little leaching by water or aqueous solutions. Fluxes may be added if required to lower the temperature of melting, without adversely affecting the fixation of activity. Apart from the case of Ru under certain conditions, the loss of activity during the firing process is negligibly small. The method is more versatile than one based on ion exchange, and allows slurries and solids to be treated as well as solutions. Comparison is made between these 2 alternative processes regarding remote operation on a highly active scale, and the development work necessary to scale up the ceramic process is outlined briefly.

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01

GENERAL 8.03.01.05

14215 AECU-4171
General Dynamics Corp. Electric Boat Div., Groton, Conn.
INVESTIGATION OF METHODS FOR RADIOACTIVE RESIN DISPOSAL. Final Report M 786. F. J. Craven. May 19, 1959. 25p. Contract [AT(30-3)-338]. (TSD-59-117). $4.80(ph), $2.70(mf) OTS.

Cement–sand–resin and litharge–glycerin–resin were investigated for use in immobilizing confined, contaminated resins from reactor water demineralizer beds. The concrete was not useful in this application because of its sensitivity to the activity in the ion exchange resin, while the litharge–glycerine gave satisfactory results. Experimental procedure and results are discussed. (J.R.D.)

14753 A/CONF.15/P/2441
North Carolina. Univ., Chapel Hill.
SOME FUNDAMENTAL PROBLEMS IN FIXATION OF RADIOISOTOPES IN SOLIDS. Henry C. Thomas. 19p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The stability of radioactive glasses and sinters and the problems of mobility of radioactivity within masses of earth are discussed. Diffusion in crystals and glasses, the stability of sinters, and adsorption and the motion of radioactive nuclides in wet earth are the topics covered. (T.R.H.)

7216 TID-7550
Division of Reactor Development, AEC.
REPORT OF WORKING MEETING ON FIXATION OF RADIOACTIVITY IN STABLE, SOLID MEDIA AT THE JOHNS HOPKINS UNIVERSITY, JUNE 19-21, 1957. James M. Morgan, Jr. 112p. $2.50(OTS).

Papers were presented at the meeting on the following subjects: waste characteristics governing fixation in soils; chemical processing of the alumina fluid calciner product into alumina silicates; fixation of fission products in stable compounds; résumé of ceramic section of Oak Ridge National Laboratory; fixation of fission products in ceramic glazes; fission product disposal in glass; leaching studies on fired clays containing radionuclides; evaluation of experimental clinkers; fixation of active wastes in solid form using natural soils as media for glass formation; separation of cesium and strontium from calcined metal oxides as a process in disposal of high level wastes; fixation of radioisotopes on Hanford type soils; tests of stability; calcination of aqueous reactor fuel wastes in a fluidized bed; experiments on fluidized bed calcination of Idaho Chemical Processing Plant wastes using radioactive feed material; ball kiln calcination of alloy fuel element wastes; incorporation of fission products into glass; ultimate disposal of long-lived fission products; high-temperature gas cleaning problems; heat evolution and dissipation; problems associated with waste calcination schemes; sintering of reactor wastes; problems associated with the formation of ceramic clinkers; and storage of reactor fuel wastes in salt formations. (W.L.H.)

22992
THE INTERACTION OF RADIOACTIVE NUCLIDES AND SOILS. AN ACCOUNT OF OUR PRESENT POSITION WITH RESPECT TO THE BASIC PROBLEMS INVOLVED. Henry C. Thomas (Univ. of North Carolina, Chapel Hill) and N. T. Coleman (North Carolina State Coll., Raleigh). p.1861-1912 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

By assuming that fixation will never be quite complete and disposal never quite final, the problem of the fate of radioactive poisons which have escaped to the environment is discussed. A classification is given of the distribution and different kinds of surface activity exhibited by the soil minerals with emphasis on complex mixtures of hydrous oxides and clay minerals. A thermodynamic description of exchange sorption and Donnan invasion is given and thermodynamic functions for various clay systems are graphically shown. (C.J.G.)

GLASS 8.03.01.06

13990 CRCE-816
Atomic Energy of Canada Ltd., Chalk River, Ont.
EQUIPMENT AND METHOD OF OPERATION FOR INCORPORATION OF FISSION PRODUCTS INTO GLASS. L. C. Watson, A. R. Bancroft, J. D. Gamble, G. T. Leaist, and D. T. Nishimura. Dec. 1958. 32p. (AECL-756). $1.00(AECL).

Equipment is described that has been used to incorporate over 1800 curies of mixed fission products into glass blocks to obtain information on this method of disposing of fission products. The two-kilogram blocks

DISPOSAL METHODS 8.03

FIXATION IN SOLID MEDIA 8.03.01

Glass 8.03.01.06

were made two at a time and contained up to 50 curies of mixed fission products per kilogram of glass. Also described is equipment for measuring the quantity of fission products released from the glass into water and for determining the behavior of the fission products when the resulting solution is passed through soil. (auth)

14867 CRDC-841
Atomic Energy of Canada Ltd., Chalk River, Ont.
THE DURABILITY OF SOME SILICATE GLASSES THAT COULD BE USED IN FISSION PRODUCT DISPOSAL.
R. W. Durham and D. Bell. Aug. 1958. 31p. (AECL-817). $1.00(AECL).

The corrosion by water of glass made by fusing nepheline syenite with various fluxing agents has been investigated. The objective is to obtain a workable glass that would incorporate waste fission products and have a high resistance to attack by water. Glass of composition 15 wt. % CaO, 85 wt. % nepheline syenite, has been found to have a corrosion rate of 2×10^{-8} g glass/cm^2-day at room temperature after the first few days of water contact. The effect of pH on the corrosion rate has been investigated and also the selective leaching of cations of different valency. (auth)

7059 A/CONF.15/P/195
THE DISPOSAL OF FISSION PRODUCTS IN GLASS.
L. C. Watson. R. W. Durham. W. E. Erlebach, and H. K. Rae (Atomic Energy of Canada Ltd., Chalk River, Ont.). 20p.

The disposal of fission products as components of a durable glass offers great promise as a method by which acceptable containment may be achieved at reasonable cost. The glass which has been studied most thoroughly at Chalk River is based on the glass-forming rock, nepheline syenite, suitably fluxed with lime. The rate of release of fission products from this glass to water is very low. For a typical glass containing 85 wt. % nepheline syenite and 15% lime, the measured rate of release of cesium-137 is equivalent to dissolution of about 10^{-7} grams of glass per square centimeter per day. The method of converting waste solution to glass involves a simple mixing of the dry, glass-forming materials with the solution of fission products in concentrated nitric acid; this solution may also contain dissolved sheathing materials. The components react to form a gel which can be dried and denitrated without giving rise to severe entrainment or dust. The mixture is melted at 1350°C and when cooled forms a glass. An extensive preliminary appraisal of methods of storing glass containing fission products was made, and it appears that storage can be accomplished at a cost under 0.01 mills per kwh. If the very low leaching rates achieved in the glass are not acceptable for the burial of megacuries of fission products in contact with ground water, dry storage can be provided. Several methods have been considered for the dissipation of heat generated in the glass by fission-product decay.

FIXATION OF ACTIVITY IN SOLID FORM BY ABSORPTION ON SOILS. PART 2. FINAL REPORT. A. B. Amphlett and D. T. Warren. Apr. 1957. 11p. (AERE-C/R-2202; FPSD/P-22)

By incorporating radioactive solutions into mixtures of waste solutions and soil, glasses are formed on heating to temperatures of ~1000°C. Leaching tests show that these are highly resistant to water and would be suitable for disposal of highly-active wastes. Only Ru volatilizes appreciably during the firing process, and its loss may be kept to a minimum by suitable control of the processing, as it is easily trapped, and could be returned to the process if required. The results of this work are compared with those of other studies on solid fixation.

568
FIXATION OF RADIOACTIVE WASTES BY FUSION WITH SILICATE MELTS. Jiří Beránek (Komise pro atomovou energii, [Prague]); Karel Lustig (Obalový ústav, Prague); and Jaroslav Saidl (Ústav jaderného výzhumu ČSAV, Prague). Jaderná energie 5, 261-5 (1959). (In Czech.)

The possibilities for fixation of radioactive wastes are briefly summarized, and waste disposal in glass is indicated to be the safest method. Details on the selection of raw materials from local resources and the different steps of technological operations are given. In conclusion various possibilities of radioactive glass storage are discussed. (auth)

DISPOSAL METHODS 8.03

GASEOUS FISSION-PRODUCT DISPOSAL 8.03.02

See also, under FISSIONABLE MATERIAL--RECOVERY,
HEAD-END TREATMENTS--Off-Gas (3.01.06),
and,
under PLANTS AND EQUIPMENT,
FILTERS (5.08),
and,
under PROCESS CHEMISTRY AND ENGINEERING,
RADIATION EFFECTS--Gases (6.15.03).

12514 BNL-545
Brookhaven National Lab., Upton, N. Y.
CATALYTIC DECOMPOSITION OF NITROUS OXIDE.
Meyer Steinberg. Mar. 1959. 10p. $0.50(OTS).

In processing waste gas streams from nuclear fuel plants for recovery of the noble gases, nitrous oxide must first be removed. A catalyst consisting of 0.5% rhodium supported on ⅛-in. alumina pellets has been found capable of decomposing nitrous oxide in simulated waste gas streams at catalyst temperatures ranging from 343 to 413°C, when gas space velocities range from 525 to 2220 standard cubic feet of gas per hour per cubic foot of packed catalyst volume. Hydrogen in concentrations up to 2.3% is simultaneously removed from the entering gas streams. Gases containing 5.6 to 22.0% by volume N_2O, 1.6 to 2.3% H_2, and 13.3 to 17.8% O_2, the remainder being N_2, were reduced by the catalyst to gases containing less than 100 ppm N_2O and no H_2. Less than 50 ppm NO was found in the effluent gas. The presence of higher oxides of nitrogen and acetylene does not decrease the activity of the catalyst. Under comparable conditions a palladium catalyst requires temperatures up to 114°C higher than a rhodium catalyst, and a platinum catalyst 270°C higher. The decomposition of N_2O over rhodium tends to follow first-order kinetics with an activation energy of +23.2 kcal/mole. (auth)

GASEOUS FISSION-PRODUCT DISPOSAL. p.147-148 of HOMOGENEOUS REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1957. Jan. 21, 1958. 207p. (ORNL-2432)

Dynamic studies of the adsorption of fission gases on HRT charcoal showed that Xe was adsorbed 16 times more strongly than Kr. In equilibrium-adsorption studies, Linde molecular sieves 5A had ~25% of the capacity of charcoal for Kr adsorption.

68 UCRL-8356
California. Univ., Berkeley. Radiation Lab.
DISSOCIATION ENERGIES OF GASEOUS OXIDES. Leo Brewer. July 1958. 4p. Contract W-7405-eng-48. $1.80(ph OTS); $1.80(mf OTS).

Preliminary thermodynamic tabulations for gaseous oxides are presented. (J.R.D.)

932 BNL-3878
Brookhaven National Lab., Upton, N. Y.
WASTE PROCESSING STUDIES MONTHLY PROGRESS REPORT [FOR] JULY 1958. M. Steinberg and S. Zwickler. July 30, 1958. 8p. $1.80(ph OTS); $1.80 (mf OTS).

An intensive study of the solubilities of Kr, Xe, N_2O, Ar, N_2, and O_2 in Freon-12 (CCl_2F_2) over a range of temperatures was carried out. Data are presented, and Henery's Law constants are given for the gases in F-12. (For preceding period see BNL-3877.)

10488 CF-58-5-59
Oak Ridge National Lab., Tenn.
PROPOSED METHOD FOR REMOVAL OF RADIO-IODINE VAPOR FROM EXPERIMENT OFF-GAS SYSTEM OF THE ORR. R. E. Adams and W. E. Browning. May 21, 1958. 13p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Various methods of removing radio-iodine from air streams were surveyed for possible use in removing radio-iodine accidentally released from reactor experiments into the experiment off-gas system of the ORR. Solid adsorber materials appear to be best suited for this purpose. An iodine decontamination factor of 2000 was experimentally determined for activated charcoal and Linde Molecular Sieve Material (13X) using I^{131} to simulate mixed radioisotopes of iodine. A conceptual design for an iodine trap containing activated charcoal is presented. The iodine removal efficiency of this hypothetical trap is discussed under conditions resulting from discharge of 3.0×10^4 curies of mixed radioisotopes of iodine into the ORR experiment off-gas system. (auth)

DISPOSAL METHODS 8.03

GASEOUS FISSION-PRODUCT DISPOSAL 8.03.02

Nuclear Metals, Inc., Cambridge, Mass.
REMOVAL OF FISSION PRODUCT GASES BY TRANSIENT MELTING. A. R. Gilman. May 6, 1957. Decl. Aug. 2, 1957. 52p. Contract AT(30-1)-1565. $9.30(ph OTS); $3.60(mf OTS).

Coextruded pin-type fuel elements were obtained with Xe in the core as a result of the decay of I^{131} introduced by previously melting the U with NaI^{131}. The removal of the Xe was attempted by transient melting in a vacuum at a speed of 3 to 5 in./min. The temperature was maintained low enough to enable the cladding to support the vertically-mounted rod and to minimize solution of the cladding in the core. Essentially complete Xe removal was achieved in the first pass, but N_2 and H_2 evolution persisted in subsequent passes. (auth)

14746 A/CONF.15/P/397
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TREATMENT OF RADIOACTIVE WASTE GASES. A. G. Blasewitz and W. C. Schmidt. 13p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The disposal of radioactive waste gases from the plant-scale processes at the Hanford Atomic Products Operation presents a problem that is of considerable importance in plant operation. Equipment developed for the efficient removal of the two principal contaminants: 1) gaseous radioactive iodine; and 2) an aerosol composed of other fission products is described. The program has led to the development of the silver reactor for the removal of gaseous iodine and deep-bed, glass-fiber filters for removing the particulate matter suspended in the gas streams. Field data and the empirical equations established for design purposes are pre-

DISPOSAL OF GASEOUS EFFLUENTS FROM NUCLEAR POWER PLANTS. B. H. Hamling and G. F. Jenkins (Union Carbide Nuclear Co., New York). J. Air Pollution Control Assoc. 7, 256-61(1958) Feb.

Information is presented on the disposal of gaseous wastes from nuclear power installations. Discussions are included on: hazards and sources of radioactive air contaminants; reactor types and supporting facilities; waste disposal facilities; and measurement and monitoring of airborne activity. (J.H.M.)

14604 A/CONF.15/P/1834
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
METEOROLOGICAL FACTORS IN THE APPRAISAL AND CONTROL OF ACUTE EXPOSURES TO STACK EFFLUENTS. James J. Fuquay. 19p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A method is developed for use in the analysis and meteorological control of atmospheric pollution problems resulting from gaseous emissions from tall stacks. Special attention is given to the dilution of the gas within the stack due to the addition of excess air. Control parameters are developed for cases in which short periods of high concentration are important, as contrasted to long-period average concentrations. Application of the method is demonstrated with a sample calculation. (auth)

TREATMENT OF GASEOUS EFFLUENTS. W. C. Schmidt. Apr. 10, 1957. 26p. (HW-49549-A)

Equipment for the removal of noxious radioactive waste gases from chemical processing facilities is described. The report is divided into 2 parts, (1) the equipment necessary for the removal of particulate radioactivity present as an aerosol and (2) radioactivity which is present as a true gas. Data on waste gas decontamination and empirical equations for design calculations are presented. A short section on the difficulties experienced in operating the equipment is also included. (This is also available in TID-7534, Symposium on the Reprocessing of Irradiated Fuels Held at Brussels, Belgium, May 20-25, 1957.)

PROCEEDINGS OF THE SRE-OMRE FORUM HELD AT LOS ANGELES, CALIFORNIA, NOVEMBER 8 AND 9, 1956. Jan. 15, 1957. 313p. (TID-7525; NAA-SR-1804)

A brief description is given on p.19, 39, and 40 of the SRE gaseous and liquid waste disposal systems. The system accepts vented gases from many of the components serviced by the N_2 and He systems, in the event that radioactivity levels in the vented gas are above some predetermined magnitude. The radioactive gas is then stored in either of two shielded tanks of 5400 ft^3 at 100 psig capacity. If, at some later time, the radioactivity level is determined to be sufficiently low, the gas may be bled from these storage tanks, diluted, and discharged out the building stack. The liquid waste is principally from fuel cleaning and hot cell operations. It is pumped from a sump to one or more of ten

DISPOSAL METHODS 8.03

GASEOUS FISSION-PRODUCT DISPOSAL 8.03.02

METEOROLOGY AS RELATED TO WASTE DISPOSAL AND WEAPONS TESTS. J. J. Fuquay. Jan. 15, 1957. 39p. (HW-47721-A)

Meteorological factors affecting the atmospheric dispersal of radioactive particles, whether stack effluent or fall out following weapons tests are discussed. Factors include atmospheric stability, basic smoke plume patterns, atmospheric dilution, fall out and rainout deposition, wind structure, and others. (This report supersedes HW-47721.)

4238 AEC-tr-3098
ISOTOPIC EFFECTS IN THE ADSORPTION OF A GAS ON SOLIDS. P. Caldirola and G. Rossi. Translated from Nuovo cimento (10) 5, 1316-32(1957). 28p.

The isotopic effects that are manifested in the adsorption process of a gaseous mixture on a solid surface have been studied by using as a basis the Lennard-Jones theory of the interaction of atoms and molecules with solid surfaces. The general outlines of this theory are given and adapted to the problem under consideration. The formulas derived for a mixture of two generic isotopic species are applied to the particular case of the adsorption of He (He^3 and He^4) on LiF. It has been found that on the adsorbent surface the isotopic enrichment δ_{ads} under stationary conditions is always lower than the δ_k of Knudson which is characteristic of diffusion phenomenon, and that it approaches it with an increase in temperature. (auth)

10385 SCL-T-188
ON THE DIFFUSION OF DUST AND GASES FROM CHIMNEY-STACKS. (O Rasprostranenii Pyli i Gazov iz Dymovykh Tryb.) A. I. Denisov. Translated by M. I. Weinreich from Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 6, 834-7(1957). 9p.

Formulas are presented for use in calculating the atmospheric diffusion of dust and gases ejected from smokestacks. (C.H.)

4525 AERE-GP/R-2028
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
RADIATION FROM GASES. W. R. Hindmarsh. Aug. 28, 1956. 33p.

Brief discussions of Boltzmann's and Saha's equations, Stefan's, Planck's, and Kirchhoff's laws, and natural, Doppler, and pressure spectral line broadening are presented. (D.E.B.)

MEASUREMENT AND ANALYSIS OF THE HOLDUP OF GAS MIXTURES BY CHARCOAL ADSORPTION TRAPS. W. E. Browning and C. C. Bolta. Aug. 10, 1956. 23p. (ORNL-2116)

The holdup behavior of gaseous fission products in charcoal traps was investigated as a function of trap geometry, type and amount of charcoal, trap temperature, flow rate, and type of inert gas used as purging agent. An analytical expression is presented for the calculation of holdup curves for gases when trap geometry and the adsorption isotherm for the gases on charcoal are known.

10944 CF-56-6-142
Oak Ridge National Lab., Tenn.
GASEOUS RADIOACTIVITY FROM HRT FUEL STORAGE TANKS. R. F. Aven. June 22, 1956. 20p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A study has been made to determine the amount of gaseous radioactivity from the fuel solution when it is stored in the outer dump tanks. The main source of gaseous activity is the decay of the fission products Br^{83}, I^{133} and I^{135} into Kr^{83}, Xe^{133}, and Xe^{135} respectively. The radioactivity of the gases leaving the reflux condenser is much too great to be sent directly to the stack. For time periods after shutdown greater than 24 hours the gaseous activity may be found from graphs. The radiation release is directly proportional to long term power. Since the radiation release to the stack must be kept low (~20 curies/day or less) it is recommended that a recombiner be used in the fuel storage system to remove deuterium and oxygen from the gaseous stream leaving the outer dump tanks. The radioactive gases can then be either held indefinitely in the low pressure system or sent through the main charcoal beds, before release to the stack. The only safe alternative to the recombiner is to hold the fuel solution in the inner dump tanks for a period of about 10 days for 5 Mw power (11 days for 10 Mw). The rate of radiation release after this period is less than 20 curies/day and can be sent directly to the stack. (auth)

21703
STATEMENT OF DONALD H. PACK, METEOROLOGIST, DEPARTMENT OF COMMERCE, WEATHER BUREAU. p.1535-78 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Plant site and weather conditions due to various factors are discussed in relation to radioactive waste disposal to the atmosphere. (C.J.G.)

DISPOSAL METHODS 8.03

GASEOUS FISSION-PRODUCT DISPOSAL 8.03.02

4530

KINETICS OF REACTIONS IN GASES. George Porter (Univ. of Sheffield, Eng.). Ann. Rev. Phys. Chem. 7, 207-30(1956).

A review of work in the kinetics of reactions in gases is presented. (T.R.H.)

21667

RADIOACTIVE WASTE MANAGEMENT OPERATIONS AT THE HANFORD WORKS. PART 3. RELEASE OF GASES, VAPORS, AND PARTICLES TO THE ATMOSPHERE. R. E. Tomlinson (General Electric Co., Richland, Wash.). p.270-81 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Operation, maintenance, and safety hazards of existing processing systems and controls for atmospheric disposal of radioactive wastes at the Hanford Plant are discussed. Radiation monitoring at various points is explained. (C.J.G.)

2824 KAPL-1015

Knolls Atomic Power Lab., Schenectady, N. Y.
EVALUATION OF KAPL SEPARATIONS PROCESS STACK EFFLUENT. J. J. Fitzgerald. Jan. 5, 1954. Decl. Aug. 22, 1957. 29p. Contract W-31-109-eng-52. $0.25(OTS).

The KAPL separations process stack effluent is evaluated. The adequacy and the efficiency of all the sampling instruments are determined. The size of the particles entrained in the stack is studied under both the light and the electron microscope. The mean particle size is less than 0.05 μ. Autoradiographs of the particulate material indicate that the majority of the activity is deposited on these submicronic particles. Chemical separations of the material deposited on the Hollingsworth and Vose, H-70 filter papers and the caustic scrubber are made. The rare earths comprise the largest portion of the particulate activity while Ru^{106} is given off in relatively large quantities during the head-end operation. The relative percentages of the activities given off during the most important phases of the separations process are tabulated. The KAPL stack effluent is then evaluated on the basis of the maximum permissible concentrations recommended in the Bureau of Standards Handbook 52. (auth)

INCINERATION 8.03.03

8414

PROBLEMS IN THE INCINERATION OF RADIOACTIVE WASTE. H. S. Jordan (Los Alamos Scientific Lab., N. Mex.). Proc. Health Phys. Soc. 152-8(1957).

An attempt is made to develop criteria for evaluating incineration as a process to assist in the disposal of contaminated waste, to indicate features that should be considered in the design of an incinerator for a large installation, and to evaluate the usefulness of the process for a small installation. (J.S.R.)

OPEN FIELD BURNING OF LOW LEVEL RADIOACTIVE CONTAMINATED COMBUSTIBLE WASTES. W. B. Harris and M. S. Weinstein (Industrial Hygiene Branch, AEC, New York). Am. Ind. Hyg. Assoc. Quart. 17, 388-90(1956) Dec.

Three investigations at three different levels of volume up to approximately 10 tons have been conducted. These involved burning of contaminated laboratory wastes containing millicurie amounts of activity in an uncontrolled open field. Extensive sampling of the area out to a distance of 2,000 feet revealed negligible contamination of the air and negligible fallout under the conditions of test. (auth)

REDUCTION OF COMBUSTIBLE, LOW-LEVEL CONTAMINATED WASTES BY INCINERATION. Louis B. Silverman and Richard K. Dickey. May 15, 1956. 20p. (UCLA-368)

Specifications of the incinerator and methods of incineration used at UCLA for disposal of small animal carcasses, excreta, paper, and towels are presented. The physical reduction of these combustible wastes resulted in better than 95% reduction by weight and volume. A summary of all loads and activities placed in the burn-all unit from January 1954 to December 1955 are tabulated.

INCINERATOR FOR RADIOACTIVE RESIDUE. W. D. McNeese, W. J. Maraman, and T. E. Chronister. Mar. 1954. Decl. Apr. 1, 1957. 22p. (LA-1691)

A batch-type incinerator has been built which will dry and burn 12 liters of wet, packed rags or the equivalent in other organic matter in 8 hr. The material is ignited and burned in a stream of O_2. Tars in the off-gas are trapped in a water bubbler, residual contaminated particles are caught by a CWS filter, and acid vapors are reacted in a caustic scrubber. The unit was designed to process Pu residues; however, other radioactive materials could be handled by the use of appropriate shielding and manipulators.

DISPOSAL METHODS 8.03

INCINERATION 8.03.03

7610 KAPL-610
Knolls Atomic Power Lab., Schenectady, N. Y.
A REPORT ON THE DEVELOPMENT AND OPERATION OF A PILOT INCINERATOR FOR CONTAMINATED COMBUSTIBLE SOLID WASTES. F. N. Schell. Oct. 1, 1951. Changed from OFFICIAL USE ONLY June 26, 1956. 65p. Contract W-31-109-Eng-52. $7.80(ph OTS); $3.30(mf OTS).

An incinerator for burning contaminated waste products is described. The equipment includes a furnace, a settling chamber, a Pease-Anthony scrubber, a water-sealed bypass around the scrubber, a rough glass wool filter, two CWS filters in parallel, and a blower. The capacity of the incinerator is approximately 40 lbs/hr. It was found that best results were obtained when the charges were baled and weighed less than 60 lbs. Data on performance and schematic sketches of the equipment are included. (C.H.)

LAND, DISPOSAL ON 8.03.04

See also, under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Legal Aspects (4.02.05).

1167 HW-SA-36
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
WASTE DISPOSAL TO THE GROUND, OPERATING PRACTICES AND EXPERIENCES AT HANFORD. C. E. Linderoth and D. W. Pearce. July 1959. 12p. OTS.

The separations plants at Hanford discharge large volumes of solutions containing radioactive materials to various ground disposal facilities. These facilities are described. Data are summarized on the volume and curies discharged through mid-year 1959. Management of large volumes of water as well as control of radioactive materials was required. Extensive research and development efforts in geology, hydrology, mineralogy, soil chemistry, analytical chemistry, and process engineering were applied to the ground disposal problems. As a result of these efforts no demonstrable hazards have been created by the disposal of wastes to ground at Hanford. (C.H.)

23063 TID-7579(p.1-16)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BIOLOGICAL IMPLICATIONS OF RADIOACTIVE WASTES. H. A. Kornberg. 16p.

Kinds of radioactive wastes associated with atomic energy production are described and their biological distribution in the environment and their potential for harm are discussed. To assure safe production, several types of measurements are needed. Examples of these and their implications are drawn from Hanford's production experience. (auth)

18246 SCTM-384-58-51
Sandia Corp., Albuquerque, N. Mex.
THE PRICE OF CONTAINING RADIOACTIVITY IN DIGGING CRATERS. Byron F. Murphey. Oct. 1958. Decl. Apr. 27, 1959. 6p. Contract [AT(29-1)-789]. $1.80 (ph), $1.80(mf) OTS.

The possibility is considered that useful craters may be obtained by means of shallow underground explosions of thermonuclear devices. The price of containing radioactivity in such craters is considered for underground and surface bursts. Data obtained from Rainier Burst during Operation Plumbbob and from Operation Teapot are used as a basis for the calculations. (C.H.)

9251
FEASIBILITY OF RADIOACTIVE WASTE DISPOSAL IN SHALLOW SEDIMENTARY FORMATIONS. J. Wade Watkins, F. E. Armstrong, and R. J. Heemstra (Bureau of Mines, Bartlesville, Okla.). Nuclear Sci. and Eng. 7, 133-43(1960) Feb.

General considerations pertinent to the disposal of radioactive wastes are reviewed. Suggested methods of disposal, geographical influences, and the factors pertaining to shipping liquid and solid radioactive wastes are discussed. The methods of disposing of oil-field brines are reviewed. The economics of brine injection is compared to costs of storing and estimated costs of disposing of high-level radioactive wastes. A comparison is made of the costs of drilling wells to different depths. The relative economics of drilling exploratory, injection, and monitoring wells to different depths in a disposal or test project is discussed. The geology of comparatively shallow and stratigraphically isolated sandstone lenses and shoestrings common to midcontinental United States is considered. Particular emphasis is given to the geological, engineering, and chemical information available about such forma-

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

GENERAL 8.03.04.01

tions that have proved to be productive of petroleum and have been repressured with fluids to stimulate oil production. Laboratory and field research problems pertinent to the disposal of radioactive wastes by injection are outlined. A hypothetical example is given of a pilot plant for secondary treatment and injection of dilute fission products into a shallow, lenticular sandstone formation with well-defined boundary conditions. Monitoring facilities and techniques designed to determine horizontal and vertical migration and differentiation of the migrating radioisotopes are described. A partial cost analysis is made of the pilot system. The advantages and disadvantages of a full-scale system of this type, as compared with other methods of disposal are discussed. (auth)

STORAGE OF ATOMIC WASTES IN GLACIAL CAPS OF THE EARTH. Bernhard Philberth. Compt. rend. 248, 2090-2(1959) Apr. 6. (In French)

On a glacial surface of 10^5 km^2, the wastes of atomic plants in which the useful power is 10^9 kw can be deposited for 100 years. Greenland alone is sufficient. However, Antarctica has glacial expanses $>10^7$ km^2. The quantity of heat released by the wastes could be decreased by storing the wastes prior to release in the ice caps. This would give a reserve of ≅2 orders of magnitude. (tr-auth)

1344

BIOGEOCHEMICAL ENRICHMENT OF FISSION PRODUCTS. Pontus Ljunggren (Geological Inst., Lund, Sweden). Nature 184, Suppl. 12, 912(1959) Sept. 19.

In a radioactivity analysis of plants, the beta activity of the plants was found to be 2 to 6 times greater than the soil from which the plant came. The beta activity concentration in various parts of the plants is discussed. (C.J.G.)

13105

GROUND DISPOSAL OF RADIOACTIVE WASTES. C. B. Amphlett. Atomics and Nuclear Energy 9, 242-4(1958) July.

The facilities for disposal of radioactive waste to ground at Hanford, Oak Ridge, Savannah River, and Chalk River are described and the experience derived from them is summarized. (T.R.H.)

THE STORAGE OF RADIOACTIVE WASTES IN ARID REGIONS. L. v. Erichsen (Univ. of Bonn). Atomkernenergie 4, 112-15(1959) Mar. (In German)

The trend of the last years seems to indicate that safe waste disposal from the future nuclear energy plants will present one of the most serious limiting factors for the further development of nuclear power. The actually applied or proposed ways and methods for radioactive waste disposal are presented and discussed. As all methods strive for the elimination of contact between radioactive materials and natural water supplies, the storing of these materials in arid districts is proposed to avoid a priori such a contact. For that purpose, some districts of the Atacama Desert may be well appropriate. The radioactive material stored there remains accessible, and it may be re-used later when an adequate demand would arise. (auth)

14866 AECU-4130

[Los Alamos Scientific Lab., N. Mex.]

RADIOACTIVE TRASH DISPOSAL AT LOS ALAMOS. John W. Enders. Sept. 15, 1958. 14p. Contract [W-7405-eng-36]. $3.30(ph), $2.40(mf) OTS.

Methods of solid radioactive waste disposal at Los Alamos are described. The principal contaminant is Pu. Because of the high toxicity of this element, it is disposed of by burial. The method is felt to be adequate for low-level alpha activity, but not for high-level beta-gamma radiation. (J.R.D.)

13032 AECU-4102

Johns Hopkins Univ., Baltimore.

FEASIBILITY OF ESTABLISHING A NATIONAL BURIAL GROUND FOR RADIOACTIVE WASTE IN THE NORTHEASTERN UNITED STATES. James M. Morgan, Jr. July 15, 1956. 126p., 1 illus. Contract AT(30-1)-1477. $21.30(ph), $6.90(mf) OTS.

A search was made within a 125-mile radius of Erie, Pennsylvania, to discover a possible site for a national land burial ground to receive and bury low and intermediate level radioactively contaminated waste. The new burial facility would serve a sixteen state section of the northeastern United States. Estimated unit burial costs and computed transportation charges indicate that a centrally located site within the section is both feasible and desirable. It will be necessary to make complete geologic, hydrologic, and radiologic investigations at any site selected as a burial ground. (auth)

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

GENERAL 8.03.04.01

14761 A/CONF.15/P/1767
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.; Oak Ridge National Lab., Tenn.; and Du Pont de Nemours (E. I.) & Co. Savannah River Lab., [Augusta, Ga.].
EXPERIENCE IN THE DISPOSAL OF RADIOACTIVE WASTES TO THE GROUND. R. E. Brown, D. W. Pearce, W. de Laguna, E. G. Struxness, J. H. Horton, Jr., and C. M. Patterson. 13p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
Up to 12 years of practical experience in controlled waste disposal at the Hanford Works, the Oak Ridge National Laboratory, and the Savannah River Plant have provided a wealth of data on the feasibility of disposal of radioactive liquid waste at shallow depths in the ground. The disposal problems at the three sites are quite dissimilar since the environments are markedly different. The geologic and hydrologic conditions at the three sites indicated early in their history that at least small volumes of low activity level wastes could be discharged to the ground but that disposal of intermediate level materials demanded more detailed knowledge of the geology, microhydrology and soil chemistry. Determination of the waste behavior in the ground based upon laboratory research, field tests and the extensive use of monitoring wells provided the data permitting the safe disposal of many billions of liters of low to intermediate level waste at Hanford. At the Oak Ridge National Laboratory and the Savannah River Plant, similar earth sciences studies and field work have shown the inadvisability of ground disposal of high level radioactive liquids. Experience in the use of cribs, trenches, seepage pits, and swamps at Hanford and Savannah is discussed. (auth)

COMMENTS ON THE BURIAL OF RADIOACTIVE WASTES IN SOIL. Roy Overstreet. p.81-5 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)
This paper delineates the precautions necessary for the safe disposal of radioactive elements in the soil. Two sets of recommendations are outlined: one pertaining to relatively short lived isotopes (half lives of 180 days or less) and the other dealing with the burial of long-lived isotopes.

14750 A/CONF.15/P/2351
Oak Ridge National Lab., Tenn.
DISPOSAL OF HIGH LEVEL RADIOACTIVE LIQUID WASTES IN TERRESTRIAL PITS—A SEQUEL.
W. de Laguna, K. E. Cowser, and F. L. Parker. 32p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
Operating procedures for the three 200 × 100 × 15 feet pits are given. Methods for detecting the motion of wastes in the Conasauga shale are described. The conclusion is that it is virtually impossible to predict from any known method of pretesting, in a proposed site in the Oak Ridge area, how a waste disposal pit will operate. (W.D.M.)

7611
GROUND DISPOSAL OF RADIOACTIVE WASTES. Roy J. Morton and Edward G. Struxness. Am. J. Public Health 46, 156-63(1956) Feb.

FACTORS AFFECTING THE DISPOSAL OF PLANT WASTES. M. E. Jefferson. p.111-116 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)
This paper describes the uses of radioisotopes as tools of agricultural research and presents the methods used at Beltsville for the disposal of low activity P^{32}, C^{14}, Fe^{55-59}, and Sr^{89} in sewage systems, combustion and/or dilution in soil.

21694
DISPOSAL OF RADIOACTIVE LIQUID WASTES TO THE GROUND AT HANFORD. D. W. Pearce (General Electric Co., Richland, Wash.). p.1124-71 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."
Low level liquid waste disposal to the ground at Hanford has been supported between a closely correlated and balanced program of theoretical study, laboratory and field experiment, and observational experience. Extensive effort in geology and hydrology, mineralogy and soil chemistry, analytical chemistry, and engineering has been applied to ground disposal problems. The more important findings from the research and development in each of these areas are outlined to show how this applies to plant practice, and indicate in general the future course of the work. (auth)

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

GENERAL 8.03.04.01

2409 CF-54-10-64
Oak Ridge National Lab., Tenn.
DISPOSAL OF NUCLEAR POWER REACTOR WASTES BY INJECTION INTO DEEP WELLS. Preliminary Report. D. A. Pecsok. July 1954. 24p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

Subterranean disposal of liquid wastes has been utilized by various chemical industries, notably the petroleum industry. Some of the published findings with regard to these field applications are summarized and the feasibility of this method of disposal for nuclear power reactor wastes is considered. Geographical, economic, chemical, and temperature considerations are discussed in detail. (auth)

21696
AN INVESTIGATION OF THE DISPOSAL OF RADIOACTIVE WASTES INTO DEEP GEOLOGIC FORMATIONS. p.1218-26 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

The injection of radioactive wastes into deep geologic formations is considered a feasible and economic approach to handling low and intermediate level wastes. Deep injection does not represent a panacea for all nuclear wastes, but rather is one possible solution to be arrived at only after considering the factors peculiar to a given situation. The basic research and development associated with deep well injection has been underway for several years and has reached the point where a full scale field test is indicated. The chemical treatment of low and intermediate level wastes will be necessary to make them compatible with the receiving formation. If the wastes at a site vary widely in chemical composition, holdup, blending, and testing may be necessary prior to chemical treatment and injection. It is almost certain that the preinjection treatment operation should include filtration and pH adjustment. Field measurements of the dispersion properties of the formation, will make possible a completely engineered disposal system, the useful formation capacity, and hence the unit cost of the injection phases of the operation, should be a calculable quantity. (auth)

GROUND-WATER CONTAMINATION 8.03.04.02

1172 IDO-12011
Idaho Operations Office. Health and Safety Div., AEC.
LIQUID WASTE DISPOSAL IN THE VICINITY OF THE IDAHO CHEMICAL PROCESSING PLANT (ICPP). Interim Report. Bruce L. Schmalz. June 1959. 29p. OTS.

Studies of the effect of discharging radioactive waste in liquid form to the ground water table in the vicinity of the Idaho Chemical Processing Plant were initiated in 1953 by the Idaho Operations Office of the AEC under a cooperative program with the Ground Water Branch of the U. S. Geological Survey. The progress gained in this program during the calendar year 1958 and January and February of 1959 is the subject of this report together with quantity of waste and the results of monitoring downgradient. A test in which fluorescein dye and a slug of common salt were introduced into the disposal system is also reported. (auth)

11267
RADIOACTIVE SUBSTANCES AND WATER: A DOCUMENTATION. Walther Kumpf, Bernd Dieterich, and Joachim Kumpf. Munich, R. Oldenbourg Verlag, 1956. 140p. (In German)

Abstracts of the papers presented at the Geneva Conference and the Cleveland Conference of 1955 on the subject of radioactive substances and water are presented. The abstracts are grouped under the following subjects: general problem of radioactive wastes; danger of radioactive materials and highest permissible concentration in water; management precautions for the protection of the population and the water supply; measurement of radioactivity in water; purification and elimination of contaminated water; radioactive content of surface waters; and radioactive fall-out. Bibliographies follow each section. (J.S.R.)

17042
SOIL DISPOSAL OF RADIOACTIVE WASTES AT ORNL: CRITERIA AND TECHNIQUES OF SITE SELECTION AND MONITORING. K. E. Cowser and F. L. Parker (Oak Ridge National Lab., Tenn.). Health Phys. 1, 152-63 (1958) Sept.

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

GROUND-WATER CONTAMINATION 8.03.04.02

The ability of soil to remove and retain the bulk of the fission product cations from aqueous solution is used as the basis for disposal of large volumes of intermediate level wastes. An experimental system consisting of three 1 million gal disposal pits has been developed at ORNL and through December 1956, received a total of 5.6 million gal of waste containing 58,000 c of Cs^{137}, 15,000 c of Ru^{106} and lesser amount of Sr^{89}, Sr^{90}, Co^{60}, Sb^{125} and the rare earths. Sodium ion and nitrate ion account for the largest part of the chemical constituents. The geologic and hydrologic characteristics of the reservation served as a guide in the selection of small areas for detailed study. The information obtained from

10565

GEOLOGIC AND HYDROLOGIC GUIDES TO THE GROUND CONTAINMENT AND CONTROL OF WASTES AT HANFORD. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 14, Session 16. R. E. Brown and W. H. Bierschenk (General Electric Co., Richland, Wash.). New York, American Institute of Chemical Engineers, 1958. 12p.

Safe, economical, near-surface ground containment of waste radioisotopes at Hanford is achieved through correlation of data from many laboratory and field tests to extensive empirical data. The combined information additionally defines significant geologic and hydrologic features and suggests the potential and problems of waste confinement at greater depths. (auth)

DISPOSAL OF RADIOACTIVE LIQUID WASTES FROM THE URANIUM RECOVERY PLANT. D. W. Rhodes and J. L. Nelson. June 3, 1957. 34p. (HW-54721)

A series of laboratory experiments was conducted to estimate disposal volumes for Uranium Recovery Plant (URP) scavenged wastes. The disposal volume was considered to be the maximum volume of waste that could be discharged to a specific disposal site such that no radioisotope with a half-life >3 yr reached the ground water in concentrations $>1/10$ of the maximum permissible concentration for that radioisotope in drinking water. The results of laboratory equilibrium and soil column tests with synthetic and actual process wastes are presented. Methods used to estimate disposal volumes from the experimental data are largely empirical and in many cases were influenced by operational experiences in the past. The data are considered applicable only to the particular soil-waste liquid system studied in this investigation.

THE CHALK RIVER LIQUID DISPOSAL AREA, 1956. I. L. Ophel and C. D. Fraser. June 1957. 42p. (CRHP-709)

Five surface pits in the Chalk River liquid disposal area have been used since December 1952 for the disposal of wastes containing fission products. The liquid disposal area is situated on elevated ground with low-lying swampy areas to the east and south. Since November 1955, the surface water of these swamps has been contaminated by the seepage of water containing several radioisotopes. Investigations show that 3 of the 5 disposal pits are contributing to this surface contamination. The streams and a lake receiving the drainage from these swamps also show low levels of contamination. Examination of the contaminated area shows Sr^{90} to be the most important of the radioisotopes present. The amounts of Sr^{90} present in the stream draining the area are not sufficient to raise the stream water to the drinking water tolerance concentration. Present levels of Sr^{90} in the plants and animals of the area do not constitute a hazard to man, and contamination is entirely confined to the Chalk River exclusion area.

HYDRAULIC CHARACTERISTICS OF HANFORD AQUIFERS. William H. Bierschenk. Mar. 3, 1957. 38p. (HW-48916)

Three analytical techniques were applied to data from aquifer tests at Hanford to determine the hydraulic characteristics of the ground-water reservoirs. These techniques are the nonequilibrium type-curve method, the modified nonequilibrium straight-line method, and the image well technique for analyzing an aquifer of limited areal extent. The selection of equations and their application in the analysis of test data were governed largely by the physical conditions of the aquifers at the test sites studied. Data are presented graphically.

WATER FOR NUCLEAR ENGINEERING. S. K. Love and W. F. White (U. S. Geological Survey, Washington, D. C.). Ind. Eng. Chem. 48, 1248-51(1956) Aug.

The outlook for adequate supplies of water of suitable quality for nuclear energy development is more favorable in some parts of the country than in others. Competition for water in some areas is intense and may pose real limitations on the development of nuclear installations. Development engineers and other scientists responsible

LAND, DISPOSAL ON 8.03.04

GROUND-WATER CONTAMINATION 8.03.04.02

for expansion of nuclear engineering projects are urged to give early and thorough attention to water requirements with reference to existing or potential availability of water supplies. The program of waste disposal from nuclear installations also must be planned carefully so that receiving streams and underground waters will not be rendered dangerous or unsatisfactory for subsequent use. It is imperative that leaders in the field of nuclear engineering lend their support and actively participate in programs that have as their objective the development and conservation of water supplies for all beneficial uses including expansion of nuclear energy installations. (ICE abst.)

13038 TID-7517(Pt. II)(Del.)(p.5-22)
General Electric Co., Schenectady, N. Y.
OPERATIONAL EXPERIENCE IN HANFORD LIQUID WASTE DISPOSAL. D. W. Rhodes, J. R. Raymond, and H. V. Clukey. p.5-22 [of] SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A SEMINAR SPONSORED BY THE AEC AND THE PUBLIC HEALTH SERVICE HELD AT THE ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO, DECEMBER 6-9, 1955. 16p.

The operational experience with ground disposal of low level radioactive liquid wastes at Hanford has been generally favorable over a period of approximately 10 years. Disposal units are placed underground to avoid radiation and contamination hazards and the liquid wastes are allowed to percolate through at least 200 feet of sediments which adsorb the long-lived radioisotopes. In more recent years, the application of laboratory findings and field observations together with chemical scavenging to reduce the concentrations of Cs^{137} and Sr^{90} has resulted in the disposal of other wastes containing 1 to 50 $\mu c/ml$ of total beta-emitters and 0.02 $\mu c/ml$ of both Cs^{137} and Sr^{90}. Continual observation of the location and movement of the radioisotopes discharged to ground has been maintained by routine sampling of monitoring wells extending to ground water in the near vicinity of the disposal sites. No ground water contamination of objectionable concentrations has resulted from ground disposal. (auth)

21697
UNDERGROUND MOVEMENT OF RADIOACTIVE WASTES. R. G. Orcutt, M. N. E. Rifai, G. Klein, and W. J. Kaufman (Univ. of California, Berkeley). p.1227-53 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Several theories are presented for describing quantitatively hydraulic dispersion, ion-exchange equilibria, and ion-exchange kinetics as they apply to the movement of radioisotopes through natural porous media. Laboratory studies were conducted with radiostrontium and several natural exchangers to determine the applicability and limitations of these theories. The laboratory results do not conclusively establish that the maximum rate of strontium movement can be readily predicted under all circumstances. However, it is believed that the theories of dispersion and ion-exchange, when used in conjunction with field-scale tests, will serve to reduce greatly the uncertainties of ground disposal operations. The salient experimental results are summarized. (auth)

RETENTION BY SOILS – GENERAL 8.03.04.03

21695
EXPERIENCE IN THE DISPOSAL OF RADIOACTIVE WASTES TO THE GROUND. R. E. Brown and D. W. Pearce (General Electric Co., Richland, Wash.); W. de Laguna and E. G. Struxness (Oak Ridge National Lab., Tenn.); and J. H. Horton, Jr. and C. M. Patterson (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). p.1205-17 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Disposal of low level liquid radioactive wastes to the ground at the Hanford Works, Washington, the Oak Ridge National Laboratory, Tennessee, and the Savannah River Plant, South Carolina, is founded on the ability of various earth materials to remove and retain fission product cations. Twelve years of practical experience in the controlled disposal of wastes to the ground at the Hanford Works, seven years at the Oak Ridge National Laboratory, and four at the Savannah River Plant, have demonstrated the feasibility, safety, and economy in the disposal of at least limited volumes of some types of liquid wastes at shallow depths. Some of the experience which indicates the potential of this disposal method and the problems involved are described. (auth)

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

RETENTION BY SOILS – GENERAL 8.03.04.03

13035 HW-53219
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EVALUATION OF SITES FOR THE DISPOSAL OF RADIOACTIVE WASTE SOLUTIONS. J. R. McHenry and J. F. Honstead. Nov. 15, 1957. 12p. Contract W-31-109-Eng-52. $3.30(ph), $2.40(mf) OTS.

The depth of soil profile above the water table, the average exchange capacity, and the capacity factor of the effective soil profile are presented for the Separations areas and surrounding area in the three contour maps. The area immediately southeast of 200-West area is found to have the greatest capacity factor. Greater volumes of radioactive liquids can be disposed of here per unit surface area than at other sites studied within current disposal limits. Because the soil profiles are also deepest in this same general area, disposal by specific retention of liquid would be most practical in this area. The soil characteristics associated with 200-East Area sites are generally less suitable for waste disposal than those of sites in the 200-West Area. Immediately south of the 200-East Area, however, the soil conditions are considered better for the disposal of radioactive liquids. The relative utility of the various sites for disposal of radioactive solutions is based on an evaluation of the soil properties only. (auth)

1334 ORNL-2415
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE DISPOSAL REPORT ON SEEPAGE PIT LIQUID WASTE—SHALE COLUMN EXPERIMENT. William J. Lacy. Nov. 12, 1957. 22p. Contract W-7405-eng-26. $0.75(OTS).

Seepage pits excavated from Conasauga shale have been used at ORNL for over five years as a method for disposing of large volumes of intermediate level radioactive liquid waste. Results are reported from a study of the adsorption capacity of the shale. From the results of laboratory studies an attempt was made to predict when the breakthrough of large quantities of radionuclides may occur, the order of occurrence for radionuclides present, and when the leaching action of rain and ground water may be expected to remove dangerous quantities of radioactivity from the saturated shale in the event the pits are abandoned as disposal units. (C.H.)

12373 HW-40990
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
ADSORPTION CHARACTERISTICS OF LONG SOIL COLUMNS. J. R. McHenry. May 1, 1955. Decl. June 11, 1958. 10p. Contract W-31-109-Eng-52. $1.80 (ph OTS); $1.80(mf OTS).

Information is presented relative to the characteristic adsorption of radioisotopes in a long laboratory soil column treated with a high salt process waste of high activity density. The movement of adsorbed cations in a soil column subjected to prolonged leaching by water also was determined. (A.C.)

7073 A/CONF.15/P/2207
A STUDY OF THE MIGRATION OF RADIOELEMENTS IN SOILS. V. I. Spitsyn, V. D. Balukova, A. F. Naumova, et al. (Academy of Sciences, U.S.S.R.). 25p.

The capacity of various soils to absorb long-lived products of U fission (Cs^{137}, Sr^{90}, Ce^{144}, Ru^{106}, Zr^{95}, Nb^{95}) has been studied. Alluvial sands, loamy soils, and clays were the main objects of investigation. The results of laboratory experiments have shown that the absorption of radioelements by soils depends to a great extent on the pH of a solution. The mixture of radioelements is absorbed more or less readily from alkaline salt solutions, while in acid medium the absorption sharply decreases. (W.L.H.)

13076
ADSORPTION OF RADIOACTIVE WASTES BY SAVANNAH RIVER PLANT SOIL. W. E. Prout (E. I. du Pont de Nemours and Co.). Soil Sci. 86, 13-17 (1958) July.

The adsorption of radioisotopes on soil was investigated in the laboratory to determine the behavior of low-level radioactive waste solutions discharged to the ground. Strontium, cesium, and plutonium distributions between soil and waste solution were studied. The effects of cation concentration and acidity were determined. The results of the distribution experiments, and material balance considerations, permit prediction of the behavior of activity in beds of soil. Laboratory tests with beds of soil gave results that agreed with these predictions. These results can be applied to the disposal of radioactive solutions to the ground. A typical application is discussed. (auth)

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

RETENTION BY SOILS – GENERAL 8.03.04.03

6391 A/CONF.15/P/1683
PHENOMENES D'ADSORPTION D'ANIONS AUX BENTONITES. (Anion Adsorption Phenomena on Bentonites). Yolande Hendrickx (Univ. of Ghent). 15p.

A study of ion adsorption phenomena on bentonites was made with the help of radioactive tracers. Bentonite consists principally of montmorillonite. The experiments were made with Cr^{51}-labeled Na_2CrO_4 and I^{131}-labeled $NaIO_3$. The adsorption for sodium chromate was determined for a series of concentrations, and the results are graphed. Negative adsorption was noted for sodium iodate. The negative adsorption was interpreted as a result of the fact that H-bentonite retained a certain amount of water which was inaccessible to $NaIO_3$, causing an increase in the concentration of the iodate solution with respect to the standard solution. The results are tabulated. (J.S.R.)

RETENTION BY SOILS – Cs, Pu, Sr 8.03.04.04

13044 ✓
SOIL ADSORPTION OF RADIOACTIVE WASTES AT LOS ALAMOS. C. W. Christenson, Eric B. Fowler, George L. Johnson, Elgin H. Rex, and Felix A. Virgil (Los Alamos Scientific Lab., N. Mex.). Sewage and Ind. Wastes 30, 1478-89(1958) Dec.

Cylindrical samples of the Tshirege member of the Bandelier tuff were tested for adsorption of radioactive nuclides from waste solutions containing Pu-239, Cs-137, or Sr-90, as well as mixtures of these. In addition, observations on leaching were made. Cs-137 and Pu-239 were readily retained by the tuff; however, the Pu-239 can be released by a subsequent discharge of solutions such as versene. Sr-90 was not retained by the tuff nearly as well as the other nuclides tested and was more easily released. (J.R.D.)

720 HW-56582
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE INFLUENCE OF LIMESTONE NEUTRALIZATION ON THE SOIL UPTAKE OF Sr^{90} FROM A RADIOACTIVE WASTE. H. L. Brandt and A. E. Reisenauer. Aug. 1958. 17p. Contract [W-31-109-eng-52]. $3.30(ph OTS); $2.40(mf OTS).

The relative order of affinity of the soil for Sr^{90} from wastes prepared in three different ways from an acidic radioactive condensate may be explained on the basis of ion exchange and mass action. The use of calcium carbonate as a neutralizing agent can introduce enough calcium into the solution to greatly inhibit the removal by soil of Sr^{90}. This effect is of importance in the ground disposal of all waste solution containing more than 0.1 MPC Sr^{90}. The proximity of calcium to strontium in the lyotropic series suggests that calcium should compete strongly with strontium for ion exchange sites in the soil even at low concentrations of calcium. The apparent strontium competitor for exchange sites in the soil in the unneutralized condensate is the hydrogen ion. Equilibrium data give some indication that dissolution of calcium from the soil by the acid waste may be militating against greater soil uptake of strontium. The use of sodium hydroxide can effect pH control without introducing any formidable competition for the strontium ion in soil adsorption. This reagent is, therefore, generally superior to limestone for neutralizing acidic radioactive wastes when efficient utilization of the soil for Sr^{90} removal is desired. (auth)

7782 ORNL-2475
Oak Ridge National Lab., Tenn.
LABORATORY STUDIES ON THE GROUND DISPOSAL OF ORNL INTERMEDIATE-LEVEL LIQUID RADIOACTIVE WASTES. Richard L. Blanchard, Bernd Kahn, and Gordon G. Robeck. Apr. 11, 1958. 34p. Contract W-7405-eng-26. $1.00(OTS).

Radioactive waste and ground water solutions were passed through columns of indigenous Conasauga shale to determine the sorptive behavior of the radionuclides. Cesium-137, the major radioactive constituent of the basic waste solution, was adsorbed very effectively with a shale/solution distribution ratio of 500. A small fraction of ruthenium-106, the only other radionuclide present in relatively large concentration, was adsorbed per unit weight of shale, but this adsorption occurred even when the radionuclide had previously passed through 200 feet of shale. The ruthenium and the small amounts of cobalt-60 and antimony-125 present were removed by coprecipitation with lead dioxide after the addition of sodium hypochlorite. By combining coprecipitation with adsorption on shale columns, it was possible to obtain decontamination factors of 2×10^3 for gross beta, 3×10^3 for gross gamma, 4×10^4 for cesium, and 2×10^2 for ruthenium. (auth)

DISPOSAL METHODS 8.03

LAND, DISPOSAL ON 8.03.04

RETENTION BY SOILS – Cs, Pu, Sr 8.03.04.04

5009
ON THE SOIL CHEMISTRY OF CESIUM 137. R. K. Schulz, Roy Overstreet, and I. Barshad (Univ. of California, Berkeley). Soil Sci. 89, 16-27(1960) Jan.

The nonexchangeable fixation of macro amounts of cesium in five soils appeared to be different in character from the corresponding fixation of potassium and ammonium. It was also concluded that the fixation of cesium-137 in soils in carrier-free amounts is an essentially different process from those predominant in the fixation of macro amounts of cesium, potassium, and ammonium. Experimental procedures are described and results are discussed. (C.H.)

17014
ADSORPTION OF PLUTONIUM BY SOIL. D. W. Rhodes (General Electric Co., Richland, Wash.). Soil Sci. 84, 465-71(1957) Dec.

Information concerning the reactions of plutonium with soil as a result of waste disposal methods at Hanford is presented. (J.E.D.)

191 HW-52055
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EFFECT OF DETERGENTS UPON ABSORPTION OF RADIOISOTOPES BY SOILS. K. C. Knoll. Aug. 1, 1957. 12p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40 (mf OTS).

Twelve detergents were tested to determine their effect upon the absorption of Sr^{90}, Cs^{137}, and Pu^{239} by soils. Each detergent was tested at four different values of pH. Results are given which compare the distribution coefficients of these isotopes between the detergent solution and the soil and between water and soil. No generalized statement can be made about the effect of the detergents. Each detergent at any hydrogen ion concentration must be considered individually. (auth)

EFFECT OF CHEMICALS UPON INFILTRATION OF WATER INTO SOILS. K. C. Knoll. June 4, 1957. 9p. (HW-50600)

The possibility of increasing the infiltration of water into soils by the addition of chemicals was investigated. Beneficial effects were obtained by adjusting the influent to a concentration of 1 ppm Separan 2610, 10 ppm Dow Corning Antifoam A, a common antifoam agent; or 0.1% by volume of Aerosol O. T., a wetting agent. The infiltration also was increased if Krilium was mixed intimately with the upper layer of soil in a column before adding water.

4784
PROBLEMS OF RADIOACTIVE WASTE IN MODERN TECHNIQUE. W. J. Spicyn (Inst. of Nuclear Research, Warsaw). Nucleonika 2, 451-4(1957). (In Polish)

Methods for separation and recovery of Cs^{137} and Sr^{90} from mixtures of fission products and the absorptive properties of soil as a medium for waste disposal are discussed. (tr-auth)

THE MOVEMENT OF RADIOSTRONTIUM THROUGH NATURAL POROUS MEDIA. PROGRESS REPORT NO. 2 COVERING PERIOD JULY 1, 1955 to June 30, 1956. Richard G. Orcutt, Warren J. Kaufman, and Gerhard Klein. Nov. 1, 1956. 58p. (AECU-3608)

The feasibility of discharging radioactive wastes into underground formations is dependent on the predictability of the movement of certain hazardous radioisotopic components. This progress report examines several theories concerned with the equilibria and kinetics of ion-exchange as they apply to estimating the rate of underground movement of radiostrontium. Laboratory studies were conducted with the objective of testing the applicability of these theories to estimating the displacement and dispersion of radiostrontium fronts in natural media. The porous media studied with both batch and column systems included several connate-water bearing sands, an agricultural soil, and a standard halloysite clay. The parameters investigated were the exchange capacity, various expressions of equilibria, the influence of calcium, sodium, and hydrogen ions on the rate of Sr movement, the hydraulic rate of liquid application, and the rate coefficients controlling the ion-exchange reactions. The results indicate that a proper application of existing ion-exchange theory will greatly reduce the uncertainties in estimating the rate of radiocontaminant travel through natural media and may ultimately provide criteria for the design of subsurface disposal systems.

10093
EQUILIBRIUM STUDIES ON NATURAL ION-EXCHANGE MINERALS. I. CAESIUM AND STRONTIUM. C. B. Amphlett and L. A. McDonald (Atomic Energy Research Establishment, Harwell, Berks, England). J. Inorg. and Nuclear Chem. 2, 403-14(1956) July.

LAND, DISPOSAL ON 8.03.

RETENTION BY SOILS – Cs, Pu, Sr 8.03.04.04

The uptake of Cs^+ and Sr^{2+} ions has been studied on a Lower Greensand soil of good exchange properties; slight fixation of Cs^+ is observed, but not of Sr^{2+}. Isotherms have been obtained for the system $Cs^+-Sr^{2+}-$soil at two different ionic concentrations; from these a value of 9.3×10^{-4} has been derived for the thermodynamic equilibrium constant of the exchange reaction $2CsX + Sr^{2+} \rightleftharpoons SrX_2 + 2Cs^+$ where X represents the exchange complex within the soil. Other relevant thermodynamic data have been calculated for this system, and the results are compared with those of other workers on the pure clay mineral montmorillonite. (auth)

6416 ✓ A/CONF.15/P/2310
SORBTSIYA MIKROKOLICHESTV STRONTSIYA I TSEZIYA V POCHVAKH. (Sorption of Tracer Amounts of Strontium and Cesium in Soils.) V. M. Klechkovskii (Klechkovsky), G. N. Tselishcheva, and L. N. Sokolova (U.S.S.R.). 19p.

The results of radioisotopic experiments on the processes of adsorption by soils of tracer amounts of strontium and cesium are presented. Data are given on the intensity of adsorption and on the desorption of tracer amounts of strontium and cesium in different soils because the sorptive properties of soils are an important factor which determines the mobility of these elements and their capacity of translocating in the soils and of being assimilated by plants. A comparison is made between the role played by calcium of the soil as a "non-isotopic carrier" of radioactive strontium and the role played by potassium as a "non-isotopic carrier" of radioactive cesium in the sorption process in the soils. On the basis of investigation some figures are cited which characterize specific features of the behavior of tracer amounts of strontium and cesium in different soils. (auth)

IN SALT FORMATIONS 8.03.04.05

See also, this section,

FIXATION IN SOLID MEDIA (8.03.01).

12246 ✓ ORNL-2700
Oak Ridge National Lab., Tenn.
STATUS REPORT ON WASTE DISPOSAL IN NATURAL SALT FORMATIONS: II. F. L. Parker, W. J. Boegly, Jr., R. L. Bradshaw, J. Crowell, E. R. Eastwood, F. M. Empson, B. D. Gunter, L. Hemphill, O. H. Myers, and E. G. Struxness. Apr. 23, 1959. 56p. Contract W-7405-eng-26. $9.30(ph), $3.60(mf) OTS.

Radioactive liquid wastes can be stored in cavities in natural salt formations if the structural properties of salt are not adversely affected by chemical interaction, pressure, temperature, and radiation. Analytical studies show that it is possible to store two-year-old waste in a 10-foot-diameter sphere without exceeding a temperature of 200°F. Laboratory tests show that the structural properties of rock salt are not greatly altered by high radiation doses, although high temperatures increase the creep rate for both irradiated and unirradiated samples. Chemical interaction of liquid wastes with salt produces chlorine and other chlorine compound gases, but the volumes are not excessive. The migration of nuclides through the salt and deformation of the cavity can only be studied in the field in undisturbed salt in place. The design of a field experiment is complete, and the materials for construction of the cavity cover and off-gas system have been chosen. (auth)

23000
REACTOR FUEL WASTE DISPOSAL PROJECT. SUMMARY REPORT. Earnest F. Gloyna, Shosei Serata, Robert S. Schechter, Kermit E. Brown, and W. R. Muehlberger (Univ. of Texas, Austin). p.2223-79 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

Research performed at The University of Texas on the storage of reactor fuel wastes in salt formations is summarized. A few of the problems investigated include: geological studies of salt domes, structural stability, permeability, thermal heat effect, creep, stress distribution, time effect, chemical effect, radiation effect, cost of developing solution cavities, and development of design principle for disposal into salt cavities. Theoretical analyses based on model tests and limited field studies have demonstrated that a salt cavity can be designed such that it is structurally stable. Although thermal factors and plastic properties of salt are very important considerations, sufficient evidence now exists which will permit the design of storage structures. The average cost to complete an average sized cavity in a salt dome for liquefied petroleum gas storage is $1.05 per barrel of storage space. (auth)

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

GENERAL 8.03.05.01

23014

ACTIVITIES OF THE UNITED STATES GEOLOGICAL SURVEY IN PROBLEMS OF RADIOACTIVE-WASTE DISPOSAL. R. L. Nace (U. S. Geological Survey, Washington, D. C.). p.2580-2645 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

The principal sources and amounts of waste materials are described and the potential hazard to water resources are outlined. The present methods of waste disposal and safety aspects of these methods are discussed. Present studies and the research program devoted to safe waste disposal are described. (C.J.G.)

23064 TID-7579(p.17-33)

Brookhaven National Lab., Upton, N. Y.

ULTIMATE DISPOSAL OF LIQUID RADIOACTIVE WASTES. L. P. Hatch. 17p. (BNL-4218).

One of the most important factors in the disposal of liquid radioactive wastes is the careful segregation under the classification of low level, intermediate level, and high level wastes. Major benefits are that full advantage may be taken of the capacity of the soil, in many regions, to remove the radioactive materials from the high volume wastes while the more elaborate and expensive disposal methods are reserved for the high level wastes, namely, the permanent storage in salt-bed cavities, and the fixation in stable solids. (auth)

20632

RADIOACTIVITY IN WATER-ENVIRONMENTAL SURVEILLANCE. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-22. Harry P. Kramer, Dade W. Moeller, and Donald A. Pecsok (Robert A. Taft Sanitary Engineering Center, Cincinnati). New York, Engineers Joint Council, 1959. 12p. $0.50.

The growing applications of nuclear technology generate wastes which challenge our environment. Knowledge of the levels of radioactive materials is necessary. Environmental surveillance programs should be instituted to provide this knowledge. Water monitoring constitutes one very important phase of such a program. Instrumentation and methodology required for such a program have been developed. (auth)

10316

WASTES YIELD ENRICHED URANIUM. GOODYEAR ATOMIC RECOVERS VALUABLE U^{235} AND U^{238} FROM DECONTAMINATION AND LAB WASTE SOLUTIONS. B. W. Penland (Goodyear Atomic Corp., Portsmouth, Ohio). Chem. Eng. News 36, 50, 52(1958) Apr. 14.

Recovery processes are outlined by which uranium-235 and uranium-236 are recovered from decontamination and laboratory waste solutions. (C.H.)

CHARACTERISTICS OF REACTOR FUEL PROCESS WASTES. J. O. Blomeke, E. D. Arnold, and A. T. Gresky. Proc. Am. Soc. Civil Engrs. 85, No. SA2, 1-10(1959) Mar.

The types and characteristics of high-level radioactive liquid wastes produced from reactor fuel processing plants are reviewed. The chemical and physical properties of these wastes are delineated and characterized for each of five specific processing methods currently in use and of three methods under development. The radionuclide distribution and the decay heat properties of such wastes as related to time of decay are also given. (auth)

LIQUID WASTE DISPOSAL METHODS AT BETTIS HOT LABORATORY. W. L. Bryant and L. M. Behr (Westinghouse Electric Corp., Pittsburgh). p.397-401 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

The processing of radioactive liquid wastes involves removing the contaminants from water used during sectioning, polishing, and etching operations. The average radioactivity level of this waste is 100 mr/hr/gal and may reach peak levels of 800 mr/hr/gal. Sufficient contaminants must be removed from the water to reduce the radioactivity to 20 mr/hr/5 gal before it can be released to the main plant processing system. The contaminants, which consist of particulate matter and soluble ions, must then be prepared for sea burial. From contaminated sources such as high level cells, metallography cells, dry waste storage pit, and the decontamination room, the liquid wastes are routed through floor drains to the underground storage tanks. The drains are fitted with polyethylene liners to allow replacement without excavation. Wastes are drawn from the tanks as the capacity of the processing system allows. Present methods of processing hot liquid wastes are expensive in time, personnel radiation exposure and material cost. Although most of the expense is inherent in this type of operation, the Bettis Hot Laboratory has

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

GENERAL 8.03.05.01

analyzed its existing liquid waste disposal equipment and procedures for possible cost reductions. The conclusions of this analysis, in addition to comments drawn from operating experience, are discussed after a brief description of each section of the waste processing system. Also included are descriptions of equipment which will replace or supplement existing equipment in conjunction with the expansion of facilities now in process and scheduled for completion in early summer, 1959. (auth)

14920 AECU-4151
Duquesne Light Co., Shippingport, Penna.
FUEL HANDLING, SERVICE AND WASTE DISPOSAL BUILDINGS DRAIN TEST. SECTION I. Test Results DL-S-230 (T-641115). First issue, Mar. 31, 1959. 10p. $1.80(ph), $1.80(mf) OTS.

The testing of nonactive drains, special drains, sanitary drains, chemical waste drains, and storm sewer drains by means of water flow and visual inspection is disucssed. (auth)

SYMPOSIUM ON RADIOACTIVITY IN INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER. Presented at the Sixty-first Annual Meeting, Boston, Mass., June 26, 1958, American Society for Testing Materials. ASTM Special Technical Publication No. 235. Philadelphia, American Society for Testing Materials, 1958. 73p. $2.50.

The increasing need for the control of contamination of water sources by radioactive waste from atomic energy installations is stressed. Procedures are described which are used for the disposal of radioactive wastes from the Pressurized Water Reactor of the Shippingport Atomic Power Station. To handle these wastes, the power plant must have as an appendage a rather complex chemical processing plant. Gases and water of low activity are disposed of in the environment. Radioactive ion exchange resins and ashes from incinerated wastes are stored in permanent underground storage tanks. Radioactive concentrate from the waste evaporators and miscellaneous solid wastes are fixed in cement for ocean burial. The spent fuel, which represents the bulk of radioactivity and is the only byproduct of value, is shipped to a fuel reprocessing plant. Reasons for maintaining high-purity water in the primary coolant system of the Pressurized Water Reactor are reviewed. The problem of radioactivity buildup on components and piping in the primary system is discussed. Analytical methods are outlined which were developed to determine activity levels in various aqueous wastes. Similarities and differences between conventional water chemistry and the radiochemistry of water are brought out. The effects on the environment of released radioactivity is considered. It is pointed out that monitoring of waste disposal systems is not sufficient for control or prediction of environmental hazards since distribution, concentrations, solubilities, and translocation of radionuclides cannot be accurately predicted. Constant monitoring for activity in soil, air, vegetation, and potable waters is necessary. It is stressed that it is the responsibility of each user of radioactivity to assure that release to the environment is kept at a safe level. (C.H.)

Water Supply and Drainage Quantities for Radio activity Laboratories, J.M.RUDDY. Air Conditioning, Heating, and Vent. 54, 10, Oct 1957 p 105-6. Usual design criteria for liquid waste flow were found to be unreliable at Brookhaven. New data, based on recorded usage in several laboratory buildings, are presented: data for design of hot and cold water piping, laboratory waste piping, and sampling and holdup tank sizing.

9479 ORNL-2311
Oak Ridge National Lab., Tenn.
RADIONUCLIDES IN REACTOR COOLING WATER—IDENTIFICATION, SOURCE AND CONTROL. D. W. Moeller. 172p. July 2, 1957. Contract W-7405-eng-26. $1.00(OTS).

A study is presented of reactor cooling systems with emphasis on the recirculating type. The objectives were identification of the radioactive nuclides present in the water at various stages in the system, determination of the source of these nuclides, and measurement of the efficiency of ion exchange beds in their removal. (W.L.H.)

THE CONTROL, CONVEYANCE, TREATMENT AND DISPOSAL OF RADIOACTIVE EFFLUENTS FROM THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT,

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

GENERAL 8.03.05.01

ALDERMASTON. W. L. Wilson, P. A. F. White, and J. G. Milton. J. Brit. Nuclear Energy Conf. 1, 149-72(1956) July.

The paper states that the principles adopted were developed from those originally devised for and used at the Atomic Energy Research Establishment, Harwell, and shows how attempts were made to overcome certain limitations that became evident there in the construction and early operational phases. It sketches these limitations and describes the solutions adopted. The paper mentions the prospective use of special decontaminants and the measures taken to deal with them. A description is given of the research that was undertaken to determine the form of the effluent-treatment and distillation plant and shows the approach which led to the type of plant and its required performance. The types and costs of chemical additives examined and the final results achieved are stated. The full-scale plant is described in detail together with particular additional developments, primarily those dealing with the safe 'canning' of active sludges. The investigation into disposal points for liquid wastes is outlined and is followed by a description of the storage facilities and discharge pipelines. Attention is drawn to the steps taken to convey the effluent safely. A description of the works at and in the River Thames is given together with an outline of the special trials showing how diffusion therein was achieved. (auth)

Equipment for Control of "Hot" Liquid Wastes, J.M. RUDDY. Plant Eng 9, 11, Nov 1955 p 102-5, 192, 194.

Methods of controlling liquid waste drainage from areas where radioactive work is done; discharge of wastes known to be uncontaminated (such as laboratory cooling and aspirator water) into drains other than special waste system to prevent unnecessary overloads; types of samplers; diagrams of sampling and neutralizing tanks.

2469 AECD-4148

Mound Lab., Miamisburg, Ohio.

LIQUID WASTE DISPOSAL RESEARCH QUARTERLY REPORT FOR APRIL, MAY, AND JUNE 1950. July 1, 1950. Decl. with deletions Jan. 20, 1956. 32p. Contract AT-33-1-GEN-53. $6.30(ph OTS); $3.00(mf OTS).

Experiments have been carried out with both neutralized second-cycle wastes and pure isotopes which show that, in general, the presence of fluoride ion does not interfere with the removal of fission products from waste solutions. Analysis of a third sample of neutralized second-cycle wastes, whose estimated age was six months at the time the analysis was complete, shows that the rare earth elements are present in higher concentrations than any of the other fission products. In a single step the activity of this solution can be reduced from an initial value of 39,000 counts per minute per milliliter to 500 to 700 counts per minute per milliliter by precipitation with either ferrous sulfide or ferrous ferrocyanide. At the same time the alpha count if reduced from 150 counts per minute per milliliter to background. The percentage activity removal by ferrous sulfide is a function of the pH at which precipitation occurs. Nuchar 000 and manganese dioxide (formed both internally and externally) are better adsorbents for activity than silica gel or activated alumina. Upon subjection of the fresh reactor waste solutions to the adsorption, metal scrub, precipitation, and filteration scheme of processing, a reduction in activity was obtained of 39,000 to 250 to 300 counts per minute per milliliter. Silica gel and activated alumina were used in combination as adsorbents, iron powder was employed for the metal scrub, and ferrocyanide was used as the precipitant for ferrous ferrocyanide. The precipitate was first thickened in a small thickener then filtered on commercial filter cloth. It was found difficult to maintain the proper pH conditions in the adsorption column for maximum activity removal. The adsorbents appeared to possess a tremendous capacity for altering the solution. A small pilot model evaporator has been designed and constructed to obtain design data for a larger unit that is contemplated. This model was designed to minimize entrainment and foaming, the main problems encountered in the operation of a "Precision Laboratory Evaporator" in current use for concentrating the waste solutions from reactor waste treatment research. (auth)

13033 HW-41440

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RECOMMENDED LIMIT FOR RADIOACTIVE LIQUID

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

General 8.03.04.01

DISPOSAL FROM HANFORD SEPARATIONS PLANTS TO SURFACE PONDS. H. V. Clukey. Feb. 16, 1956. 5p. $1.80(ph), $1.80(mf) OTS.

A control limit for the activity density of radioactive materials which may be permitted in large-volume waste waters discharged from the Hanford separations plants to open ponds is set forth. The limit 5×10^{-5} microcuries of beta emitters per cc of waste solution was recommended for use in operational control, at the same time providing a criterion for in-line monitoring facilities and alternate routing facilities for the time that the activity density exceeds control limit. (J.R.D.)

Radioisotopes in Sewage Treatment, A. W. Kenny. Surveyor v 116 n 3385 Mar 9 1957 p 225. Basic problem with radioactive discharges to sewers is to set limits for concentration of each radioisotope present; hazard to sewer workers; effect of radiation on sewage purifying organisms; hazard from contaminated sewage sludge.

MONITORING 8.03.05.02

See also, under HAZARDS AND PROTECTION, MONITORING (4.01.09).

13036 HW-59298
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM RECYCLE TEST REACTOR LIQUID AND GASEOUS WASTE DISPOSAL. J. E. Hard and D. R. Koberg. Feb. 17, 1959. 10p. Contract [W-31-109-Eng-52]. $3.30(ph), $2.40(mf) OTS.

For normal operation adequate instrumentation has been incorporated to detect off standard conditions and initiate corrective action. Additional instrumentation for the routine measurement of radioactive materials released to the atmosphere and the river was given serious consideration. A careful evaluation which is summarized leads to the conclusion that additional instrumentation is not warranted for the process waste systems. In this conclusion it is recognized that heat exchangers can fail and radioactivity may be released to the river. As additional experimental facilities are added to the PRTR, the waste disposal program will be reviewed and changes made to maintain adequate control on radioactive materials released to environs. (auth)

20631
THE NEED FOR BIOLOGICAL MONITORING OF RADIOACTIVE WASTE STREAMS. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-6. Richard F. Foster (General Electric Co., Richland, Wash.). New York, Engineers Joint Council, 1959. 19p. $0.50.

Data are presented to illustrate how radiation exposure arising from radioactive wastes in surface waters may be either over- or under-estimated when computed from discharge rates. The importance of biological concentration of certain isotopes and the need for monitoring at various points of water use are emphasized. (auth)

13036 HW-59298
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM RECYCLE TEST REACTOR LIQUID AND GASEOUS WASTE DISPOSAL. J. E. Hard and D. R. Koberg. Feb. 17, 1959. 10p. Contract [W-31-109-Eng-52]. $3.30(ph), $2.40(mf) OTS.

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14246 TID-7568(Pt. 2)(p.13-23)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

MONITORING 8.03.05.02

AUTOMATIC ANALYZING MONITOR. H. G. Rieck, C. A. Ratcliffe, and L. C. Schwendiman. p.13-23 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 11p.

A monitor is described which automatically measures and records the total beta-emission rate and the concentrations of sodium-24, neptunium-239, arsenic-76, copper-64, manganese-56, phosphorus-32, and silicon-31 in a reactor waste stream. ~~Samples are withdrawn from the waste stream once each hour and transferred to sample dishes. Chemical treatment is used to re-~~

AN ALPHA MONITOR FOR WASTE STREAMS. Edward C. Wingfield. Jan. 1957. 8p. (DP-197)

A continuous α monitor was developed for aqueous streams that may contain traces of radioactivity. A scintillation screen was submerged directly in the water. The instrument detected concentrations as low as 3.3×10^{-10} c/ml. The monitor's sample cell could be decontaminated easily if background activity accumulated within it.

10125

A SYSTEM WHICH CONTINUOUSLY RECORDS WATER LEVEL AND CONTAMINATION. Ford Kalil and J. M. Garner, Jr. (Oak Ridge National Lab., Tenn.). Nucleonics 14, No. 7, 56-60(1956) July.

The system consists of a gamma-radiation monitor which continuously measures the radiation dose of the lakes or streams in which waste is deposited. A continuous water-elevation recorder, and a telemetering system which transmits the water level and radiation dose to a central station are described. (W.L.H.)

ENGINEERING TEST REACTOR ENGINEERING DESIGN AND SAFEGUARDS REPORT. July 1956. 347p. (IDO-24020; GEAP-0554; KE-56-19-R)

Of particular interest in this report (p. 44-90) are the following: A description of the gross γ monitoring devices in the reactor building; airborne particle monitors; area monitoring in the compressor and heat exchanger buildings; personnel monitoring; water and service water monitoring: primary secondary, and fission products monitoring; stack gas and bypass demineralizer monitoring; information on the normal disposal of radioactive solid, liquid, and gaseous wastes. Also included are plans of the buildings and a liquid waste disposal layout flow diagram.

MONITORING THE LIQUID WASTES DISCHARGED FROM THE IDAHO CHEMICAL PROCESSING PLANT. William C. King. June 12, 1956. 29p. (IDO-14378)

A continuous liquid waste monitor which has been in operation for 24 months at the Idaho Chemical Processing Plant is described. By detecting the γ activity, the monitoring system provides a method of measuring the activity in large volumes of liquid wastes which are discharged from the ICPP. The monitoring system, as described, provides a permanent record of the flow-rate and instantaneous concentration of γ activity in the discharged waste independent of background activity. It will integrate the product of the flow-rate and count-rate to give the total activity discharged over any given period of time. The monitor activates alarms if the concentration of activity in the discharge stream becomes too great. It also collects a continuous proportional sample of the discharged liquids which can be submitted for radiochemical analyses.

REACTOR EFFLUENT RADIATION MONITORING. R. J. Leuba and J. C. Veburg (Tracerlab, Inc., Richmond, Calif.). p.19-27 in "Proceedings of the 1959 Biannual National Nuclear Instrumentation Symposium."

The monitoring of gaseous and liquid wastes from reactor and processing plant sites requires a wide variety of sampling, detection, and information-processing equipment. Some of the design factors involved in the selection and construction of instrumentation for waste monitoring are discussed. (auth)

TREATMENT 8.03.05.03

21652

AMP—EFFECTIVE ION EXCHANGER FOR TREATING FISSION WASTE. J. Van R. Smit, W. Robb, and J. J. Jacobs (National Chemical Research Lab., Pretoria). Nucleonics 17, No. 9, 116, 118, 120-3(1959) Sept.

The feasibility of separating Cs^{137} from fission-product solutions by means of ammonium phosphomolybdate (AMP) was demonstrated by experiments. The behavior of Zr^{95} and Nb^{95} when present in solutions as cations is discussed. The possibility of treating neutral

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

TREATMENT 8.03.05.03

fission-products solutions with columns of AMP is investigated. The advantages and disadvantages of AMP are presented. (C.J.G.)

RADIOACTIVE CONTAMINANT REMOVAL FROM WASTE WATER: ENGINEERING DESIGN FEATURES. Mark C. Culbreath (Burns and McDonnell Engineering Co., Kansas City, Mo.). Proc. Am. Soc. Civil Engrs. 85, No. SA 3, 41-53(1959) May.

The design and operation of a plant at Oak Ridge National Lab. on the collection, treatment, and disposal of large volume (0.5 to 0.7 mgd), low-level radioactive liquid waste are described. The design of the lime-soda softening process treatment plant for the removal of Sr and the total rare earths from the process waste water is given. (auth)

15698

RADIOACTIVE CONTAMINANT REMOVAL FROM WASTE WATER: EVALUATION OF PERFORMANCE. K. E. Cowser and Roy J. Morton (Oak Ridge National Lab., Tenn.). Proc. Am. Soc. Civil Engrs. 85, No. SA 3, 55-76(1959) May.

The design and operation of a plant at the Oak Ridge National Lab. for the collection, treatment, and disposal of large volume (0.5 to 0.7 mgd), low level radioactive liquid waste is described. The performance of the lime-soda softening process treatment plant for the removal of Sr and other materials is described. (auth)

CONTAMINATION AND DECONTAMINATION TESTS OF A DRAINAGE SYSTEM FOR RADIOACTIVE WASTE WATERS. P. Cohen, G. Pardo, and G. Wormser (Centre d'Études Nucléaires, Saclay, France). Énergie nucléaire 1, 23-6(1959) Jan.-Apr. (In French)

Contamination studies of waste water containing I^{131} were made with a consideration of the effects of the time of contact, the pH of the solution, the dilution of the contaminant liquid, and the form of the evacuation channel. It was concluded that for the most effective decontamination, it was necessary to neutralize the iodic acid effluents. A considerable fraction of the effluent is retained by the walls of the evacuation channel. (J.S.R.)

17942

MEANS AND METHOD OF TREATING WATER. P. A. F. White and A. A. Smales (to U. K. Atomic Energy Authority). British Patent 790,474. Nuclear Eng. 3, 414(1958) Sept.

Removal of small quantities of radioactive substances from contaminated water (residual radioactivity of aqueous effluent) is effected by a precipitate formed from tannic acid and a soluble calcium compound under alkaline conditions. This is maintained in the water for a period of 3 to 5 hours, and the precipitate is then separated.

14751 A/CONF.15/P/2354

Oak Ridge National Lab., Tenn.

THE TREATMENT OF LARGE-VOLUME, LOW-LEVEL WASTE BY THE LIME-SODA SOFTENING PROCESS. K. E. Cowser, Roy J. Morton, and E. J. Witkowski. 28p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

At Oak Ridge National Laboratory, the collection and disposal of large volume (0.5 to 0.7 million gpd), low level radioactive liquid waste is accomplished through a process waste water system. The wastes from laboratory sinks, decontamination-pad drains, floor drains, storage canals, evaporator condensates, and water from various development processes are collected in an excavated settling basin (approximately 1.6 million gallons design capacity) and discharged through a continuous flow-measurement, proportional-sampling station into White Oak Creek, White Oak Lake (a 50 acre, 10^7 ft^3 impoundment), and the Clinch River. To Minimize the danger of accidental or emergency discharges and increase the factor of safety for normal operations, a process waste water treatment plant was essential. The plant employs gravimetric chemical feeding, flash mixing, coagulation, and sedimentation, and has a capacity of 500,000 gallons per day. The recirculation of plant effluent, the return of preformed crystals (sludge), and repeated precipitation is possible. An 800,000 gallon equalizing basin is provided to minimize fluctuations in chemical composition of the influent wastes. Operating experience during the past year has shown that the plant is capable of removing 90% of the radioactive strontium and rare earths and reducing the calcium content to less than 30 ppm. Operation of the plant is controlled by routine analytical determinations and is being improved by statistically designed laboratory studies. (auth)

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

TREATMENT 8.03.05.03

8351 BLG-13
Brussels. Centre d'Etude de l'Énergie Nucléaire.
TREATMENT OF RADIOACTIVE EFFLUENTS WITH SAWDUST OR BROWN-COAL. P. Dejonghe, N. Van de Voorde, and M. D'hont. Dec. 4, 1957. 24p.

Sawdust, rotted sawdust, and brown-coal can be used for radioactive effluent treatment. Generally the volume of rotted material consumed is less than 1% of the volume of treated water at a removal of more than 95% of the radioactivity. In most cases this adsorption should be preceded by a chemical precipitation in order to remove bi- and trivalent chemical impurities. (auth)

Quelques etudes en rapport avec le traitement chimique d'effuents radio-actifs, P.Dejonghe, M.D'Hont. Energie Nucleaire 1, 1 Jan-Mar 1957, p 27-33.

Studies in connection with chemical treatment of radio-active effuents; elimination of ruthenium from residual waters by treatment with ferrous sulphate gives better results than flocculation and precipitation elimination of hexavalent uranium with tannic acid and trisodium phosphate gives good results; interference with treatment of versene and teepol was investigated.

3303
REACTOR WATER PROCESSING: HOW IT IS DONE IN APPR. A. Louis Medin (ALCO Products, Inc., Schenectady, N. Y.). Nucleonics 15, No. 12, 72, 74, 76, 78, 80-1(1957) Dec.

The water treatment facilities provided for the Army Package Power Reactor (APPR) are described. Although the APPR is a relatively small pressurized-water reactor, the water treatment problems of larger commercial power reactors should be similar. (L.T.W.)

PREPARATION OF WASTE FOR LIQUID DISPOSAL. J. W. Ullmann. May 1, 1957. p.377-88 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM MAY, 20-25, 1957. BOOK I. 475p. (TID-7534)

This paper describes typical approaches which are used for liquid waste disposal. These include: asphalt lined pits; evaporation; crystallization; precipation; and ion exchange.

15694 ERDL-1451-RR
Engineer Research and Development Labs., Fort Belvoir, Va.
THE REMOVAL OF RADIOACTIVE MATERIAL FROM WATER BY SERIAL COAGULATION, BY ION EXCHANGE, AND BY CHARCOAL ABSORPTION (SALTY DOG VII). William J. Lacy, Ronnie R. Rollins, and Lester M. Lawless. June 22, 1956. 24p. Project 8-75-07-214.

Methods of removing radioactive materials from water by serial coagulation, by ion exchange, and by charcoal adsorption were examined. Results indicate that all of the Ru-106–Rh-106, Zr-95–Nb-95, and Ce-144–Pr-144 present may be removed by serial coagulation, also over 98% of Ba-140–La-140, and Sr-90–Y-90 can be removed by this method as well as 87.8% of mixed fission products. The capacity of ion exchange resins such as Amberlite Ir-120 for removing Sr-89 from water is essentially independent of flowrate, column length, temperature, and pH. Granular bone charcoal was tested for radioisotope removal from water. The highest removal was obtained with Ag-110 (89.2%) and Pr-144 (88.8%) while the lowest removal was with Na-24 (38.3%). Pretreatment of contaminated water with dimethylglyoxime was found to be beneficial in charcoal removal of radioisotopes. Using this additive more than 98% of the Sr-89, Ba-140, La-140, Zr-95, Nb-95, Ca-45, Y-91, Ag-110, and Ce-144–Pr-144 present were removed. (J.R.D.)

7184 CF-55-10-153
Oak Ridge National Lab., Tenn.
WATER DECONTAMINATION: AN ION EXCHANGE PILOT PLANT STUDY. William J. Lacy and Don C. Lindsten. Oct. 21, 1955. 13p. Contract [W-7405-eng-26]. $3.30 (ph OTS); $2.40(mf OTS).

Under certain circumstances, water supplies may contain appreciable concentrations of radioisotopes from hospitals, university research laboratories, industries, or the use of atomic or thermonuclear weapons. Many methods of water decontamination are in use and have been reported on including adsorption, coagulation, distillation, and ion exchange. Ion exchange materials and processes have been used for many years for water softening. More recently they have been used on a laboratory scale to study

DISPOSAL METHODS 8.03

LIQUID WASTES 8.03.05

Treatment 8.03.05.03

their effectiveness for removing radioactive ions from contaminated solutions. Reported here are the results of an ion exchange study on a much larger scale. The investigation not only included the effectiveness of the method for removing the radioactive material but also some measurements on the radiation hazard involved. (auth)

Massachusetts Inst. of Tech., Cambridge. Sedgwick Labs. of Sanitary Science.
A STUDY OF THE REMOVAL OF RADIOACTIVE PARTICULATE MATTER FOR WATER BY COAGULATION. Nathan C. Burbank, Jr., Robert A. Lauderdale, and Rolf Eliassen. Sept. 1, 1955. 116p. Contract AT(30-1)-621. (NYO-4440).

The primary objective of the research was to determine the effectiveness of the common methods of coagulation used in water treatment to remove radioactive particulate matter and the fundamental mechanism of the process. There are 75 references to report and published literature.

6047 A/CONF.15/P/2345
DECONTAMINATION AND POTABILIZATION OF THE WATERS OF THE RIVER PLATE FOLLOWING ACCIDENTAL CONTAMINATION BY FISSION PRODUCTS. Leopoldo José Anghileri (Comision Nacional de Energia Atómica, Buenos Aires). 36p.

Tests were carried out to demonstrate the decontamination of the River Plata water in case of an accident. The investigation consisted of adding a known quantity of radioactive substance to the water, subjecting it to the chosen process, and determining what amount of radioactive material was eliminated from the liquid. The three decontamination techniques tested were decontamination with coagulant, precipitation with Na_3PO_4 and NaOH, and precipitation of $(HO)_3Fe$. (W.D.M.)

7069 A/CONF.15/P/1676
TREATMENT OF RADIOACTIVE EFFLUENTS AT THE MOL LABORATORIES. P. Dejonghe, L. Baetsle, and G. Mosselmans (Centre d'Etude de l'Energie Nucléaire, Brussels). 22p.

The cold effluents (sanitary waste and decontaminated radioactive water) are flocculated with sodium phosphate and pumped through a trickling filter. The average decontamination obtained is about 85% for alpha emitters and 75% for beta emitters. The cool effluents (activity $< 10^{-3}\mu c/ml$) can be treated by several methods. Provisions have been made for two successive chemical flocculations eventually followed by an adsorption. The warm waste treatment (activity between 10^{-3} and 1 $\mu c/ml$) is still in the experimental stage. The following methods are used: evaporation for some chemically contaminated wastes, browncoal filtration for reactor effluents, and a combination of chemical treatment and browncoal adsorption in other cases. (auth)

WATER, DISPOSAL IN8.03.06

See also, under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Legal Aspect (4.02.05).

CONTAINERS 8.03.06.01

SIMULATION OF CONTAINER VENTING UNDER SEA WATER. Technical Report No. 59. M. J. McGoff and S. J. Rodgers. Dec. 31, 1957. 22p. (NP-6541)

The underwater release of radioactive contaminants from a reactor compartment was simulated by ejecting contaminated steam and air from an open end 2 in. pipe submerged in 10 ft of synthetic sea water. Two runs were conducted with Na^{24} and Rb^{86} representing a water soluble contaminant, and I^{131} representing a water soluble or a volatile contaminant, depending upon the oxidation state of the I_2. These runs indicated the efficiency of sea water in removing airborne and steamborne radioactive contaminants. The 10 ft column of sea water removed about 95% of the total contaminant activity escaping from the vapor container. The removal distribution among the components was ~100% of Rb^{86}, 96% of Y^{90} and 86% of I^{131}, thus indicating least removal of the volatile contaminant.

UNITED STATES' SEA DISPOSAL OPERATIONS. A. SUMMARY TO DECEMBER 1956. Arnold B. Joseph. 16p. (WASH-734)

Some atomic energy activities in the United States have been disposing of radioactive wastes at selected ocean disposal sites since early 1946. It is the purpose of this report to describe the extent of these disposal operations including a summary of types of packaging used, and of places where the wastes are dumped. The status of related oceanographic research (1956) is briefly discussed.

DISPOSAL METHODS 8.03

WATER, DISPOSAL IN 8.03.06

CONTAINERS 8.03.06.01

755
ESTIMATION OF CURIE CONTENT OF PACKAGED RADIOACTIVE WASTES. Frederick B. Oleson (Brookhaven National Lab., Upton, N. Y.). Arch. Ind. Health 12, 383-7(1955) Oct.

At Brookhaven National Laboratory solid radioactive wastes are packed in concrete-lined barrels for sea burial. Most of the activity comes from mixed fission products over one year old. In order to determine the amount of activity thus disposed of, it is necessary, in practice, to relate the mr/hr readings of gamma survey instruments at a specified distance from the barrels to the activity in curies. To make this relationship quantitative, it has been necessary to obtain a known amount of the activity in highly concentrated liquid form and to make a measurement of the r/hr per curie of total activity at 1 ft for various thicknesses of the concrete lining. An analysis of the gamma-ray energy spectrum using a gray-wedge spectrometer showed that over 95% of the gammas

GENERAL 8.03.06.02

23026
THE 1958 INTERNATIONAL CONFERENCE ON THE LAW OF THE SEA. Arthur E. Gorman (Atomic Energy Commission, Washington, D. C.). p.2875-80 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

A discussion is presented on Article 48 (from a report of the International Law Commission) which deals with the pollution of the high seas by radioactive waste. (C.J.G.)

10522 CF-58-3-109
Oak Ridge National Lab., Tenn.
DISPERSION OF SOLUBLE RADIOACTIVE MATERIAL IN WATER. Fred S. Dunning and John C. LeDoux. Mar. 20, 1958. 36p. Contract [W-7405-eng-26]. $6.30 (ph OTS); $3.00(mf OTS).

Theories of diffusion processes in water are discussed and the dispersion of radioactivity is calculated from an interpretation of the molecular diffusion equation with modifications which tend to fit the equation to experimental data. From this the dose rate resulting from fission products in solution are made for a number of situations of interest. Parametric solutions are obtained and plotted on graphs which may be used to obtain water concentrations and thence dose levels. (auth)

10126
THE DISPERSAL OF EFFLUENT IN THE SEA. J. Wright (Atomic Energy Research Establishment, Harwell, Berks, England). Atomics 7, 274-9(1956) Aug.

The aspects of radioactive effluent disposal from the chemical plant to be associated with the British Pu production piles are briefly discussed. Experiments were made to determine the nature of processes leading to physical dispersion of the radioactivity from the point of discharge in the sea. A general summary of the results is included. (B.J.H.)

21689
DISPOSAL OF LOW LEVEL LIQUID RADIOACTIVE WASTES IN SURFACE WATERWAYS. Harold A. Thomas, Jr. and Gordon McKay (Harvard Univ., Cambridge, Mass.). p.1005-9 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Radioactive liquid waste disposal to surface waterways is discussed relative to safety, economics, dispersal, and ultimate fate. (C.J.G.)

21691
RADIOACTIVE WASTE DISPOSAL TO SURFACE WATERS. E. C. Tsivoglou (Robert A. Taft Sanitary Engineering Center, Cincinnati). p.1048-73 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Activities of the Public Health Service directed toward the control of radioactive contamination of surface waters are briefly reviewed. Findings from investigations conducted in the vicinities of major AEC sites are discussed. (D.E.B.)

OCEANS 8.03.06.03

3257
RADIOACTIVE WASTE DISPOSAL INTO ATLANTIC AND GULF COASTAL WATERS. A Report from a Working Group of the Committee on Oceanography of the National Academy of Sciences—National Research Council. Second Printing. Publication 655. Washington, D. C., National

DISPOSAL METHODS 8.03

WATER, DISPOSAL IN 8.03.06

OCEANS 8.03.06.03

Academy of Sciences—National Research Council, 1959. 42p. $1.00.

Taking into account the effects of local oceanographic conditions and possible health hazards, recommendations are made as to the amounts of different radioactive isotopes that can be disposed of safely in any one area. The study provides an estimate of the rate of return of radioactive substances to man. A theoretical study of dilution by turbulent mixing processes was also made. Because of the assumptions made, all estimates of concentration at a given distance and time are probably higher, by at least a factor of ten, than would actually exist in practice. An estimate was made of the maximum permissible concentration of each of several radioisotopes in sea water, below which contamination of marine food products will not lead to greater than allowable intake by humans. Twenty-eight possible disposal sites are listed. (C.J.G.)

16349 AERE-E/R-2625

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

EXERCISE MERMAID. P. Bowles, R. H. Burns, F. Hudswell, and R. T. P. Whipple. Aug. 1958. 230p. $6.30(BIS).

The exercise was performed because of the proposal to erect an Atomic Energy Research Establishment at Winfrith Heath, Dorset, England. This proposal would involve continued discharge of radioactive liquid effluent to the sea. Trials were initiated to measure the dispersal rate of soluble effluent, simulated by fluorescent dye, from various points south of Arish Mell. The objects were to determine the optimum position for outlet of discharge pipe and to obtain fundamental data for estimating the contamination likely to arise. (W.D.M.)

A SUMMARY OF THE BIOLOGICAL INVESTIGATIONS OF THE DISCHARGES OF AQUEOUS RADIOACTIVE WASTE TO THE SEA FROM WINDSCALE WORKS, SELLAFIELD, CUMBERLAND. H. J. Dunster and F. R. Farmer. Jan. 1958. 14p. (IGS-R/R-3)

For about 5 yr, experimental discharges of radioactivity have been made from the United Kingdom Atomic Energy Authority's Windscale Works, Sellafield, to the coastal water off Cumberland. Samples of fish, seaweed, sea bed and shore sand have regularly been taken and their activity assessed. This report summarizes the results of that program and concludes that the maximum permissible discharge rate is not <15,000 c/month of total β activity. Specific limitations are necessary for Sr^{90}, Pu, and Ru^{106}.

THE DISPOSAL OF RADIOACTIVE WASTE TO THE SEA DURING 1956 BY THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY. H. J. Dunster. Jan. 1958. 4p. (IGS-R/R-2)

The United Nations Scientific Committee on the Effects of Atomic Radiation recently asked to be supplied with information about the disposal of radioactivity into the sea. They considered that releases into coastal waters would not be significant unless they exceeded 1,000 curies/yr. In the United Kingdom, only the Atomic Energy Authority discharges wastes approaching this activity, and they do so only from one establishment, Windscale Works, Sellafield, Cumberland. The Works contains reactors, chemical plants, and laboratories which are concerned both with plant control and with the technology of nuclear power, and the wastes therefore contain primarily fission products and nuclear fuels such as U and Pu. This report gives in tabulated form the radioactive wastes discharged to the sea by the above works. The results of marine monitoring off Windscale Works for 1956 are included.

16350 AEC-tr-3296

IS IT PERMISSIBLE THAT ATOMIC INDUSTRY WASTE BE DUMPED INTO THE BLACK SEA? V. A. Vodianitskii (Vodianitsky). Translated by the Oak Ridge National Lab. Library Staff from Priroda 2, 46-52(1958). 16p.

Arguments are offered for the assumption that vertical displacement is negligibly small in the Black Sea, making it possible to dispose of radioactive waste at the bottom. (T.R.H.)

6699 IGR-TN/D-443

Gt. Brit. Dounreay Works, Caithness, Scotland.

FACTORS AFFECTING THE DISTANCE OF THE DISCHARGE POINT FROM THE SHORE IN THE SEA DISPOSAL OF EFFLUENT. A. E. Shaw. Feb. 1957. 11p.

DISPOSAL METHODS 8.03

WATER, DISPOSAL IN 8.03.06

OCEANS 8.03.06.03

5829 WASH-734
Division of Reactor Development. Engineering Development Branch, AEC.
UNITED STATES' SEA DISPOSAL OPERATIONS. A SUMMARY TO DECEMBER 1956. Arnold B. Joseph. 16p. $3.30(ph OTS); $2.40(mf OTS).
Some atomic energy activities in the United States have been disposing of radioactive wastes at selected ocean disposal sites since as early as 1946. It is the purpose of this report to describe the extent of these disposal operations including a summary of types of packaging used, and of places where the wastes are dumped. The status of related oceanographic research (1956) is briefly touched upon. (auth)

6683 A/CONF.15/P/296
SEA DISPOSAL OF LOW ACTIVITY EFFLUENT. P. Bowles, R. H. Burns, F. Hudswell, and R. T. P. Whipple (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.
A proposal was made to discharge mildly radioactive liquid effluent, arising at the new Atomic Energy Establishment at Winfrith Heath, into the sea off the Dorset coast. Experiments are described which were performed at sea from August to November 1956 to determine the rate of sea dilution of a tracer dye by sampling and analysis under varying weather and tidal conditions, to determine significant gradients capable of influencing dilution rates, to obtain data on tidal streams, to sample marine life and deposits from the sea bed, and to study the contour of the sea bed in the area. Results are summarized. (C.H.)

7066 A/CONF.15/P/1355
OCEANOGRAPHICAL RESEARCHES ON THE WASTE DISPOSAL OFF THE COAST OF TOKAI-MURA. (Marine Safety Agency, Japan; Japan Meteorological Agency; Meteorological Research Inst., Japan; Tokai Regional Fisheries Research Lab., Japan, and Ibaragi Prefectural Fisheries Exptl. Station, Japan) 16p.
In coöperation with the Japan Atomic Energy Research Institute the oceanographical survey was carried out off the coast of Tokai-Mura, Ibaragi Prefecture, in the fall of 1956 in connection with waste disposal at sea. As a result of the survey it was shown that the tidal current is strong and a counterclockwise small circulation exists in an area south off Tokai-Mura on the western side of the Kuroshio. When some substances are discharged into the sea off Tokai-Mura, they are likely to be drifted southwards along the coast and spread over the area of the circulation. Then they are transported by the Kuroshio further to the high sea The distribution of submarine sediments was investigated, and the β radioactivity of sediments was measured. No remarkable activity was found in the area.

21698
ENVIRONMENTAL FACTORS AFFECTING THE DISPOSAL OF RADIOACTIVE WASTE MATERIALS INTO TIDAL ESTUARIES AND COASTAL BODIES OF WATER. D. W. Pritchard (Johns Hopkins Univ., Baltimore). p.1278-98 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."
The environmental factors which will affect the disposal of various forms of radioactive wastes into the marine environment are discussed with particular emphasis on harbors, estuaries, and coastal waters. Not only is purposeful introduction of radioactive materials into such environments discussed but also accidental introduction which might result from an unforeseen catastrophe to a shore based reactor, or from a collision involving a nuclear powered ship. The fate of such wastes, with emphasis on possible return routes to man, is considered. This information can be utilized in evaluating the risks to man from disposal of radioactive wastes in the marine environment as compared to the costs and risks which might result from other methods of disposal. (C.J.G.)

7072 A/CONF.15/P/2058
CONCERNING THE POSSIBILITY OF DISPOSING OF RADIOACTIVE WASTE IN OCEAN TRENCHES. V. G. Bogorov and E. M. Kreps (U.S.S.R.). 16p.
The discharge of radioactive waste into deep ocean depressions is based on the assumption that the mass of water in depressions at great depth is devoid of vertical or horizontal circulation. It was proved on the basis of data obtained in the exploration of 12 deep ocean depressions, and particularly of the Tonga depression, that in every depression there is a circulation of water which, though slow, is measured by decades and not by hundreds of years. (auth)

DISPOSAL METHODS 8.03

WATER, DISPOSAL IN 8.03.06

Oceans 8.03.06.03

7060 A/CONF.15/P/297
THE DISPOSAL OF RADIOACTIVE LIQUID WASTES INTO COASTAL WATERS. H. J. Dunster (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 21p.

The data obtained during five years of experimental discharges of dilute liquid waste from Windscale Works, Sellafield, Cumberland, into the Irish Sea are reviewed. The results include measurements of the resulting radioactivity of fish, seaweed, sea bed, and shore sand, and where these are significantly different from natural levels of radioactivity, they are related to the amounts of radioactivity discharged. Maximum permissible levels of radioactivity in the relevant materials have been derived from the recommendations of the International Commission on Radiological Protection, and these have been used in conjunction with the monitoring results to estimate the maximum permissible rates of discharge from Windscale works. The discharge rates to date have ranged up to about 50,000 curies per year and the results reported show that this figure could safely be increased to several hundred thousand curies per year. Specific limitations are needed on the discharge rates of ruthenium 106, which is strongly adsorbed into surfaces, and of strontium 90 and alpha emitters, which tend to concentrate in human bone. The problems of relating these results from Windscale to discharges from other sites are discussed, and results are included for some small scale experimental discharges of radioactivity from Dounreay, Caithness, Scotland. (auth)

RIVERS 8.03.06.04

7063 A/CONF.15/P/1175
PROBLEME DU REJET DES RESIDUS RADIOACTIFS LIQUIDES AU C.E.A. TRAITEMENTS ABOUTISSANT A DES REJETS EN RIVIERE. (Disposal of the Radioactive Effluents at the "Commissariat a l'Energie Atomique." Treatment Leading to Evacuation into a River). Duhamel, Menoux, and Candillon (Commissariat a l'Energie Atomique, Paris). 13p.

The problem of the treatment of liquid radioactive wastes at the Commissariat a l'Energie Atomique is considered with the idea of ultimate disposal in rivers in a condition which satisfies protection standards. The types of wastes from Saclay, Fontenay-aux-Roses, Bouchet, and Marcoule are described. The optimum conditions in which the wastes should be in order to satisfy all precautions are discussed with an examination of dilution, evolution of activity in the rivers, choice of disposal site, and isotopic dilution of the waste radioelements. (J.S.R.)

PLANTS AND EQUIPMENT 8.04

9773
DESIGN AND CONSTRUCTION OF A MODEL PLANT FOR THE PURIFICATION OF RADIOACTIVE WASTES (DECONTAMINATION). Ernst Plötze (Univ. of Freiburg i. B.). Atomkern-Energie 3, 186-90(1958) May. (In German)

The design and construction of a model plant for the purification of radioactive wastes were described. After a description of the start-up procedure, the various methods to test and ascertain the quantitative quality of the decontamination are discussed. (J.S.R.)

PROTECTION OF EXTERIOR BURIED WASTE LINES. Engineering Study No. 6. G. U. Udine. Sept. 24, 1952. Changed from OFFICIAL USE ONLY May 22, 1957. 43p. (HW-24500)

The protection of buried waste lines leading from radiochemical plants at Hanford is discussed. Methods in general use and methods presently used at Hanford are evaluated. Proposed types of waste line encasements, cathodic protection, and hazards from possible leaks in existing lines are discussed. A comparison of costs of existing and proposed methods is made and recommendations are given.

11149 HW-51841
[General Electric Co. Hanford Atomic Products Operation], Richland, Wash.
[THE PROPOSED SYSTEM FOR RADIO REMOTE CONTROL OF A BULLDOZER FOR BURIAL OF RADIOACTIVE WASTE.] (Summary letter and scope Blueprint). G. L. Davis. Feb. 19, 1957. 4p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

PLANTS AND EQUIPMENT 8.04

GENERAL SPECIFICATION FOR THE PWR COMMERCIAL NUCLEAR POWER PLANT WASTE DISPOSAL EQUIPMENT. E. Spec.-566210-A. [Dec. 12, 1955]. 6p. (WAPD-PWR-PMA-206)

13044 LWS-24632
California Research and Development Co., Livermore, Calif.
PROCESS DESIGN FOR THE LIVERMORE WASTE DISPOSAL PLANT. Summary Report. J. L. Schewennesen, L. R. Michels, and M. L. Feldman. Sept. 10, 1952. Decl. Apr. 1, 1957. 29p. (CRD-T1-184). $6.30(ph OTS); $3.00 (mf OTS).

Some of the singular problems connected with radioactive waste processing at the Livermore site are outlined. Several methods for treating and disposing of wastes were evaluated. These include disposal at sea in shielded containers following various degrees of concentration, underground storage of neutralized wastes at Livermore, direct dispersion of wastes in large volumes of sea water, and rail or truck shipment to either Hanford or Los Alamos for underground storage at these sites. Approximate costs per year are tabulated for these methods. (B.J.H.)

2470 AECU-3244
Massachusetts Inst. of Tech., Oak Ridge, Tenn. Engineering Practice School.
TEST OF STEAM JACKETED FALLING FILM EVAPORATOR. G. R. Nelson, T. F. Furlong, and J. B. Robinson. June 28, 1950. 11p. For Carbide and Carbon Chemicals Div., K-25 Plant. Contract [W-7405-eng-26, Subcontract 70]. (KT-76). $3.30(ph OTS); $2.40(mf OTS).

The results of a test to obtain operating data on a steam-heated falling-film evaporator for elimination of radioactive condensates the maximum practical steam pressure useable was 25 psig. The maximum flow of feed without flooding was about 0.2 lb/min. The maximum flow of feed for 10 psig steam pressure was 2 lb/min. Entrainment was encountered in all runs. The highest concentration obtained using 1.7% nitrate solution for feed was 38.4%. The average over-all heat transfer coefficient was found to be 386 ± 77 BTU/(hr)(sq ft). (F.S.)

2343 IDO-14079
American Cyanamid Co. Atomic Energy Div., Idaho Falls, Idaho.
IDO LIQUID WASTE PLANT, CPP 604 BUILDING OPERATING EQUIPMENT MANUAL. S. F. Fairbourne, V. W. Irvine, A. M. Larson, B. H. Macklin, L. G. Pearson, and H. L. Sexton, comps. May 22, 1952. Changed from OFFICIAL USE ONLY May 29, 1956. 164p. Contract [AT(10-1)-177]. $25.80(ph OTS); $7.80(mf OTS).

A manual is presented dealing with information on some of the equipment in building CPP 604. The equipment is arranged according to number and a brief description and function are given. WM equipment is used in storage of liquid waste and WL is used in treating liquid wastes in the 604 area. A sketch of the vessels, heat exchangers and instruments is shown, giving nozzle arrangement and size. Additional information can be found from the fabricators or reference drawing numbers that are given. (J.E.D.)

RECOVERY OR REMOVAL OF MATERIALS 8.05

See also,

FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL (2.00).

Al-CONTAINING WASTES 8.05.01

See also, under FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL,

ALUMINUM (2.02),

and,

under PROCESS CHEMISTRY AND ENGINEERING,

SPECIAL PROCESSES--Diban Ion Exchange (6.17.06).

RECOVERY OR REMOVAL OF MATERIALS 8.05

Al-CONTAINING WASTES 8.05.01

3259

TREATMENT OF FISSION PRODUCT WASTE. J. B. Huff (to U. S. Atomic Energy Commission). U. S. Patent 2,897,049. July 28, 1959.

A pyrogenic method of separating nuclear reactor waste solutions containing aluminum and fission products as nitrates comprising, spraying the solution on a bed of burning petroleum coke in an underground retort, collecting the easily volatile gases resulting as the first fraction, then passing chlorine gas through the bed and collecting the resulting gaseous chlorides, including aluminum chloride as the second fraction, permitting the coke bed to cool and collecting the ash as the third fraction, which will contain all the longest lived radioactive fission products in greatly reduced volume.

CALCINATION OF ALUMINUM-TYPE REACTOR FUEL WASTES IN A FLUIDIZED BED. E. S. Grimmett. Aug. 1, 1957. 18p. (IDO-14416)

The conversion of aqueous Al-type reactor fuel wastes into a free-flowing granular Al_2O_3 solid by means of a fluidized bed calciner, has been studied at the Idaho Chemical Processing Plant. A 6-in. diameter calciner at ICPP has been successfully operated on simulated Al type waste over feed rates varying from 20 to 110 ml/min, over temperatures ranging from 180° to 500°C, and for periods of operation between startup and shutdown of from 8 to 336 hr.

13992 IDO-14462

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

DESIGN BASES FOR ICPP WASTE CALCINATION FACILITY. D. K. MacQueen and J. I. Stevens. Apr. 22, 1959. 22p. Contract AT(10-1)-205. $0.75 (OTS).

A demonstrational, semi-works scale, waste calcination unit is being constructed at the Idaho Chemical Processing Plant. This unit will convert the fission product-containing aluminum nitrate solutions now being stored in underground stainless steel tanks to granular alumina and fission product oxides. This change in phase of the wastes, and the concomitant reduction in volume, may result in significant reductions in waste storage costs and increase radiological safety during the long storage period required for decay of the fission products. The facility has been designed as a 60 gallon per hour semi-works unit to permit evaluation of the process in full-scale equipment. The potential reduction in the quantity of ICPP liquid wastes in storage is, however, an important objective of this unit. The process design was based primarily on laboratory and pilot plant studies made at both the Idaho Chemical Processing Plant and the Argonne National Laboratory. The basic process is the injection of the waste solutions into an air-fluidized bed maintained at 400°C. The water and nitric acid in the feed appear in the overhead off-gas stream; the aluminum and fission product nitrates decompose to the corresponding solid oxides and are continuously withdrawn as a bottoms product. The solid product will be pneumatically conveyed to air-cooled underground bins for retention. The off-gas will be cleaned and released to the atmosphere. (auth)

REMOVAL OF FISSION PRODUCTS FROM REACTOR WASTES: LABORATORY STUDIES OF LIQUID-LIQUID EXTRACTION FROM AN ACID ALUMINUM NITRATE SOLUTION. Herman L. Krieger, Bernd Kahn, and Conrad P. Straub. May 24, 1957. 36p. (ORNL-2297)

Liquid-liquid extraction of the major long-lived fission products was evaluated as a method for decontaminating an acid $Al(NO_3)_3$ waste. Tributyl phosphate, di-2-ethylhexyl phosphoric acid, tridecyl phosphine oxide, tri-n-octyl amine and thenoyl trifluoroacetone were found to be effective in extracting one or more of the Ce, Y, Zr, Nb, and Ru tracers used in this study.

THE ALKALINE METHOD FOR TREATMENT OF HIGH RADIATION LEVEL ALUMINUM WASTES. I. R. Higgins. Jan. 17, 1957. 7p. (CF-57-1-139) (O.R.N.L.)

The method is based on caustic precipitation and centrifugation (which removes the Cs and small amounts of Sr, rare earths, Zr, Nb, and Ru). These are removed in the supernatant and run through a cation exchange column. This separates Zr-Nb and Ru. The effluent is precipitated and the Zr-Nb is stored in an asphalt pit. The Ru then may be recovered from the precipitate. The precipitate from the original centrifugation is calcined, pressed and transported to a deep well.

SEPARATION OF NITRATE AND ALUMINUM FROM RADIOACTIVE CHEMICAL WASTES. John B. Huff. Nov. 1, 1956. 19p. (IDO-14392)

A laboratory process for fractionating Al and NO_3^- from fission products in solution is described. Nitrates are removed by reduction to NO_2^- with C. Excess C absorbs the residues to form a porous sinter. The sinter is chlorinated at elevated temperatures to expel Al as the volatile Cl^-.

RECOVERY OR REMOVAL OF MATERIALS 8.05

Al-CONTAINING WASTES 8.05.02

Burning the C residue from chlorination yields an ash of crude fission product compounds. Some plant design problems are discussed.

5581

BALLS KEEP SOLIDS MOVING. Chem. Eng. 63, No. 3, 120, 122(1956) Mar.

A ball mill-kiln for concentrating fission products in Al_2O_3 produced from the $Al(NO_3)_3$ content of waste is described. The apparatus, combining a ball mill and a rotary kiln, is designed for continuous operation. (C.W.H.)

1330

CONCENTRATING FISSION PRODUCTS. L. P. Hatch and W. H. Regan, Jr. (Brookhaven National Lab., Upton, New York). Nucleonics 13, No. 12, 27-9(1955) Dec.

The techniques of removal of nitric acid from unalloyed U fuel wastes, of $Al(NO_3)_3$ from the wastes from U–Al alloy fuels, and of Zr fluorides from Zr-alloyed fuel wastes are discussed. The design of a ball mill-kiln for concentrating fission products in Al_2O_3 produced from $Al(NO_3)_3$ content of waste is given. Pretreatment methods which can be used before the ultimate disposal of fission products in montmorillonite clay are discussed. (B.J.H.)

SEPARATION OF FISSION PRODUCTS FROM ALUMINUM WASTE SOLUTIONS BY ION EXCHANGE. Period covered: September 1947–September 1948. R. E. Blanco, I. R. Higgins, and A. H. Kibbey. Aug. 14, 1956. 52p. (ORNL-301(Rev.))

DIBAN—ION EXCHANGE WASTE DISPOSAL SCHEME. PART I. I. R. Higgins and R. G. Wymer. Nov. 28, 1955. 20p. (ORNL-1984)

A scheme, based on experimental work, is proposed for decontaminating radioactive wastes that contain $Al(NO_3)_3$ and HNO_3 as their primary constituents. Ninety per cent of the Nb and >95% of the Ru and Zr are removed by a $Fe(OH)_3-MNO_2$ scavenging precipitation. The $Al(NO_3)_3$ is converted to dibasic $Al(NO_3)_3$ by destructive distillation, and dissolved by a 12 hr digestion at 160°C. The Sr, Ce, and rare earths are removed by cation exchange in a continuous contractor. The decontamination waste can be volume-reduced to about 6M Al before disposal and then stored cheaply. The fission products can be eluted from the column, concentrated into a small volume of highly radioactive waste, and stored with all necessary precautions.

BIOLOGICAL 8.05.02

BIOLOGICAL TREATMENT OF SEWAGE AND INDUSTRIAL WASTES. VOLUME II. ANAEROBIC DIGESTION AND SOLIDS-LIQUID SEPARATION. Joseph McCabe and W. W. Eckenfelder, Jr., eds. New York, Reinhold Publishing Corporation, 1958. 335p.

Twenty-eight papers on various aspects of anaerobic digestion and solids-liquid separation are presented. The material, originally presented at a conference at Manhattan College in April 1957, is divided into three parts entitled: anaerobic treatment, sedimentation and flotation, and vacuum filtration and sludge conditioning. (T.R.H.)

THE MECHANISM OF ACCUMULATION OF FISSION PRODUCTS BY FINE PARTICLES AND MARINE ORGANISMS. R. F. Jones and Isabel Batty. Dec. 1957. 11p. (IGR-TN/W-755)

A brief review of the results of investigations carried out to determine the accumulation of fission products, particularly Ru^{106}, by fine particles and marine plants and animals is presented. Detailed results of the investigations will be the subject of a separate report. The period covered is from Sept. 1956 to July 1957.

4398 AECU-3406

Illinois. Univ., Urbana. Engineering Experiment Station. THE EFFECT OF RADIOACTIVE SUBSTANCES ON SLUDGE DIGESTION. Final Report. R. H. Harmeson and J. C. Dietz. Jan. 1957. 40p. Contract AT(11-1)-218. $7.80(ph OTS); $3.30(mf OTS); $3.30(mf OTS).

Engineering Experiment Station Bulletin No. 441, available at Univ. of Illinois, $0.85.

A study of the effect of various concentrations and combinations of radioactive materials on the anaerobic digestion of sewage sludges at various temperatures was undertaken. Particular emphasis was placed on P^{32}, I^{131}, and S^{35}. The effects of these materials on digestion was measured by quantitative digestion such as: rate, volume, quality of gas production, pH, acidity, volatile acids, odor, drying characteristics of sludge, and moisture obtained from drying of sludge. (W.L.H.)

RECOVERY OF URANIUM FROM SALINE SOLUTIONS BY BIOLOGICAL SLIMES. Final Report. B. B. Ewing, W. R. Drynan, and E. F. Gloyna. Oct. 1, 1955. 33p. (ORO-148)

The phenomenon responsible for the removal of U from a liquid and concentration upon biological material is a result of U utilization during metabolism, adsorption on

RECOVERY OR REMOVAL OF MATERIALS 8.05

BIOLOGICAL 8.05.02

the surface of the cell or absorption into the cell, and precipitation onto the zoogloeal surfaces. It has been found in repeated tests that most of the U uptake effected by the biological sludge occurs within 5 or 10 min of mixing. Violent mixing does not greatly improve uptake. The amount of suspended solids in biological suspensions has been found to influence the removal of U. The initial concentration of U in solution also effects the uptake. Usually the ratio of U recovered to sludge solids was lower for small initial concentrations. The biological activity of the sludge has been found to have an important effect on the concentration of U.

LABORATORY STUDIES ON THE REMOVAL OF PLUTONIUM FROM LAUNDRY WASTES. John F. Newell, C. W. Christenson, J. D. Shaykin, H. L. Krieger, D. W. Moeller, and C. C. Ruchhoft. 2p. (AECU-837; LADC-800)

Laboratory scale chemical coagulation experiments were made in parallel with 2 stages trickling filter experiments. Results indicated that the Pu removal could be attained either chemically or biologically but the simplicity of operation and the volume of sludge to be disposed of seemed to favor the latter treatment. Satisfactory Pu removal was obtained by chemical precipitation with $CaCl_2$, CaO, NaOH, activated silica, and $FeCl_3$ added in sequence at pH values of 11.5 or higher.

7071 A/CONF.15/P/2025
PILOT PLANT FOR DECONTAMINATION OF LABORATORY LIQUID WASTES. K. A. Bolshakov, A. T. Avdonin, V. T. Borchev, F. V. Rauzen, et al. (U.S.S.R.). 22p.

The technology and equipment of a plant for decontamination of radioactive sewage from research institutions using radioactive isotopes are described. The technology is based on the coprecipitation of radioactive isotopes with hydroxide residues, following by ion exchange sorption. Any changes in the chemical and radiochemical composition of the sewage are taken in account. When treating sewage containing considerable amounts of organic substances, biological purification in air tanks precedes the conventional decontamination. The contamination is effective enough for a safe disposal of purified sewage into open water reservoirs. (auth)

ELECTROLYTIC 8.05.03

11420
TREATMENT OF RADIOACTIVE WASTES USING ION TRANSFER MEMBRANES: REMOVAL OF BULK ELECTROLYTES. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 55, Session 16. E. A. Mason, E. J. Parsi, and A. J. Giuffrida (Ionics, Inc. and Massachusetts Inst. of Tech., Cambridge). New York, American Institute of Chemical Engineers, 1958. 35p.

Use of anion transfer membranes in electrolytic cells has been investigated as a means of removing and separating bulk electrolytes from cationic fission products. Nitric acid and aluminum nitrate were used as typical electrolytes, and sodium was used as a tracer representing cationic species. Deacidification of nitric acid and precipitation of hydrous aluminum oxide in granular form were accomplished. The mechanism of deacidification, effect of operating variables, and stability of membranes to chemical and radiation attack are discussed. A brief cost estimate is included. (auth)

CHEMICAL PROCESSING WASTE TREATMENT. D. L. Barney. p. 13, 15-19 of REPORT OF THE CHEMISTRY AND CHEMICAL ENGINEERING SECTION FOR MAY, JUNE, JULY, 1956. 87p. (KAPL-1573).

The neutralization step in the electrolytic process for waste treatment was simulated. It was found that in this step significant decontamination is obtained from Sr, Zr+Nb, and rare earths, but not from Ru or Cs. In the electrolysis of alkaline nitrate solution, only a small amount of H_2 is produced and the only gaseous reduction product of nitrate formed in significant amounts is NH_3. The concentration of nitrite ion, formed by reduction of nitrite, builds up to a steady-state concentration. Progress is reported in determining design factors for an electrolysis cell to be used in a process for treating Purex nitrate wastes. Indications are that cell compartmentation will not be necessary and that electrical costs for the electrolysis step will be (10¢/gal of Purex waste.

RECOVERY OR REMOVAL OF MATERIALS 8.05

FISSION PRODUCT REMOVAL 8.05.04

See also, under PROCESS CHEMISTRY AND ENGINEERING,

SPECIAL PROCESSES--UAP Process (6.17.23),

Metal Recovery (6.17.15).

Cs AND Sr 8.05.04.01

22051
RECOVERY OF CESIUM FROM WASTE SOLUTIONS. W. H. Burgus (to U. S. Atomic Energy Commission). U. S. Patent 2,892,680. June 30, 1959.

This patent covers the precipitation of fission products including cesium on nickel or ferric ferrocyanide and subsequent selective dissolution from the carrier with a solution of ammonia or mercuric nitrate.

6458 A/CONF.15/P/1315
ETUDE SUR L'UTILISATION DES ARGILES ROUMAINES COMME ECHANGEURS D'IONS. DECONTAMINATION DES EAUX RADIOACTIVES. (A Study on the Use of Romanian Clays as Ion Exchangers). Gh. Ioanid, Gh. Mastacan, F. Bunus, M. Popesco, S. Stanciu, and A. Ciocănel (Inst. de Recherches Chimiques, Bucharest). 23p.

The behavior of some Romanian clays as ion exchangers for Sr^{90} and Cs^{137} was reviewed. A discussion is given of the research on the processing and regeneration possibilities of such clays as were found to be active. Their characteristics are further interpreted through a mineralogical study. (auth)

2242 IEA-4
São Paulo, Brazil. Universidade. Instituto de Energia Atômica.
RECOVERY OF CESIUM-137 FROM FISSION PRODUCTS IN WASTES OF NUCLEAR REACTOR INSTALLATIONS. (Recuperacão do Cêsio-137 dos Resíduos de Fissão em Instalacões Nucleares). Fausto W. Lima, Alcidio Abrão, and Constancia Pagano. July 1959. 14p.

A process for the recovery of Cs^{137} from fission product wastes is described. The process is based on the entrainment of cesium by alum, and it differs from the usual procedures in that the alum crystallization is carried out in alcoholic medium. It is, therefore, unnecessary to heat the solution and then to cool it for the alum crystallization. Decontamination factors of up to 10^6 are attained in a single co-crystallization, which is carried out in a very simple operation. Six times less alum is used than in the procedure where it is necessary to heat the solution. (auth)

13041
SOME EXPERIMENTS ON THE DECONTAMINATION OF LIQUID WASTE CONTAINING RADIOACTIVE STRONTIUM. CHEMICAL TREATMENT WITH A LABORATORY SCALE PLANT. E. Cerrai, A. Scaroni, and C. Triulzi (CISE, Milan). Energia nucleare (Milan) 6, 207-17(1959) Mar.

A laboratory scale plant was studied for decontamination of liquid waste containing radiostrontium. Preliminary experiments were carried out on a bench scale to determine the best operating conditions. (auth)

SEPARATION OF CESIUM AND STRONTIUM FROM CALCINED METAL OXIDES AS A PROCESS IN DISPOSAL OF HIGH LEVEL WASTES. A. Abriss, J. J. Reilly, and E. J. Tuthill. Apr. 1957. 12p. (BNL-453)

Results are reported from exploratory studies to determine design parameters for a plant for processing Redox Al-type and STR Zr-type wastes for the recovery of Sr^{90} and Ca^{157}. The three types of leaching procedures investigated included a non-continuous agitated system, a continuous non-agitated system, and a continuous system with mixing. Data are presented graphically.

4784
PROBLEMS OF RADIOACTIVE WASTE IN MODERN TECHNIQUE. W. J. Spicyn (Inst. of Nuclear Research, Warsaw). Nucleonika 2, 451-4(1957). (In Polish)

Methods for separation and recovery of Cs^{137} and Sr^{90} from mixtures of fission products and the absorptive properties of soil as a medium for waste disposal are discussed. (tr-auth)

Separation of Cesium and (or) Strontium from Waste Fission Products. Warren C. Clifford and Raymond E. Burns. U.S. Patent 2,769,780 (Nov 6, 1956)

Cs and Sr are separated from fission product solutions by precipitation of Ni and Co ferrocyanide.

RECOVERY OR REMOVAL OF MATERIALS 8.05

FISSION PRODUCT REMOVAL 8.05.04

Cs AND Sr 8.05.04.01

THE REMOVAL OF CESIUM AND STRONTIUM FROM RADIOACTIVE WASTE SOLUTIONS. W. W. Schulz and T. R. McKenzie. Nov. 29, 1955. Decl. Nov. 20, 1956. 13p. (TID-7517(Pt. Ia); HW-40180)

Methods for the removal of Cs by ferro- and ferricyanides and montmorillonite clays, and Sr by neutralization or precipitation with Ca or Sr phosphates from various aqueous waste solutions are presented.

20627

PROBLEMS OF RADIOACTIVE WASTE PRODUCTS IN MODERN INDUSTRY. Spitsyn. (Translated from Referat. Zhur. Khim. No. 12, 1958, Abstract No. 40117.)

The methods are briefly described for the separation and the utilization of the degradation products of U^{235}, primarily of Cs^{137} and Sr^{90} (evaporation, precipitation, concentration, and others), as well as the methods of burying the radioactive waste products.

7068 A/CONF.15/P/1515

ELIMINATION OF TRACES OF RADIOACTIVE ELEMENTS FROM AQUEOUS SOLUTIONS. I. FORMATION OF SILICA GEL IN SOLUTIONS CONTAINING TRACES OF RADIOELEMENTS AS A MEANS FOR THE ELIMINATION OF ACTIVITY IN RADIOACTIVE EFFLUENTS. M. Milone, G. Cetini, and F. Ricca (Univ. of Turin). II. THE USE OF BASIC SILICA GEL FOR THE ELIMINATION OF RADIOELEMENTS IN AQUEOUS SOLUTIONS. G. Cetini and F. Ricca (Univ. of Turin). 19p.

The efficiency of the formation of silica gel for the elimination of traces of Sr^{90} and Cs^{137} in the active waters is reviewed. A study is made of the effect of the pH during the formation of the gel and of the presence of various concentrations of Al ions. A report is submitted on the results of Sr^{90} and Cs^{137} adsorption. A study is made of the influence of the conditions of precipitation of the gel and of the activation temperature on the adsorbing capacity of the basic silica gel. (auth)

FISSION PRODUCT RECOVERY FROM CHEMICAL PROCESSING PLANT WASTE SOLUTIONS. G. B. Barton, J. L. Hepworth, E. D. McClanahan, Jr., R. L. Moore, and H. H. Van Tuyl. Feb. 26, 1957. Decl. July 25, 1957. 25p. (HW-48776-RD)

A process is described for the recovery of potentially valuable long lived fission product activities from the first cycle acidic waste solutions which result from the solvent extraction processing of nuclear reactor fuel elements. The metal ferricyanides and ferrocyanides were extensively investigated as scavenging agents for Cs^{137}, and the effects of process variables are reported. Cesium zinc ferrocyanide ($Cs_2ZnFe(CN)_6$) was found to be the most effective and is used for purposes of concentration and isolation. Subsequent chemical processing results in either a mixed chloride ($2CsCl \cdot ZnCl_2 \cdot {}^1/_2\ Fe_2O_3$) or pure CsCl product suitable for use in high intensity radiation sources. Ce^{144}, rare earth, and Sr^{90} activities are recovered by a series of process steps which depend on coprecipitation on $Fe(OH)_3$ and on the solubility behavior of the rare earth oxalates, of $Ce(IO_3)_4$, and of $SrCO_3$.

GENERAL 8.05.04.02

1315

THE EXTRACTION OF INDIVIDUAL FISSION PRODUCTS FROM CHEMICAL PROCESS WASTES. Presented at the International Conference on Radioisotopes in Scientific Research, Sept. 9-20, 1957 at Paris. No. UNESCO/NS/RIC/16. K. Saddington. London, Pergamon Press, Ltd., 1957. 20p.

Methods are described which have been used in the U.K.A.E.A. for producing from fission product waste solutions radioactive sources of two different types: Intense sources (1,000-2,000 curies) of Cs^{137} for use in medicine, industry and as a research tool; smaller sources for chemical studies and research applications, of unusual isotopes, such as Np^{237}, which have hitherto been available, if at all, only in milligram quantities. (auth)

1291 HW-48776 RD

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FISSION PRODUCT RECOVERY FROM CHEMICAL PROCESSING PLANT WASTE SOLUTIONS. G. B. Barton, J. L. Hepworth, E. D. McClanahan, Jr., R. L. Moore, and H. H. Van Tuyl. Feb. 26, 1957. Decl. July 25, 1957. 25p. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).

A process is described for the recovery of potentially valuable long-lived fission product activities from the first cycle acidic waste solutions which result from the solvent extraction processing of nuclear reactor fuel elements. The metal ferricyanides and ferrocyanides were extensively investigated as scavenging agents for Cs^{137}, and the effects

RECOVERY OR REMOVAL OF MATERIALS 8.05

FISSION PRODUCT REMOVAL 8.05.04

GENERAL 8.05.04.02

of process variables are reported. Cesium zinc ferrocyanide was found to be the most effective and is used for purposes of concentration and isolation. Subsequent chemical processing results in either a mixed chloride or pure cesium chloride product suitable for use in high intensity radiation sources. Cerium^{144}, rare earth, and Sr^{90}

A RADIOCHEMICAL SEPARATION FOR COBALT-60 IN AQUEOUS WASTE SOLUTIONS. R. A. Schneider. Jan. 1, 1957. 26p. (HW-47896)

Several methods of chemically separating Co^{60} from aqueous waste solutions and interfering nuclides were investigated. In the most suitable method, Co^{60} is carried from solution as a mixture of insoluble cobaltous and ferrous cobalticyanides after the cobaltic amine complexes have been destroyed by reduction and acid deammoniation. Removal from solution is ~99.9% complete. An average radiochemical yield of 98.1% is obtained for the complete separation procedure. The procedure involves no precise techniques or exacting measurements, and has been adopted for routine use.

157

PURIFICATION OF THE ACTIVE DEPOSIT OF OLD RADIOEMANATION AMPOULES. C. Ferreira de Miranda. Faculty of Sciences in Lisbon B3, 191-5(1957). (In Portuguese)

23002

STATEMENT OF A. F. RUPP, THE OAK RIDGE NATIONAL LABORATORY, FISSION PRODUCT PILOT PLANT. p.2335-44 of **"Hearings on Industrial Radioactive Waste Disposal. Volume 3."**

Methods for removing the important long-lived fission products from waste solutions produced in processing spent reactor fuel elements in a pilot plant are given. (C.J.G.)

11777 AECU-3359

[Los Alamos Scientific Lab., N. Mex.]

TREATMENT OF WASTES CONTAINING RADIOACTIVE BARIUM, LANTHANUM, STRONTIUM, AND YTTRIUM. [J. P. Hutchinson, E. H. Rex, E. R. Mathews, and C. W. Christenson]. [1956]. 15p. Contract [W-7405-eng-36]. $3.30(ph OTS); $2.40(mf OTS).

The design and operation are described of a plant for the treatment of wastes containing radioactive Ba, La, Sr, and Y. The method combines tank storage and cation exchange for separation of the radioisotopes. A flow diagram of the plant is included. Essentially it consists of a rate of flow regulator to control flow of waste pumped from a storage tank, a resin column, and equipment for regeneration and treatment of spent regenerant. Plant operating data are summarized. (C.H.)

RUTHENIUM 8.05.04.03

See also, under FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL, RUTHENIUM (2.42).

FISSION PRODUCT RUTHENIUM VOLATILITY IN A HIGH TEMPERATURE PROCESS. C. E. May, B. J. Newby, K. L. Rohde, and B. D. Withers. July 1, 1958. 51p. (IDO-14439)

A study has been completed of the behavior of fission product Ru during the calcination of an $Al(NO_3)_3-HNO_3$ raffinate at 400°C. The degree of volatility of the Ru as well as the effect of nitrate pretreatment of aqueous feed, dilution of the nitrate content of the feed, and drastic reduction of the oxidizing power of the calciner atmosphere on the volatility have been defined. Several types of bench-scale calciners were used with aqueous feeds of actual processing plant raffinate or synthetic raffinates traced with Ru from the plant raffinates. It has been found that with raffinates of 1.6M $Al(NO_3)_3$ and 1.0M HNO_3 calcined at 400°C, about 90% of the Ru is volatile. Pretreatment with 0.1 or 1.0M nitrite ion was inadequate to inhibit the very significant volatility of the Ru. Similarly dilution of the aqueous feed with water, with the resultant minor reduction in the oxidizing power of the calciner atmosphere, was also ineffective in inhibiting Ru volatility. The presence of an excess of NO_2 in the calciner atmosphere greatly reduced the volatility of the Ru. In the latter case, the O_2 concentration was reduced to 0.01 mole %. Increasing the calcination temperature from 400 to 550°C also reduced the apparent Ru volatility.

THE BEHAVIOUR OF RUTHENIUM IN THE FIXATION OF FISSION PRODUCTS. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 67, Session 16. W. E. Erlebach and R. W. Durham (Atomic Energy of Canada, Ltd.,

RECOVERY OR REMOVAL OF MATERIALS 8.05

FISSION PRODUCT REMOVAL 8.05.04

RUTHENIUM 8.05.04.03

Chalk River, Ont.). New York, American Institute of Chemical Engineers, 1958. 25p.

At some stage in most high-temperature processes for incorporating fission product wastes in a solid siliceous matrix, ruthenium compounds are oxidized to a volatile form. When a mix of fission products in nitric acid and ground nepheline syenite is dried, denitrated, and fused, ruthenium is lost at each stage. The drying stage loss, which usually approaches 100 percent of the ruthenium in the mix, can be eliminated by neutralizing the mixture. The loss during denitration of a strongly basic mix may amount to 0.5% of the ruthenium. The loss during the subsequent fusion stage of a neutralized mix, which may reach 70 percent of the ruthenium, can be substantially reduced by heating the mix in an atmosphere such as carbon dioxide. (auth)

RUTHENIUM BEHAVIOR IN NITRIC ACID DISTILLATION. A. S. Wilson. Sept. 1, 1956. Decl. Mar. 16, 1957. 18p. (HW-45620)

The volatilization of Ru increases with increasing HNO_3 concentration and reaches a plateau at acid concentrations of about 8 to 10M. Only about 1 to 2% of the Ru, at the most, is volatilized. Mild reducing agents such as HNO_2, NO_2, and a 30% TBP-Soltrol 170 mixture, suppress the volatilization of Ru from HNO_3. In the absence of air Ru distills from HNO_3 as RuO_4. In the presence of air an unidentified Ru species appears in the distillate.

RUTHENIUM DISTILLATION IN PUREX ACID WASTE EVAPORATION. J. R. Flanary and V. J. Reilly. July 20, 1953. Decl. Feb. 14, 1957. 8p. (CF-53-7-130)

Ru has been found to distill to a significant extent from boiling 7N HNO_3. The formation of distillable Ru at this acidity requires an appreciable length of time, but is noticeable in 5 to 10 hr. There is some evidence from this work that Ru distills more readily from dilute acid containing $Fe_2(SO_4)_3$, H_2SO_4, and $NaNO_3$, the non-volatile components of Purex acid wastes.

PROGRESS REPORT FOR JANUARY, 1950. CHEMICAL RESEARCH SECTION. F. W. Albaugh. Feb. 15, 1950. Decl. Feb. 19, 1957. 36p. (HW-16076)

Data are given on RuO_4 decontamination from Redox solutions by distillation; Zr-Nb decontamination of dissolver solution on extraction-scrub with and without scavenging; decontamination of metal waste extracted with TBP; and decontamination of $BiPO_4$ process non-U wastes (Pu scavenging by tannic acid).

5102 MonT-223
[Clinton Labs., Oak Ridge, Tenn.]
THE PREPARATION OF RUTHENIUM TRACER FROM WASTE METAL SOLUTION. A. T. Gresky. Dec. 3, 1946. Decl. Jan. 10, 1956. 12p. Contract W-35-058-eng-71. $3.30(ph OTS); $2.40(mf OTS).

The separation and purification of Ru by distillation of RuO_4 has been applied to waste metal solutions. Physical and chemical properties of Ru are summarized. (auth)

ION EXCHANGE 8.05.05

See also, under PROCESS CHEMISTRY AND ENGINEERING,

ION EXCHANGE (6.12),

SPECIAL PROCESSES--Diban Ion Exchange (6.17.06).

1555 ORNL-2491
Oak Ridge National Lab., Tenn.
DEVELOPMENT OF A CONTINUOUS ION EXCHANGE PROCESS FOR THE REMOVAL AND RECOVERY OF HIGH-PURITY CESIUM FROM ALKALINE WASTE. I. R. Higgins and A. F. Messing. Nov. 6, 1958. 32p. Contract W-7405-eng-26. $1.00(OTS).

A process was developed for the removal and recovery of high-purity cesium from alkaline waste solutions using the Higgins continuous countercurrent ion exchange contactor. Cesium is selectively sorbed on the phenolic methylene sulfonic resin Duolite C-3, along with strontium, the rare earths, and other cationic fission products. At feed rates up to 2000 gal/ft^2 hr, tracer activities in a synthetic alkaline waste solution were reduced to background levels of 0-50 c/ml min, corresponding to decontamination factors of $>10^4$ for cesium and $>10^3$ for strontium and the rare earths. Cesium was removed from the contactor by selective elution with

RECOVERY OR REMOVAL OF MATERIALS 8.05

ION EXCHANGE 8.05.05

hydrochloric acid to produce a product containing about 1% sodium along with tracer quantities of strontium and the rare earths. A cost estimate was prepared which showed that Cs^{137} would cost 6 cents per curie from a plant designed to produce 22,000 curies/day. (auth)

3375 AERE-E/R-2707
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
OPTIMUM CONDITIONS FOR THE USE OF VERMICULITE IN THE DECONTAMINATION OF RADIO-ACTIVE EFFLUENT. T. D. Wright and J. Monahan. Oct. 1958. 16p. $0.35(BIS).

It is shown that the ion exchange efficiency of vermiculite (a natural magnesium aluminosilicate) is impaired by the precipitation of magnesium hydroxide in the exchanger matrix when considering the removal of radioactive isotopes from effluent at pH 11.5 to 12.0. Experiments are described which show that this deficiency can be overcome by either of the following operations: conversion of the vermiculite to the sodium form prior to use; neutralization of the column influent to pH 7.0. It is concluded that the former method is the better, both from an economic and practical point of view. (auth)

7118 CF-58-3-67
Oak Ridge National Lab., Tenn.
PROPOSED DEVELOPMENT PROGRAM FOR TREATMENT OF RADIOACTIVE WASTES FROM MERCHANT SHIP REACTORS. I. R. Higgins and W. J. Neill. Mar. 19, 1958. 6p. $1.80(ph OTS); $1.80(mf OTS).

A proposed development program is made for the treatment and disposal of radioactive wastes from Merchant Ship Reactors. Both ion exchange resin and filters are to be used for coolant system cleanup. The development program is concerned with methods of handling and packaging of the spent resin, filter cake and rare gases for safe disposal. (auth)

1308
MIXED BED ION EXCHANGE FOR THE REMOVAL OF RADIOACTIVITY. H. Gladys Swope (Argonne National Lab., Lemont, Ill.). J. Am. Water Works Assoc. 49, 1085-1102(1957) Aug.

Experimental work using mixed bed ion-exchange resins for removing old mixed fission products from tap water showed that the highest decontamination factors were obtained when the water was adjusted to pH 2.5 with nitric acid. This adjustment increased the anion content of the water and it is therefore recommended that a 3:1 ratio of anion to cation resin be used. Flow rate appears to be an important consideration in removing radioactivity and should not exceed 2 gpm per cubic foot of mixed resin. The capacity of a mixed bed exchanger for the removal of radioactivity is based on the amount of total dissolved solids in the feed. The lower the dissolved solids content the larger the throughput. (auth)

REMOVAL OF CARRIER-FREE RADIOISOTOPES FROM PURE WATER BY MIXED-BED ION EXCHANGE COLUMNS; APPLICATION TO PWR WASTE DISPOSAL SYSTEM. W. T. Lindsay and C. S. Abrams. 35p. (WAPD-PWR-CP-2126)

It has been demonstrated that the magnitude of the decontamination factors obtainable on processing high-resistivity solutions of carrier-free isotopes, representative of the alkali metal, alkaline earth, rare earth, Ru, Rh, Zr, and Nb fission products in the PWR primary coolant, are at least as great as required by the PWR Waste Disposal System design. The volume of high-resistivity water, containing the above mentioned representative isotopes at levels equivalent to or greater than the expected maximum steady-state levels of the corresponding fission products in the PWR coolant after 24 hr decay, which can be processed by the PWR waste disposal ion exchangers before activity break-through is such that resin consumption would be negligible. It is even possible the normal resin deterioration and mold growth would govern the resin replacement rate. Hold-up of discharged coolant prior to or subsequent to ion exchange for a period of over 24 hr is unnecessary for the isotopes studied. Process rates through the ion exchanger could be raised to the equivalent of 7.5 $g/m/ft^2$ (23.5 g/m total flow rate) without sacrifice of resin performance for removal of the isotopes.

PROCESS OF TREATING RADIOACTIVE LIQUIDS SO AS TO REDUCE THEIR RADIOACTIVITY. J. Bouchard (to L'Auxiliaire des Chemins de Fer et de l'Industrie). British Patent 769,121. Nuclear Eng. 2, 266(1957) June.

Rivers or entire stretches of water may become contaminated and dangerous due to the presence of naturally

ION EXCHANGE 8.05.05

radioactive ions, or ions which have become radioactive by induction. Purification is only possible by extracting these ions. For this purpose ion exchangers have been used to which the contaminating ions could be fixed. These ion exchangers are characterized by high porosity and a large contact area. However, it has been found that the reduction in radioactivity is sometimes insufficient. Difficulties are avoided by associating with or substituting for the usual ion exchangers, ions selected first as a function with the nature of the radioactive ions to be eliminated (mostly heavy metal ions), so as to shift the exchange equilibrium in the direction of the maximum fixation of these radioactive ions and, secondly, so that the exchange ions are not prone to pass out in solution in the effluent liquid. The ions of non-radioactive heavy metals are those having an atomic weight in excess of 100 as, e.g., lead, barium, mercury, cadmium, silver, bismuth. The exchange may be carried out in two exchangers in series. The first contains the heavy metal ions, the second the usual ions. (auth)

2543 WAPD-PWR-CP-2636
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
ION EXCHANGE REMOVAL OF FISSION PRODUCTS FROM HIGH PURITY WATER. DEVELOPMENT WORK ASSOCIATED WITH THE PWR RADIOACTIVE WASTE DISPOSAL SYSTEM. W. T. Lindsay, Jr. and C. S. Abrams. [1957?]. 76p. $12.30(ph OTS); $4.50(mf OTS).

Laboratory experiments and tests associated with in-pile loop operations are reported showing that removal of Cs^{137}, Ba^{140}, Sr^{90}, Ce^{144}, Ru^{106}, Zr^{95}, I^{131}, and other radioisotopes from high-purity water is accomplished by passage through mixed-bed ion exchange columns in the hydrogen-hydroxyl form. Decontamination factors for these isotopes averaged 10^3 across single 30-in. beds for processed volumes up to 7500 column volumes. Decontamination factors as high as 10^9 were observed for Sr^{90}. (auth)

6614 AWRE-O-42/55
Gt. Brit. Atomic Weapons Research Establishment, Aldermaston, Berks, England.
PHYSICOCHEMICAL INVESTIGATIONS INTO THE ABSORPTION AND REMOVAL OF RADIOISOTOPES FROM TEXTILES (RADIOLOGICAL DECONTAMINATION). PART I. POLYVALENT CATIONS ON COTTON. D. G. Stevenson. Nov. 7, 1955. 51p.

The effect of several variables governing the removal of representative radioisotopes from cotton has been studied and it is shown conclusively that the uptake and removal are straightforward ion exchange processes on a carboxylic material. In order to effect efficient removal under mild conditions it is necessary to use a complexing agent which will form an anionic complex with the contaminant ion. The activation energy of the process is 12 kcals and high temperatures are therefore very beneficial. Limits of decontamination are set mainly by the low diffusion rates. The general behavior is governed by mass action with respect to the solution within the fibre and this is in turn governed by Donnan membrane effects. The stability constant of the cerium-cotton complex is estimated at 3×10^5, and of the decontamination reaction with EDTA $\log^{-1}$ 8.16. Diffusion constants in the more effective solutions at 25°C are of the order of 5×10^{-10} cm^2/sec. (auth)

1163; KLX-1372
Vitro Corp. of America, New York.
PROJECT SUMMARY. DECONTAMINATION OF DILUTE LOW ACTIVITY WASTES (24-A3). Job 24-A. July 5, 1952. Decl. Mar. 12, 1957. 74p. Contract AT(30-1)-850. $12.30(ph OTS); $4.50(mf OTS).

This investigation lead to the successful design and operation of an ion exchange resin pilot plant in which 50,000 gal of simulated still over heads, containing 500 c/m/ml (~ 10 ppm total solids) of Purex waste, were processed per ft^3 of resin at 40 gal/hr with a final effluent activity of $\sim 10^{-6}$ $\mu c/ml$. Provision was made for the disposal of the loaded resin as a monolith or for elution and disposal of the eluate as a monolith with re-use of the adsorbent. (auth)

6528 A/CONF.15/P/1566
RECOVERY OF URANIUM FROM REJECTED LIQUIDS BY IONIC EXCHANGE. M. B. Crespi, A. A. Suller, and E. G. Macchiaverna (Comision Nacional de Energia Atomica, Buenos Aires). 9p.

A description is given of a method for the recovery of the uranium contained in a filtrate of the uranium peroxide precipitation ($UO_4 \cdot H_2O$). As carried out in a plant, this filtrate contains 100 to 300 mg U per liter at a pH of 2 to 3, with 1.3 volumes of H_2O_2. Under these conditions, the uranium is absorbed by strong cationic resins and eluted according to the reverse elution technique. This gives a high concentration factor for the uranium, and the efficiencies obtained are satisfactory. A possible theoretical interpretation of the process is presented. (auth)

RECOVERY OR REMOVAL OF MATERIALS 8.05

ION EXCHANGE 8.05.05

12377 KLX-1218
Kellex Corp., New York.
PRELIMINARY PROCESS DESIGN FOR WASTE RESIDUE RECOVERY PLANT. Job 23. June 30, 1951. Decl. Apr. 3, 1957. 45p. Contract AT(30-1)848. $9.30(ph OTS); $3.60(mf OTS).

A basis is established for design and engineering of a projected waste recovery plant for the economic recovery of U as U_3O_8 from waste residues held in storage. The design is based on the sulfuric acid leach-ion exchange process. (F.S.)

9629 KLX-1220
Vitro Corp. of America, New York.
LIQUID WASTE TREATMENT (23C). Summation Report for the Period February 1950 through April 1951. Job 23. Nov. 21, 1951. Decl. Feb. 28, 1957. 14p. Contract AT(30-1)848. $3.30(ph OTS); $2.40(mf OTS).

On the basis of results given, it appears that U can be removed economically from MCW main sewer liquor, using Dowex-2 resin. It is possible to recover U from MCW C-3 discard liquor by adsorption on aminized cotton and from MCW acid raffinate and MCW acid sewer liquor by adsorption on phosphorylated cotton cloth. The recovery of U from Peterson discard liquor by ion exchange appears impractical because of formation of precipitates within the column. It does not appear economically feasible to recover U from sump recovery liquor. Two composites representing the proposed "new refinery" waste streams were investigated. With one composite, representing a plant operating with C-3 process and no acid sewer, adsorption by ion exchange is questionable, since a precipitate which forms slowly on mixing the components would probably interfere with column operation. With the other composite representing the combined sewers from a plant using the "Slurex" process, the volume of waste treated per cu ft of resin and the column loading are low, which would make the cost per pound of U_3O_8 recovered unduly high. From the health physics point of view, adequate decontamination of the liquor is obtained and for this reason operation of the process may be warranted. (D.E.B.)

5264 WAPD-PWR-CP-2126
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh].
REMOVAL OF CARRIER-FREE RADIOISOTOPES FROM PURE WATER BY MIXED-BED ION EXCHANGE COLUMNS; APPLICATION TO PWR WASTE DISPOSAL SYSTEM. W. T. Lindsay and C. S. Abrams. 35p. $6.30 (ph OTS); $3.00(mf OTS).

7070 A/CONF.15/P/2024
DECONTAMINATION OF LOW SALINE AND LOW ACTIVE EFFLUENTS OF RADIOCHEMICAL INDUSTRIES. S. A. Voznesenskii(Voznesensky), G. A. Sereda, P. F. Dolgikh, and L. I. Baskov (U.S.S.R.) 11p.

The purification and concentration of isotopes in radioactive effluents to a minimum volume is a most pressing problem. The average chemical composition and radiochemical composition of the effluents investigated are given along with the allowable levels and decontamination factors. The flow sheet for decontamination is given. It features coagulation and ion exchange resin sorption. (W.D.M.)

IRRADIATION 8.05.06

See also, under PROCESS CHEMISTRY AND ENGINEERING, RADIATION EFFECTS--Surveys and Theory (6.15.11).

PROCESS FOR THE DESTRUCTION OF RADIOACTIVE RESIDUES. L. Verschraeghen. British Patent 802,971. Nuclear Eng. 4, 284(1959) June.

The residual material is exposed to radiation, such as nuclear particles, as a result of which, long-life radioactive constituents are transformed into either stable isotopes or short-life radio-isotopes. After irradiation these isotopes are separated from the remainder by fractionation. Should the remainder still show too high a radioactivity, the material is added to a fresh batch, to be treated and processed a second time. Various methods of processing are described. In the case of a homogeneous reactor, the residue material may be placed in special conduits in the interior of the reactor or, alternatively, if available in the form of gases, liquids or solutions, it may be added to the radioactive material passing through the homogeneous reactor; if available in solid form, it may be incorporated in the control rods. In the case of a heterogeneous reactor, the material to be treated may be placed in recesses of the fuel bars or, where slow neutrons are used, in the body of the graphite moderator.

RECOVERY OR REMOVAL OF MATERIALS 8.05

IRRADIATION 8.05.06

DESTRUCTION OF RADIOACTIVE DECAY BY IRRADIATION. (to Louis Vercharaeghen). German Patent DAS 1 042 780. Nov. 6, 1958. Atompraxis 5, 248(1959) June. (In German)

Radioactive decay was destroyed by exposing the unstable substance to electromagnetic or corpuscular radiation so that the radioactive materials were transformed into stable isotopes or into isotopes with short-lived radioactivity. These isotopes can then be separated by physical, chemical, or physicochemical fractionation from the remaining radioactive material. The irradiation can be done in a reactor or particle accelerator, depending on the nature of the decaying isotope. The transformation can result from fission, fusion, or simple transmutation processes. By this method the dangerous radioisotopes can be eliminated.

PRECIPITATION 8.05.07

See also, under FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL,

PRECIPITATION (2.37),

and,

under PROCESS CHEMISTRY AND ENGINEERING,

PRECIPITATION (6.14),

SPECIAL PROCESSES--UAP Process (6.17.23).

14719 A/CONF.15/P/530
Los Alamos Scientific Lab., N. Mex.
AQUEOUS DECONTAMINATION OF PLUTONIUM FROM FISSION PRODUCT ELEMENTS. R. S. Winchester and W. J. Maraman. 8p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A survey of aqueous plutonium recovery and purification methods as applied to plutonium-rich reactor fuels has been made. These methods consist of precipitating plutonium fluoride, oxalate, and peroxide, sorbing on anion exchange resins, and solvent-extracting with tri-n-butyl phosphate. The standard fluoride, oxalate, and peroxide precipitation methods gave decontamination factors of plutonium from the typical fission product elements zirconium, molybdenum, ruthenium, and cerium ranging from 0.002 for cerium to 140 for molybdenum. Sorption of plutonium on anion exchanger resins from 8 M nitric acid solutions and the subsequent elution resulted in decontamination factors of 16 for ruthenium to 52 for zirconium. Solvent extraction of

tion of plutonium from 8 M nitric acid solution by primary, secondary, tertiary, and quaternary amines gave greater over-all decontamination. The secondary amine was selected for recovery processing. Plutonium is recovered and purified from pyrometallurgical and analytical wastes on a 300-gram scale using secondary amine solvent extraction followed by oxalate precipitation. A flowsheet for this process is discussed. (auth)

14748 A/CONF.15.P/1768
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FISSION PRODUCT RECOVERY FROM RADIOACTIVE EFFLUENTS. R. L. Moore and R. E. Burns. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Processes are described for the recovery of cesium-137 from Purex type, first cycle waste solutions which result from the solvent extraction reprocessing of reactor fuels. Flowsheets are presented for recovering cesium from neutralized wastes by coprecipitation with zinc ferrocyanide or from acidic solution by precipitation with zinc ferricyanide or zinc cobalticyanide. Further processing converts the cesium to cesium chloride, a stable form suitable for use in high intensity gamma irradiation sources. Modification of the cesium recovery process enables isolation of other valuable products including rare earths, cerium-144, and strontium-90 activities. Experience at Hanford Atomic Products Operation in the use of similar procedures for decontaminating certain effluents prior to discharge to the ground is described. A comparison of objectives and results obtained in these procedures to those suggested for fission product recovery is made. The effect of recovering certain fission products, particularly long-lived nuclides, from effluents on temporary or long term storage or disposal of the effluent is discussed. (auth)

RECOVERY OR REMOVAL OF MATERIALS 8.05

PRECIPITATION 8.05.07

1336
EFFLUENT TREATMENT. PRECIPITATION–ION EXCHANGE METHODS. K. G. Seedhouse (Industrial Group, Risley). Nuclear Eng. 2, 413-17(1957) Oct.

The increase in size and number of reactors in operation will accentuate the problem of fission product disposal. Work is described aimed at achieving greater decontamination factors than present large-scale methods at the lowest possible cost. (auth)

9255 KLX-10066
Vitro Labs., West Orange, N. J.
FISSION PRODUCT SEPARATIONS STUDY. Quarterly Progress Report [for] December 1, 1956–February 28, 1957. Vitro Job 2077. R. A. Keeler, C. J. Anderson, and M. Kibrick. Mar. 31, 1957. 26p. For [Oak Ridge National Lab.] Contract W-7405-eng-26, Subcontract No. 994. $0.35(OTS).

Study of the solubility of $SrSO_4$ in H_2O and in HNO_3 at 0 to 350°C was continued. Results indicate that the solubility of $SrSO_4$ in H_2O decreases with increasing temperature, whereas in HNO_3 it increases with temperature. Tests were conducted with 5M HNO_3 to illustrate the effect of coprecipitating agents. The feasibility of using a $SrSO_4$ precipitation process for the decontamination of acid wastes is discussed. Selected minerals were evaluated in room-temperature batch tests as inorganic exchangers for removing Cs and Sr from 2.5M and 7.0M HNO_3. (For preceding period see KLX-10057.) (W.L.H.)

5828 HW-47896
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A RADIOCHEMICAL SEPARATION FOR COBALT-60 IN AQUEOUS WASTE SOLUTIONS. R. A. Schneider. Jan. 1, 1957. 26p. Contract W-31-109-Eng-52. $0.25(OTS).

Several methods of chemically separating Co^{60} from aqueous waste solutions and interfering nuclides were investigated. In the most suitable method, Co^{60} is carried from solution as a mixture of insoluble cobaltous and ferrous cobalticyanides after the cobaltic ammine complexes have been destroyed by reduction and acid deammoniation. Removal from solution is approximately 99.9% complete. An average radiochemical yield of 98.1% is obtained for the complete separation procedure. The procedure involves no precise techniques or exacting measurements, and has been adopted for routine use. (auth)

5292
VOLUME REDUCTION OF RADIOACTIVE WASTE BY CARRIER PRECIPITATION. R. E. Burns and M. J. Stedwell (Hanford Atomic Products Operation, Richland, Wash.). Chem. Eng. Progr. 53, 93F-5F(1957) Feb.

A new waste-scavenging process removes Cs^{137} and Sr^{90} on carrier precipitates, permitting the disposal of large volumes of wastes to ground. The demonstrated ability of metal ferrocyanides to remove Cs from aqueous wastes suggests their use in a Cs recovery process. (auth)

187 TID-10142
Hanford Atomic Products Operation, Richland, Wash.
DECONTAMINATION OF BISMUTH PHOSPHATE PROCESS FIRST CYCLE WASTE SUPERNATANTS. R. E. Burns, H. S. Gile, and C. R. McMullen. Sept. 10, 1953. Decl. Oct. 2, 1956. 17p. Contract [W-31-109-Eng-52]. $0.30 (OTS).

First decontamination cycle wastes from the Hanford Atomic Products Operations Bismuth Phosphate Process are made alkaline and stored in large underground tanks. Settling of solids produced on making the wastes alkaline effects considerable decontamination but not enough that very large volumes of the supernatants can be discharged to ground. The effectiveness of tannic acid, Ca_2PO_4, CaC_2O_4, $Fe_4[FeCN_6]_3$, and Fe_2FeCN_6 as carrier precipitates, and CaC_2O_4, Attaclay, and Attapulgus clay as solid adsorbents for the decontamination of supernatants from aged first cycle wastes has been studied. Plutonium, fission-product, and gross salt content of supernatants from several waste tanks are given along with decontamination factors for Pu and fission products obtained when these supernatants were treated under varying conditions with the adsorbents and carrier precipitates noted above. (auth)

12386 MLM-835
Mound Lab., Miamisburg, Ohio.
PILOT PLANT STUDIES OF THE FERROUS SULFIDE PROCESS FOR THE DECONTAMINATION OF PUREX-TYPE REACTOR WASTES. Final Report. T. Apenyi, W. Recher, P. J. Schauer, T. C. Tesdahl, J. Tullis, and J. Woeste. Apr. 17, 1953. Decl. Mar. 1, 1957. 46p. Contract AT-33-1-GEN-53. $0.35(OTS).

The ferrous sulfide ferrous hydroxide-calcium phosphate method for decontaminating high-salt-content reactor wastes was studied on a pilot-plant scale using as a feed a typical (Purex) reactor waste. Results obtained in the pilot plant duplicated to a large degree those obtained in laboratory tests. Waste streams with an activity level in

PRECIPITATION 8.05.07

the order of 5×10^6 counts per minute per milliliter (alpha plus beta) were processed, and an over-all decontamination factor of 2.7×10^2 was realized. Precipitates were separated from liquids by settling proceses. Total volume reduction of liquids to solids was 15.5 to 1. Modifications in the process promise to yield a decontamination factor of 4×10^4 and a volume reduction greater than 30 to 1. (auth)

6249 AECD-4066
Mound Lab., Miamisburg, Ohio.
RESEARCH ON REACTOR WASTE DISPOSAL. Information Report. C. S. Lowe, M. McEwen, F. C. Mead, Jr., and E. Orban. Dec. 15, 1950. Decl. with deletions Jan. 10, 1956. 29p. Contract AT-33-1-gen-53. $4.80(ph OTS); $2.70(mf OTS).

Laboratory work on second decontamination cycle wastes centered around FeS precipitation, ferrous ferrocyanide precipitation, and preformed adsorbent methods. The best results were obtained with ferrous sulfide as a precipitant in conjunction with an adsorbent. It was possible to take the freshest second decontamination cycle waste solution available and to remove all the activity countable by treating first with activated C in the presence of H_2S and then precipitating ferrous sulfide three times under the same conditions. Equally good results were obtained by passing the same original solution through an activated C column and subsequently through an activated alumina column impregnated with ferrous Fe. The ferrous ferrocyanide precipitation method has removed as much as 97.9% of the activity. This treatment may have application where process time and storage capacity are of little concern, such as in a cascade system. On a continuous basis of processing second cycle crib wastes, a possible method exists in a treatment consisting of silica gel adsorption, activated alumina adsorption, metallic Fe scrub, ferrous ferrocyanide precipitation, neutralization, and filtration. The burial volume of concentrate from such a method is very low compared to the original waste volume, and expensive process solution storage is not required in the processing operations. The activity level in the final supernatants could be maintained below 300 cpm/min/ml. Decontamination of "fresh" first cycle wastes is best accomplished by repeated scavenging with FeS. Where column operation proves desirable, passage through silica gel will remove better than 99% of the gross activity, thus permitting further processing to be accomplished with relatively little shielding. Repeated use of the silica gel appears possible by stripping with oxalic acid. FeS scavenging of wastes has given decontamination factors of the order of 60, leaving residual activity of 5×10^5 cpm/min/ml. A significant amount of this residual activity is carried by a precipitation of $Fe(OH)_2$. Additional activity is removed with MnO_2 yielding an overall decontamination factor of 1×10^4. (auth)

10033 AERE-C/R-289
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
REMOVAL OF α ACTIVITY FROM EFFLUENT. SOME EXPERIMENTS ON THE USE OF TANNIC ACID AND LIME. A. A. Smales and L. Airey. Dec. 1948. Decl. May 9, 1957. 9p.

Experiments are described showing that a simple treatment of tap water with tannic acid followed by lime water to pH 7.5 will remove 98 to 100% of the α activity due to added U, Pu, or Po whereas in the absence of tannic acid very little U is removed. The quantity of tannic acid needed is related to the amount of U to be removed, a 10:1 tannic acid: U ratio being satisfactory. The precipitate settles and filters readily, and the treatment is suggested as one possibly applicable to the Harwell effluent. A similar treatment, followed by a delay period after filtration of two weeks, will remove >96% of the α activity due to Th and its daughters. The treatment is not satisfactory for Ra and daughters (approximately 50% efficiency for α's) while for fission products it is only partially successful (85% efficient for β's). (auth)

6518 A/CONF.15/P/1177
PROCEDE DE RETENTION ET DE RECUPERATION DE L'URANIUM DANS LES EFFLUENTS LIQUIDES. (Process for Retention and Recovery of the Uranium Contained in Liquid Effluents.) Pierre Pagny (Société Potasse et Engrais Chimiques, Paris). 15p.

A process is presented for the recovery of uranium from liquid effluents in the form of a rich concentrate. Uranium in effluents having a pH of at least 3 can be adsorbed at 80 to 90°C by passing the effluent over a filtrating bed composed of tribasic alkaline earth phosphates. The tribasic calcium phosphate or mixed alkaline earth phosphates, such as the double phosphate of

PRECIPITATION 8.05.07

calcium and barium or the products resulting from the hydrolysis of the components, is preferable for the filtrating bed. The pH of the effluents is a principal factor in the adsorptive properties of the bed. The effluents can also be freed of uranium by agitating them in the presence of a phosphate precipitate. The concentrate of uranium is then separated by filtration or decantation. Detailed results are given. (J.S.R.)

7065 A/CONF.15/P/1178
THE INDUSTRIAL PROBLEMS RAISED BY THE PROCESSING OF RADIOACTIVE LIQUIDS. SOME OF THE SPECIFIC SOLUTIONS APPLIED AT MARCOULE.
C. Bernaud (Société Générale d'Exploitations Industrielles, Paris). 12p.

The main features of the Marcoule radioactive effluents are given, and it is concluded that even with the low mean specific activity discharge cannot be made to the Rhone without previous treatment. The detailed examination of the characteristics of the effluents, in particular their considerable inactive dissolved product content, the search for maximum elasticity in operation, and the small amount of time available to study and develop new processes on an industrial scale, led to the choice of a processing method using coprecipitation and chemical coagulation. Coagulation takes place in the presence of lime at a pH of about 11.5. (W.D.M.)

7061 A/CONF.15/P/308
DEVELOPMENT OF A SELF-CONTAINED SCHEME FOR LOW-ACTIVITY WASTES. R. H. Burns and E. Glueckauf (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.

The main advantages of a self-contained scheme for the treatment of radioactive wastes are the avoidance of public opposition to discharges, the avoidance of the need for negotiation, as for example where two or more countries are involved, and water economy. Further, in certain locations it may not be possible to discharge wastes to the environments. The proposed scheme separates the wastes into re-usable water and liquid or solid concentrates. Preferably any solids formed should be of an unleachable nature. The first stage of the treatment consists of a calcium and iron phosphate precipitation followed, if necessary, by a sulfide treatment. Some chemical engineering aspects of the precipitation processes are described and a comparison made between various types of clarifiers. The treatment of the chemical sludges formed is of great importance and the freeze drying process, in use at A.E.R.E., Harwell, is described. The chemically treated effluent after clarification is passed through columns of natural vermiculite to remove any remaining strontium and cesium. Experience with this natural ion exchange material is given and the chemistry of exchange outlined. The advantages of incorporating an electro-deionization process in the treatment are outlined and the performance of such a process is compared with conventional mixed-bed exchange columns. The experience gained with laboratory and pilot plant electro-deionization units is described. Considerable experimental work has been carried out at A.E.R.E., Harwell on the heat drying and fusion of concentrates to form unleachable ceramics. Results obtained to date are given and the future program described. Suggested layouts for self containment are set out and the possible use of these for the cooling pond water for nuclear power stations is discussed. Finally, costs for the whole process are estimated. (auth)

SOLVENT EXTRACTION 8.05.08

See also, under PROCESS CHEMISTRY AND ENGINEERING,

SOLVENT EXTRACTION (6.16),

SPECIAL PROCESSES--Americium Recovery (6.17.01).

1173
FISSION PRODUCT WASTE FROM REACTORS—PROCESSING OF HIGHLY ACTIVE SOLUTIONS. T. V. Healy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. Chem. Eng. 4, 538-42(1959) Oct.

A discussion is given of the extraction processes in which HNO_3 is used as a salting-out agent for waste products of natural uranium reactors. Extraction processes are given for the removal of cesium-137 and strontium-90 together, cesium by direct precipitation, and cerium-144 and ruthenium-106 by TBP separately. (C.J.G.)

RECOVERY OR REMOVAL OF MATERIALS 8.05

FISSION PRODUCT REMOVAL 8.05.04

7492 CF-53-9-188
Oak Ridge National Lab., Tenn.
RECOVERY OF 7500 AREA SALVAGE MATERIAL. S. Mann and J. E. Bigelow. Sept. 24, 1953. Decl. Feb. 13 1957. 18p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Salvage material from the 7500 Area, consisting mostly of ground-up concrete and other waste in nitric acid, was processed for recovery of its uranium content. The U^{235} content was originally estimated at 825.8 g, with an estimated isotopic purity of 92%. Of the total uranium actually present in pilot plant feed (1098.3 g) 97.9% was recovered, 1.16% was lost to samples and low activity waste streams, and 0.91% was lost to waste due to equipment failure. Processing rate was limited by the low flooding rate of this material, at times as low as 24 gal/hr/sq ft for some batches of feed. Column on stream time efficiency was 87%. The material was processed by solvent extraction using 5% tributyl phosphate (TBP) in Amsco diluent. Only slight modifications were required to adapt the equipment

11640 KT-79
Massachusetts Inst. of Tech., Oak Ridge, Tenn.
Engineering Practice School.
APPLICATION OF PULSE COLUMN TO RECOVERY OF URANIUM IN WASTE SOLUTIONS. R. P. Webb, W. L. Griffith, M. E. Nathan, and J. F. O'Donnell. June 28, 1950. Decl. Mar. 4, 1957. 13p. For Carbide and Carbon Chemicals Div. [K-25 Plant]. Contract [W-7405-eng-26, Subcontract 70]. $3.30(ph OTS); $2.40(mf OTS).

SURVEYS AND BIBLIOGRAPHIES 8.06

See also, under PROCESS CHEMISTRY AND ENGINEERING,

SPECIAL PROCESSES,

for sites not listed here.

BIBLIOGRAPHIES 8.06.01

11436 CF-58-7-77
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE TREATMENT AND DISPOSAL —A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE, PART 2. J. O. Blomeke. July 22, 1958. 24p. Contract [W-7405-eng-26]. $4.80(ph), $2.70(mf) OTS.

This bibliography of the unclassified literature on radioactive waste treatment and disposal has been compiled from references published in the Nuclear Science Abstracts, Volume 11, No. 11 (June 15, 1957), through Volume 12, No. 12 (June 30, 1958). The bibliography brings up to date a previous bibliography published as CF 57-8-118. (auth)

TREATMENT AND DISPOSAL OF GASEOUS, LIQUID AND SOLID RADIOACTIVE WASTES. Information Bibliography. Nov. 1957. 34p. (IGRL-IB/R-28)

This is a title list of 251 unclassified report, book and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts; *Nuclear Science Abstracts;* Geneva Conference (1955) papers; Cleveland, Ohio, Nuclear Congress (1955) papers; *Engineering Index* (1950-1955); and *Industrial Arts Index* (1956).

RADIOACTIVE WASTE TREATMENT AND DISPOSAL—A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE. D. L. Africk, P. E. Novak, and J. O. Blomeke. Oct. 3, 1957. 33p. (CF-57-8-118)

This bibliography of the unclassified literature on radioactive waste treatment and disposal has been compiled from references published in the *Nuclear Science Abstracts*, Volume 4, No. 1 (January 15, 1950) through Volume 11, No. 10 (May 31, 1957). The 304 references have been categorized as to subject matter, and brief abstracts have been included where needed to show pertinent information not indicated by either the document title or category.

SURVEYS AND BIBLIOGRAPHIES 8.06

BIBLIOGRAPHIES 8.06.01

11175 UCRL-4891
California. Univ., Livermore. Radiation Lab.
RADIOACTIVE WASTE PROCESSING AND DISPOSAL (1950-1957) BIBLIOGRAPHY. Frederick E. Frost. May 6, 1957. 23p. Contract W-7405-eng-48. $4.80(ph OTS); $2.70(mf OTS).

This bibliography consists of reports compiled from the AEC Library Card Catalog. Only the classified and unclassified report literature is included. For the published literature the reader is referred to an unpublished paper by M. Cason (UCRL–Livermore Library). All progress reports covering the work on radioactive waste disposal have been omitted in order to exclude a large amount of duplicate information which is usually found in more detail in topical reports. For information prior to Jan. 1, 1950, it is suggested that the reader refer to TID–3008–Radioactive Waste Processing and Disposal, H. E. Voress and Fred E. Croxton, Aug. 1, 1951 (Secret). The references are arranged by report number under disposal of wastes or processing of wastes. (auth)

9136 UCRL-5068
California. Univ., Livermore. Radiation Lab.
RADIOACTIVE WASTE DISPOSAL. [A Bibliography]. Apr. 25, 1957. 12p. Contract W-7405-eng-48. (M-6301). $3.30(ph OTS); $2.40(mf OTS).

This is a selective bibliography of books and periodical articles relating to radioactive waste disposal. Material in the bibliography is concerned primarily with methods for the handling and disposal of wastes and the results of these methods. Auxiliary material indicating methods of determining radioactivity in wastes has been included. Sources consulted include: Chemical Abstracts, 1950 to 1955; Engineering Index, 1950 to 1955; Industrial Arts Index, 1950 to March 1957; Nuclear Science Abstracts, 1950 to March 15, 1957; Physics Abstracts, 1950 to 1955; the Library card catalog; and the Technical Information Division AEC card catalog. (auth)

21670
BIBLIOGRAPHY OF SELECTED HANFORD LITERATURE ON RADIOACTIVE WASTE DISPOSAL. p.339-70 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Radiation protection standards pertaining to waste disposal practices are appended. (D.E.B.)

TID-3311
Radioactive Waste Processing and Disposal - a Bibliography - H.E. Voress, T.F. Davis, T.N. Hubbard, Jr.

Presents 698 references to unclassified reports on current and proposed radioactive waste processing and disposal of solutions from plants and laboratories, decontamination of surfaces, air cleaning, and other related subjects. Author, corporate author, subject, and report number indexes are included.

CHALK RIVER 8.06.02

18708 ✓ AECL-799(Paper 9)
Atomic Energy of Canada Ltd., Chalk River, Ont.
THE HANDLING OF WASTES FROM A NUCLEAR REACTOR. C. A. Mawson. Paper 9 of ATOMIC POWER SYMPOSIUM HELD AT CHALK RIVER, ONTARIO, MAY 4 AND 5, 1959. 10p.

Radioactive wastes produced by a nuclear reactor vary from intensely active sources such as the spent fuel elements to dilute solutions or gases which can be dispersed into surface waters or into the air without danger. Gaseous, liquid, and solid wastes from a reactor such as CANDU are discussed. Methods for disposing of high-level solid and liquid wastes at Chalk River are reviewed. An estimate of the cost of the waste-handling system for CANDU is presented. (W.D.M.)

DISPOSAL OF RADIOACTIVE WASTE. K. Saddington and W. L. Templeton. London, George Newnes Limited, 1958. 108p.

Problems associated with the containment and disposal of fission products from power reactors are discussed. The importance of adequate waste disposal facilities on the development of the nuclear power industry is stressed. Topics discussed in detail include the formation and nature of radioactive waste, the biological effects of radiation, the discharge of wastes to the natural environment, the treatment of airborne wastes, the treatment of liquid effluents, disposal methods for solid wastes, and the utilization of individual fission products. Methods of waste disposal which have been used in the past are re-examined and discussed in relation to expected future needs. (C.H.)

SURVEYS AND BIBLIOGRAPHIES 8.06

CHALK RIVER 8.06.02

REPORT ON WASTE DISPOSAL SYSTEM AT THE CHALK RIVER PLANT OF ATOMIC ENERGY OF CANADA LIMITED. C. A. Mawson. July 1956. 16p. (CRB-658; AECL-344)

Disposal methods now in use at the Chalk River Project are presented. Also discussed are new methods proposed and on test for disposal of waste.

EUROPE (AND OTHERS) 8.06.03

PHILOSOPHY AND PRACTICE OF RADIOACTIVE WASTE DISPOSAL. R. B. Temple. Commonwealth Eng. 46, 76-8(1958) Nov. 5.

The views of the Australian Atomic Energy Commission regarding radioactive waste disposal are presented. (auth)

2544

FISSION-PRODUCT DISPOSAL. K. Saddington (United Kingdom Atomic Energy Authority, Windscale Works, Sellafield, Cumb., Eng.). J. Brit. Nuclear Energy Conf. 3, 290-8(1958) Oct.

The problem of the disposal of unwanted radioactive fission products formed during the operation of a nuclear reactor will increase with the increased utilization of nuclear power. In this paper the nature and magnitude of the problem are discussed, the methods used for its solution in the past are described, and some consideration is given to possible future developments designed to ensure that the problem does not at any time limit the growth of the industry. (auth)

4165 IGRL-IB/R-28

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

TREATMENT AND DISPOSAL OF GASEOUS, LIQUID AND SOLID RADIOACTIVE WASTES. Information Bibliography. Nov. 1957. 34p.

This is a wide selection of unclassified report, book, and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. reports abstracts; Nuclear Science Abstracts; Geneva Conference (1955) papers; Cleveland, Ohio, Nuclear Congress (1955) papers; Engineering Index (1950-1955); and Industrial Arts Index (1956). (auth)

THE SAFE DISPOSAL OF WASTE FROM ATOMIC ENERGY ESTABLISHMENTS. B. J. Lister. Roy. Soc. Promotion Health J. 78, 498-506(1958) Sept.-Oct.

The aims in disposal of radioactive wastes are, first, to ensure, irrespective of cost, that the limits set for maximum permissible levels of radiation to individuals and to the public are not exceeded, and second, having regard to cost, convenience, and the national importance of the application, to reduce the radiation doses below these levels. In general, there are only two methods of radioactive waste disposal—dispersion to the environment (to atmosphere, seas or rivers), or storage. Almost all forms may be employed, depending upon hazards and problems involved: disposal may be by dispersal to the atmosphere or to rivers in the case of low activity wastes; burial or packaging for disposal at sea in cases of high radiation level. Two new approaches appear promising: the possibility of chemical separation of constituents after reasonably short periods of storage (10—20 years), or fixing fission products in solid form, e.g., by absorbing in clay or incorporating in cement or ceramics. (T.C.O.)

RADIOACTIVE WASTES RESULTING FROM THE PEACEFUL OR MILITARY UTILIZATION OF ATOMIC ENERGY. Claude Paoletti and A. Delaud. Age nucléaire No. 6, 33-43(1957) Sept.-Oct. (In French)

The peaceful or military utilization of atomic energy leads to the accumulation of radioactive wastes. These waste products consist of heavy natural radioactive elements, radioactive elements induced by neutrons, and radioactive elements resulting from the fission of nuclear fuel. The primary radioactive elements in each of these categories are discussed. A comparison is made of the radioactivity resulting from an atomic bomb and that caused by a nuclear reactor. The quantities of radioactive wastes that will be produced in the future are discussed and possible dangers are reviewed. 43 references. (J.S.R.)

9774

THE DISPOSAL OF RADIOACTIVE WASTE MATERIAL. Thomas Jaeger. Atomkern-Energie 3, 190-6(1958) May. (In German)

A survey of the question of the disposal of radioactive wastes and of the adopted and proposed methods is given. 62 references. (J.S.R.)

SURVEYS AND BIBLIOGRAPHIES 8.06

EUROPE (AND OTHERS) 8.06.03

8322
THE TREATMENT OF RADIOACTIVE WASTES FROM THE KARLSRUHE ATOMIC RESEARCH CENTER. S. Krawczynski (Kernreaktor Bau- und Betriebs-GmbH., Karlsruhe, Ger.). Kommunalwirtschaft No. 9, 8p. (1959) Sept. (In German)

The sources, quantities, and compositions of radioactive waste materials from various operations are described, and methods of treatment are discussed. Sampling, decontamination, precipitation, and evaporation procedures are included. (T.R.H.)

1361
THE SAFE DISPOSAL OF RADIOACTIVE WASTES. H. J. Blythe. Energia nucleare (Milan) 4, 375-8(1957) Oct. (In Italian)

Systems for disposal of gaseous, liquid, and solid wastes are described. (M.H.R.)

Fission Product Disposal from Windscale, P.V. DANCKWERTS. Nuclear Eng 1, 1, Apr 1956, p 25-7.

Disposal of fission products resulting from operation of first British plutonium producing piles, etc, at Windscale, England; results of study of dispersal effects of tide and wind on bulk dumpings of fluorescein in sea, and concentration characteristics of slit, seaweed and fish, before low activity effluent was discharged; how initial estimates erred on side of safety.

PROCESS DESIGN FOR THE LIVERMORE WASTE DISPOSAL PLANT. SUMMARY REPORT. J. L. Schwennesen, L. R. Michels, and M. L. Feldman. Sept. 10, 1952. Decl. April 11, 1957. 29p. (LWS-24632; CRD-T1-184)

Some of the singular problems connected with radioactive waste processing at the Livermore site are outlined. Several methods for treating and disposing of wastes were evaluated. These include disposal at sea in shielded containers following various degrees of concentration, underground storage of neutralized wastes at Livermore, direct dispersion of wastes in large volumes of sea water, and rail or truck shipment to either Hanford or Los Alamos for underground storage. Approximate costs per year are tabulated for these methods.

ORNL 8.06.04

11439 ORNL-2601
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE MANAGEMENT AT OAK RIDGE NATIONAL LABORATORY. F. N. Browder, comp. and ed. April 17, 1959. 58p. Contract W-7405-eng-26. $1.75(OTS).

Previously issued as CF-59-1-97.

The collection, treatment, disposal, and monitoring of radioactive wastes (solid, liquid, and gaseous) at Oak Ridge National Laboratory are described in detail. Illustrations of facilities, maps, and tables of data on waste volumes and radionuclides discharged to the environment are included. The philosophy and history of waste management are discussed. The report constitutes an evaluation of waste management at ORNL, concluding that the low degree of radioactive contamination of the air and water by ORNL does not represent a hazard to the local environment or population. (auth)

7781 CF-57-12-143
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE DISPOSAL AND DECONTAMINATION ANNUAL REPORT FOR 1957. E. J. Witkowski. Apr. 18, 1958. 11p. Contract [W-7405-eng-26]. $3.30 (ph OTS); $2.40(mf OTS).

The operation of facilities, which include the hot-chemical and the metal waste systems, the process waste system, and the radioactive gas disposal system, is described. Also included is a report on equipment decontamination and off-shift services performed for the research divisions. (W.L.H.)

COMPILATION AND ANALYSIS OF WASTE DISPOSAL INFORMATION. E. D. Arnold. Mar. 1957. Decl. Mar. 13, 1957. 284p. (CF-57-2-20(Del.))

This report summarizes waste processing, treatment, and disposal information as extracted from many documents on the various aspects of the general problem. The material in this report is intended to serve as background for a program proposal at ORNL covering waste processing for fission product recovery, waste treatment and handling, and ultimate disposal of high-level, intermediate-level and low-level radioactive wastes. In addition to an introduction to the complex of problems in waste treatment and handling, a summary of various ultimate disposal schemes and re-

ORNL 8.06.04

lated studies, the report catalogues informative papers on phases of: (a) waste solution characteristics, (b) economics, (c) predictions of activity and volume buildup in a nuclear power economy, (d) potential health hazards of fission and transmutation products, (e) waste storage, decay, and shipment prior to ultimate disposal, (f) fission product recovery processes and utilization, (g) treatment and disposal of intermediate- and low-level wastes, (h) reviews of engineering studies of problems at existing processing plant waste disposal sites, (i) disposal of wastes in tanks, (j) disposal of wastes in deep wells, (k) disposal of wastes in salt-domes, underground formations and the ocean, and (l) self-sintering at elevated temperatures as a method of ultimate disposal. A master reference list of 256 references is appended.

10867 CF-56-10-15
Oak Ridge National Lab., Tenn.
WASTE AND DISPOSAL SYSTEM. J. E. Kuster. Oct. 1, 1956. 11p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Waste and vent systems discussed in detail are venting and evacuation, flooding, liquid waste, evacuation of holdup tank, steam blowdown from heat exchangers, disposal, gaseous wastes, and waste storage emergency overflow. (M.H.R.)

THE NATURE AND MAGNITUDE OF RADIOACTIVE WASTES AS INFLUENCED BY TYPES OF REACTORS AND FUEL PROCESSING—PRESENT AND PROSPECTIVE. Floyd L. Culler, Jr. May 4, 1956. 85p. (CF-56-5-2)

A bibliography of 65 references is included.

21671
STATEMENT OF K. Z. MORGAN, DIRECTOR OF THE HEALTH PHYSICS DIVISION, OAK RIDGE NATIONAL LABORATORY. p.428-60 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

A discussion is given of the waste management facilities and the effectiveness of these facilities. (C.J.G.)

PWR (SHIPPINGPORT) 8.06.05

See also, this section,

PLANTS AND EQUIPMENT (8.04).

RADIOACTIVE WASTE DISPOSAL SYSTEM. J. R. LaPointe. July 24, 1957. 9p. Contract AT-11-1-GEN-14. (AECU-3602)

Seven illustrations are given for convenience in developing operating procedures for disposal of PWR wastes. The illustrations include radioactive waste disposal systems for service building wastes, liquid effluents, solid and gaseous wastes, cooling water, steam system, and miscellaneous service lines.

RADIOACTIVE WASTE DISPOSAL. p.121-126 of DESCRIPTION OF THE SHIPPINGPORT ATOMIC POWER STATION. June 1957. 146p. Contract AT-11-1-Gen-14. (WAPD-PWR-970)

The ultimate disposal criteria for the PWR are described. The liquid wastes will be delivered, stored in underground stainless steel tanks and/or processed through demineralizers and a gas stripper or if within permissible limits the liquid is blended with the condenser cooling stream for discharge to the Ohio River. The system has been designed to process 16000 gal/month of 1.7 μc/ml. Spent demineralizer is stored in underground tanks. Combustible solid wastes will be burned in the incinerator with ashes and wash water slurried and stored in resin storage tanks. Gases from the combustion process will be scrubbed and filtered. Other solids will be sealed in drums for marine burial. Flowsheets for the waste disposal facilities are included.

CONTROL OF RADIOACTIVE MATERIAL AT THE PRESSURIZED WATER REACTOR. Jacques R. LaPointe and Robert D. Brown. [1957]. 24p. (WAPD-T-436)

Prepared for presentation at the 1957 Nuclear Engineering and Science Congress, March 10-16, Philadelphia.

Criteria are presented for the ultimate disposal of radioactive wastes from the Pressurized Water Reactor. The design aspects involved in applying these principles to the radioactive disposal facilities are discussed. The types of wastes encountered and the processes developed at the plant are detailed.

PWR (SHIPPINGPORT) 8.06.06

HOW RADIOACTIVE WASTES WILL BE HANDLED AT PWR. J. R. LaPointe (Westinghouse Electric Corp., Pittsburgh). Nucleonics 15, No. 5, 114-16(1957) May.

966 WAPD-PWR-PMF-278(Issue 2)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
PWR RADIOACTIVE WASTE DISPOSAL SYSTEM. ACTIVITY BALANCE. July 16, 1956. 9p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

An activity balance was developed for the PWR Radioactive Waste Disposal System to show the degree of radioactive contamination of wastes throughout the process and outside the control area. (auth)

11418 WAPD-PWR-CP-1945
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
WASTE DISPOSAL TREATMENT OF PWR HOT LAUNDRY AND DECONTAMINATION ROOM WASTES. Paul Cohen. Mar. 23, 1956. 3p. Appendix I: SURVEY OF APPLICATION OF STANDARD WATER CLARIFICATION PROCEDURES TO PWR LAUNDRY AND DECONTAMINATION ROOM WASTES. R. Lloyd. 11p. (WAPD-PWR-CP-1912). Appendix II: CONFERENCE BETWEEN R. LLOYD AND J. R. LaPOINTE TO ESTABLISH TENTATIVE PROCEDURES AND DETERMINE EQUIPMENT FOR APPLYING ADSORPTION-FLOCCULATION TREATMENT TO PWR LAUNDRY WASTE. R. Lloyd and J. R. LaPointe. 4p. (WAPD-PWR-CP-1929). Appendix III: EVAPORATION OF DECONTAMINATION ROOM WASTES. C. S. Abrams. 4p. (WAPD-PWR-CP-1930). (WAPD-PWR-CP-1945, $1.80(ph OTS); $1.80(mf OTS); WAPD-PWR-CP-1912, $3.30(ph OTS); $2.40(mf OTS); WAPD-PWR-CP-1929 and WAPD-PWR-CP-1930, $1.80(ph OTS); $1.80(mf OTS) ea.)

This report and three appendixes were issued separately, but are cataloged as a unit.

The necessity for treatment of hot laundry and decontamination room wastes prior to disposal at the Shippingport Pressurized Water Reactor site is pointed out, and means for accomplishing this are discussed. A feasible procedure suggested consists of an adsorption-flocculation treatment with supernate disposal by dilution, pass through an evaporator, transfer to surge and decay tanks, with final sludge concentration in drums for retention and burial at sea. (T.R.H.)

967 WAPD-PWR-PMF-360
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
PWR RADIOACTIVE WASTE DISPOSAL PLANT. [1956]. 7p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

Criteria used in the design of the Radioactive Waste Disposal System for the Shippingport Pressurized Water Reactor are presented. (W.L.H.)

Waste Disposal

1923 WAPD-T-387
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
A DISCUSSION OF THE RADIOACTIVE WASTE DISPOSAL FACILITIES AT THE SHIPPINGPORT ATOMIC POWER STATION. [1956]. 8p. $1.80(ph OTS); $1.80(mf OTS).

21674
PRESENTATION ON SHIPPINGPORT ATOMIC POWER STATION (PWR) WASTE DISPOSAL FACILITIES. A. L. Bethel, J. R. LaPointe, and W. J. Hahn (Westinghouse Electric Corp., Bettis Atomic Power Div., Pittsburgh). p.620-64 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Criteria and controls required for satisfactory waste disposal are discussed. A description of the waste treatment process is presented. (C.J.G.)

RADIOACTIVE WASTE DISPOSAL SYSTEM. 314p. SYSTEM DESCRIPTION NO. 24 of SHIPPINGPORT ATOMIC POWER STATION MANUAL. VOLUME 2. (TID-7020(Vol. II) (SYSTEM DESCRIPTION NO. 24))

A radioactive waste disposal system was designed to provide facilities necessary to contain, process, and dispose of radioactive wastes from the Pressurized Water Reactor plant and its auxiliaries in such a manner as not to exceed specified tolerances for discharge of radioactive materials to the environment. Procedures and equipment used in segregating, processing or storing, and ultimate disposal of the radioactive wastes are described in detail.

U.S. – GENERAL 8.06.06

21688
HEARINGS ON INDUSTRIAL RADIOACTIVE WASTE DISPOSAL. HEARINGS BEFORE THE SPECIAL SUBCOMMITTEE ON RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON INDUSTRIAL RADIOACTIVE WASTE DISPOSAL, JANUARY 28, 29, AND 30; FEBRUARY 2 AND 3, 1959. VOLUME 2. Washington, D. C., Joint Committee on Atomic Energy, 1959. p.987-1823. $2.25 (GPO).

Reports are included on the treatment and controlled dispersal of low and intermediate level wastes to the atmosphere, surface waterways, the ground, and the ocean. Environmental investigations associated with the development program are also discussed. (C.J.G.)

4142 CF-59-11-6
Oak Ridge National Lab., Tenn.
THE ORIGIN AND NATURE OF RADIOACTIVE WASTES IN THE ATOMIC ENERGY PROGRAM. F. R. Bruce. Nov. 30, 1959. 69p. OTS.

The sources from which radioactive wastes arise, their quantities, compositions, and properties which are pertinent in considering disposal methods are examined. The methods which are described for reprocessing U and Al–U alloys clad with Al are well established. There is, however, uncertainty in defining the nature of radioactive wastes from reactor fuel reprocessing because processing methods have not been selected, and for this reason several approaches to waste disposal are presented. Data and flowsheets for various processes are included. 82 references. (J.R.D.)

1230
HANDLING, TREATMENT, AND DISPOSAL OF RADIOACTIVE WASTES. Joseph A. Lieberman (U. S. Atomic Energy Commission, Washington, D. C.). p.435-46 of "Australian Atomic Energy Symposium, 1958."

A review is presented on the disposal of radioactive wastes arising from raw materials and metal fabrication operations. Treatment of the wastes for storage are discussed relative to evaporation, neutralization, precipitation, crystallization, and ion exchange. The effects arising from ultimate disposal of these wastes to the environment are discussed. (C.J.G.)

6070
RADIOISOTOPE WASTES HANDLING. H. Gladys Swope (Argonne National Lab., Lemont, Ill.). Sewage and Ind. Wastes 31, 1191-6(1959) Oct.

The uses of radioisotopes and the methods and problems encountered in the disposal of radioactive waste are reviewed. Waste disposal methods used at Argonne National Laboratory are discussed. (C.J.G.)

3249 AECU-4331
Nuclear Science and Engineering Corp., Pittsburgh and Nichols Engineering and Research Corp., New York.
TREATMENT AND DISPOSAL OF HIGH-LEVEL RADIOACTIVE LIQUID WASTES. Eli I. Goodman and Herman L. Sturza. Dec. 1958. 286p. Contract AT(36-1)-44. OTS.

The major purpose of this publication is to collect all pertinent data on treatment and disposal of radioactive wastes into one volume in order to: provide a basic reference for existing methods; indicate the status of research and development projects; and present an outline of proposed methods. Coverage was limited to consideration of high-level radioactive liquid wastes. At the present these wastes come from nuclear-fuel reprocessing plants. Chapter two highlights and summarizes the important aspects of the text. Chapter three acquaints individuals whose technical training is not specifically in nuclear subjects with the fundamentals they need to understand radioactive wastes. In chapter four the basic nature of the problem and its relation to the nuclear economy is presented. Chapter five presents the data on the radiological safety aspects of this problem. In chapter six the available information on the economic aspects of the problem is summarized. Chapter seven is primarily concerned with liquid-waste storage technology. Chapter eight presents data on evaporation, acid removal, neutralization, adsorption and ion exchange, solvent extraction precipitation and crystallization, drying, pyrolysis, and thermal fusion. Chapter nine deals with final-disposal methods such as ocean disposal, shallow-pit disposal, deep-well disposal, self-fixation in pits, and cave and mine storage. (W.L.H.)

4968
TREATING AND DISPOSING OF RADIOACTIVE WASTES W. J. George (Wyandotte Chemicals Corp., Wyandotte, Mich.). Chem. Eng. 66, No. 25, 151-5(1959) Dec. 14.

The problem of handling and storage of radioactive waste is discussed. The treatment of wastes by evaporation, fixation in solids, precipitation, ion exchange, and calcination is described. Ultimate disposal methods such as salt cavities, deep wells, and ocean burial are described. (W.L.H.)

SURVEYS AND BIBLIOGRAPHIES 8.06

U.S. – GENERAL 8.06.06

1176
INDUSTRIAL RADIOACTIVE WASTE DISPOSAL, SUMMARY-ANALYSIS OF HEARINGS, JANUARY 28, 29, 30, FEBRUARY 2, 3, AND JULY 29, 1959, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. Washington, D. C. Joint Committee on Atomic Energy, 1959. 44p. (GPO)

The nature of radioactive wastes from various operations is discussed. Waste management at Hanford, Naval, Savannah River, and Shippingport reactors and in fuel reprocessing at Hanford, Idaho Chemical Processing Plant, and Savannah River is evaluated. The progress made on disposal of low- and high-level wastes is reported. The activities of Federal, State, and international agencies relative to safety hazards in waste disposal are discussed. (C.J.G.)

1168 HW-SA-39
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIOACTIVE WASTE DISPOSAL—A SIGNIFICANT FACTOR IN THE DEVELOPMENT OF NUCLEAR POWER. PART I. THE PROBLEM OF HIGH-ACTIVITY SOLUTIONS. C. E. Linderoth and W. A. Haney. PART II. THE PROBLEM OF LOW-ACTIVITY SOLUTIONS. J. F. Honstead and L. C. Schwendiman. Mar. 4, 1959. 33p. Contract W-31-109-Eng-52. OTS.

Some of the troublesome control problems encountered in radioactive waste management result from the very wide range and quite low values representing the MPC's of various radioisotopes. Wastes may have a radioactive material concentration within a very broad range, from about 2000 curies per gallon down to barely detectable trace concentrations. Some of the practices and problems of low- and high-activity waste disposal are discussed and related to the growth of nuclear power. (W.D.M.)

23028
COMMENTS ON THE HEARINGS ON WASTE DISPOSAL. Ralph E. Lapp. p. 3035-8 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

Questions are brought up and discussed which were not fully covered in the Hearings before the Special Subcommittee on Radiation. (C. J. G.)

13077
DISPOSAL OF RADIOACTIVE WASTES. II. Thomas Jaeger. Atomkern-Energie 3, 273-7(1958) July. (In German)

In this second part on disposal of radioactive wastes, the methods for disposal in use at the Idaho Chemical Processing Plant, Hanford, Oak Ridge, Harwell, and Windscale are reviewed. 17 references. (J.S.R.)

14749 A/CONF.15/P/2004
[Division of Reactor Development], AEC.
THE ROLE OF WASTE MANAGEMENT IN THE DEVELOPMENT OF THE NUCLEAR ENERGY INDUSTRY. Joseph A. Lieberman. 9p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Distinction is made between the various categories of radioactive wastes evolving from different segments of the nuclear energy industry. Capabilities and operating experience of treatment and disposal systems presently in use for low-level wastes from laboratories and reactors are described. Emphasis is given to the highly radioactive liquid wastes resulting from the chemical reprocessing of irradiated nuclear fuels. Present handling and treatment methods for this category of wastes are discussed. Development activities directed toward ultimate disposal systems for high-level wastes are noted. Distinction is made between treatment and disposal systems which have been engineered to prototype scale and those systems which are in the development stage. Based on present knowledge, judgments on the evolution of ultimate disposal systems are given. Basic criteria pertinent to ultimate disposal of highly radioactive wastes including the environmental aspects are delineated. (auth)

SECTION 9.0 TO STATUS REPORT ON THE DISPOSAL OF RADIOACTIVE WASTES. Floyd L. Culler, Jr., comp. and ed. Sept. 3, 1957. 47p. Contract W-7405-eng-26. (CF-57-3-114(Rev.) (Suppl. 1))

Chemical processes for fission product concentration, removal, or fixation are discussed. The concept of a multipurpose waste processing facility is reviewed. Waste treatment processes discussed in detail include evaporation, precipitation processes for fission product recovery from high level aqueous systems, fission product recovery by ion exchange, and fission product recovery by solvent extraction.

U.S. – GENERAL 8.06.06

WASTE DISPOSAL RESEARCH. p.52-88 of HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JULY 31, 1957. Nov. 26, 1957. 131p. (ORNL-2384)

Progress and/or data are reported for the following topics: analysis of water, soils, and river bottom mud for fission products; solvent extraction of fission products from acid $Al(NO_3)_3$ solutions by various solvents; development of ceramic mixtures for disposal of high level wastes by sintering; leaching of sintered material; adiabatic self sintering experiment; disposal in deep wells and salt formations; laboratory soil columns studies using Cs^{137} tracer and waste solutions for adsorption on dried Conasauga shale; removal of non-cationic radionuclides from intermediate level waste by $KMnO_4$ and NaOCl; wastes released to ORNL pit; evaporation and seepage in the pits and hydrology of the pits; extent of underground dispersion; and selection of future disposal sites.

14747 A/CONF.15/P/1073
Oak Ridge National Lab., Tenn.
MULTIPURPOSE PROCESSING AND ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. E. G. Struxness and J. O. Blomeke. 23p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The many unit processes and unit operations applicable to integrated waste processing and ultimate disposal systems are discussed. The flow diagrams are useful in presenting the concept of multipurpose waste processing as a necessary companion to multipurpose fuel reprocessing. The steps for processing wastes of different types include: evaporation, acid and neutralized storage, solid-liquid separation, extraction of useful or hazardous fission products from various liq-

2893
OUTLOOK FOR WASTE DISPOSAL. Nucleonics 15, No. 11, 155-64(1957) Nov.

A survey of experts in the field of waste disposal is presented. Agreement was unanimous that a permanent plan for final disposition of these wastes will be found.

1335 WASH-742
Division of Reactor Development, AEC.
STATUS REPORT ON HANDLING AND DISPOSAL OF RADIOACTIVE WASTES IN THE AEC PROGRAM. Aug. 1957. 41p. $1.25(OTS).

The waste disposal standards of the AEC are briefly outlined. The present waste situation is discussed, with emphasis on high-level liquid wastes as the major waste problem in the AEC today as measured by dollars, curies of radioactivity, and potential health hazard. All the other kinds and categories of wastes, though significant, are several orders of magnitude less important. The other types of wastes discussed at length are low and intermediate level liquid wastes, solid wastes, and gaseous wastes. Estimates of future wastes are given.

STATUS REPORT ON THE DISPOSAL OF RADIOACTIVE WASTES. Floyd L. Culler, Jr. and Stuart McLain, comps. and eds. June 25, 1957. 232p. (CF-57-3-114(Rev.))

A comprehensive survey of waste disposal techniques, requirements, costs, hazards, and long-range considerations is presented. The nature of high level wastes from reactors and chemical processes, in the form of fission product gases, waste solutions, solid wastes, and particulate solids in gas phase is described. Growth predictions for nuclear reactor capacity and the associated fission product and transplutonic waste problem are made and discussed on the basis of present knowledge. Biological hazards from accumulated wastes and potential hazards from reactor accidents, ore and feed material processing, chemical reprocessing plants, and handling of fissionable and fertile material after irradiation and decontamination are surveyed. The waste transportation problem is considered from the standpoints of magnitude of the problem, present regulations, costs, and cooling periods. The possibilities for ultimate waste management and/or disposal are reviewed and discussed. The costs of disposal, evaporation, storage tanks, and drum-drying are considered.

4360 TID-7581(p.37-51)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
RECOVERY OF SOURCE AND SPECIAL NUCLEAR MATERIALS. Walter H. Hoose. 15p.

The procedures for handling scrap SS materials which have been transferred to the UCNC Y-12 Plant for recovery are discussed. The application of proper segregation and packaging of such scrap to economical processing is illustrated by typical process flows. A few of the problems associated with the evaluation of scrap SS material are mentioned. (auth)

U.S. – GENERAL 8.06.06

EFFLUENT DISPOSAL CONSIDERATIONS AND SUMMARY OF METHODS USED. C. E. Stevenson. May 1, 1957. p.351-62 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

Certain problems involved in the disposal of effluent other than products from the chemical processing of nuclear fuels for fissionable material recovery are discussed. Major considerations of effluent treatment are outlined and the types of effluents are listed and described. The chief methods which have been used, studied, or proposed in the United States for the treatment and disposal of radioactive wastes from processes are noted and briefly compared in regard to experience obtained and future application.

10868 KAPL-M-DAM-1
Knolls Atomic Power Lab., Schenectady, N. Y.
RÉSUMÉ OF RADIOACTIVE WASTE HANDLING AT THE KNOLLS ATOMIC POWER LABORATORY. D. A. Manieri and C. N. Perleberg. May 1956. 6p. Contract W-13-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The history of waste handling operations at KAPL is reviewed. (M.H.R.)

ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. W. A. Rodger and P. Fineman. May 1, 1957. p.407-54 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

This detailed report describes problems of disposal of 50 yr accumulation of long lived isotopes; effect of residual Sr^{90} on discardability of waste; cribbing operations; ORNL disposal in terrestrial pits; ground disposal at Chalk River; earth disposal at Savannah River; Project Hope waste pit; use of deep wells; disposal of wastes in salt domes; ocean disposal; reduction of liquids to solids; adsorption on montmorillionite clay; waste solidification by fused salt calcination; fixation of wastes in clay flux mixes; flush bed calcining of wastes to oxides; and heat problems of fission product wastes.

SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A SEMINAR SPONSORED BY THE AEC AND THE PUBLIC HEALTH SERVICE, HELD AT THE ROBERT A. TAFT ENGINEERING CENTER, CINCINNATI, OHIO, DECEMBER 6-9, 1955. October 1956. 313p. (TID-7517(Part 1b))

Information on the following experimental and theoretical studies are given in detail on the following subjects: Determination of Sr^{90} By Precipitation and Extraction Method; Fixation of Radioactive Wastes in Clay-Flux Mixes; Heat Experiments For Self Fixation of Radioactive Wastes in Clay-Flux Mixtures; Use of Artificial Clays in Removal and Fixation of Radioactive Nuclides; Processing of High Level Atomic Wastes With the View to Ultimate Disposal; Heat Conduction Losses in Reactor Waste Basins; Potential Hazards Associated With the Release of Laboratory Liquid Waste to the Mohawk River; Geological and Hydrological Aspects of the Disposal of Liquid Radioactive Wastes; Some Geologic Factors That Influence Disposal of Radioactive Wastes Into Pits; Disposal of Low-Level Liquid Radioactive Wastes In Inland Waterways; Preliminary Studies on the Fate of Fission Products in the Illinois River Systems; and Heat Problems in the Disposal of High Level Radioactive Wastes.

8340 WASH-408
Division of Reactor Development, AEC.
DISPOSAL OF RADIOACTIVE WASTES IN THE U.S. ATOMIC ENERGY PROGRAM. Abel Wolman, A. E. Gorman, and J. A. Lieberman. May 17, 1956. 15p. $0.20(OTS).

The AEC program for the handling and disposal of wastes from the nuclear energy industry is outlined. Recent research and development projects for disposal of high-level wastes are listed. (C.W.H.)

A SURVEY OF RADIOACTIVE WASTE DISPOSAL. Fritz A. Hedman. March 1, 1956. 15p. (CRLR-648)

This report presents a summary of information pertinent to the recently assigned Chemical Corp's responsibility for radioactive waste disposal. All directives of Army, NBS, AEC for burial, incineration, disposal at sea, preparation of waste for disposal, and handling of wastes are briefly summarized.

23024
EXPERIENCES AND OBSERVATIONS OF THE WASHINGTON STATE DEPARTMENT OF HEALTH ON PROBLEMS ASSOCIATED WITH THE DISPOSAL OF RADIOACTIVE WASTES. Emil C. Jensen and Robert L. Stockman (Washington State Dept. of Health). p.2856-65 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

Waste disposal problems confronting the health department and the program by which the health department is guided are discussed. (C.J.G.)

SURVEYS AND BIBLIOGRAPHIES 8.06

U.S. – GENERAL 8.06.06

2410 CF-55-8-97
Oak Ridge National Lab., Tenn.
THE IMPACT OF RADIOACTIVE WASTE DISPOSAL ON CHEMICAL PROCESSING. Conrad P. Straub and E. G. Struxness. Aug. 15, 1955. 16p. Contract W-7405-eng-26. $3.30(ph OTS); $2.40(mf OTS).

An attempt was made to bring to attention the need and desirability of reconsidering and reexamining fuel element construction, reactor operation techniques, chemical processing procedures, and waste disposal practice now in use to produce less hazardous and toxic waste effluents. Pre-treatment for the removal of some of the longer-lived materials such as Sr^{90} and Cs^{137} is also pertinent. (auth)

23007
STATEMENT ON INDUSTRIAL PARTICIPATION IN WASTE DISPOSAL. p.2483-87 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

Waste disposal activities are divided into two categories, long term problems of custodial care and protection of the public and activities in which there is no long term problem. Hazards arising in both categories are discussed. (C.J.G.)

21706
SUMMARY OF RESEARCH AND DEVELOPMENT WORK CONDUCTED FOR THE U. S. ATOMIC ENERGY COMMISSION. Department of Sanitary Engineering and Water Resources, Johns Hopkins Univ., Baltimore. p.1673-1723 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

A summary of research and development work for the United States Atomic Energy Commission on contamination by radioisotopes, disposal practices of atomic energy installations, methods for the fixation of radioisotopes on or in solid media, and sites for future radioactive waste disposal is presented. (C.J.G.)

21664
RADIOACTIVE WASTE MANAGEMENT OPERATIONS AT THE HANFORD PLANT. H. M. Parker (General Electric Co., Richland, Wash.). p.171-98 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

The radioactive waste generated from the principle operations of the plant is enumerated. Management of the waste products is discussed. (C.J.G.)

PRINCIPALS AND RECOMMENDATIONS RELATING TO WASTE DISPOSAL. G. W. Morgan. p.7-16 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)

This paper describes methods of waste disposal used within the Atomic Energy Commission. Methods employed include disposal by dilution; incineration; concentration by ion exchange adsorptions on clays and distillation; confinement by storage in tanks, burial in soil and disposal in the ocean.

0015
RADIOACTIVE WASTE DISPOSAL FOR THE SMALL ISOTOPE USER. Herman Cember (Univ. of Pittsburgh). Am. Ind. Hyg. Assoc. Quart. 17, 89-91(1956) Mar.

21669
RADIOACTIVE WASTE MANAGEMENT OPERATIONS AT THE HANFORD WORKS. PART 5. DISPOSAL OF INTERMEDIATE AND LOW-LEVEL WASTES TO THE GROUND. D. W. Pearce (General Electric Co., Richland, Wash.). p.308-18 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Intermediate and low-level waste from Hanford is disposed to swamps, cribs, and trenches. To ensure containment of the radioisotopes on the soil column, various waste streams from the plant are kept separate. Standards on the disposal of radioactive liquids are given. (C.J.G.)

21673
STATEMENT OF PHILLIPS PETROLEUM CO. AS OPERATOR OF THESE FACILITIES UNDER CONTRACT WITH THE ATOMIC ENERGY COMMISSION RE WASTE MANAGEMENT OPERATIONS PROGRAM ON THE COLLECTION, HANDLING, PROCESSING AND DISPOSAL OF WASTE MATERIALS AT THE IDAHO CHEMICAL PROCESSING PLANT, MATERIALS TESTING REACTOR AND ENGINEERING TEST REACTOR. p.610-14 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Liquid, solid, and gaseous waste processing programs for the Idaho Chemical Processing Plant, the Materials Testing Reactor, and the Engineering Test Reactor are presented. (C.J.G.)

U.S. - GENERAL 8.06.06

21679

WASTE MANAGEMENT OPERATIONS AT BROOKHAVEN NATIONAL LABORATORY. F. P. Cowan and L. Gemmell. p.744-67 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

A flow diagram is presented which illustrates the major features and interrelationships of the waste control system. Gaseous, liquid, and solid wastes are discussed separately. Methods of processing solid wastes for local and sea disposal are covered. (C.J.G.)

21680

RADIOACTIVE WASTE MANAGEMENT AT THE KNOLLS ATOMIC POWER LABORATORY. p.768-811 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Waste processing and disposal methods for solids, liquids, and gases are given. Facilities and procedures used in conjunction with waste disposal are discussed. Annual operating costs for 1958 are presented. A description of radiation monitoring in all phases of the waste disposal program is presented. (C.J.G.)

21681

RADIOACTIVE WASTE DISPOSAL PRACTICES AT LOS ALAMOS. C. W. Christenson. p.812-25 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

The methods of control and containment of radioactive wastes are taken up in the order of solids, liquids, and airborne wastes. (C.J.G.)

21683

RADIOACTIVE WASTE DISPOSAL AT LAWRENCE RADIATION LABORATORY. Nelson B. Garden (Univ. of California, Berkeley). p.842-3 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Radioactive waste disposal problems in handling, processing, and storage are presented. (C.J.G.)

21684

WASTE MANAGEMENT AT THE APPR-1. p.876-89 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

The Army Package Power Reactor I has operated successfully for 20 months. An environmental monitoring program has been in effect since the pre-construction period to ensure that there is no increase in radioactivity in the area. Effluent monitors provide a control for the discharge of gaseous wastes to the atmosphere and liquid wastes to the Potomac River. All gaseous wastes to date have been vented to the atmosphere. Liquids, the greatest contributor to the radioactive wastes, have been collected and discharged safely to the river. Solid wastes are accumulated irregularly and are disposed of by approved methods. (auth)

21686

RADIOACTIVE WASTE DISPOSAL AT THE BETTIS PLANT. p.900-23 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

All of the liquid, solids, and airborne radioactive wastes, generated at the Bettis Plant, are collected, monitored, processed, and disposed of in accordance with prescribed limits and procedures. If the concentration of radioactivity in the liquid is below specified limits, the water is dumped to the storm sewer and is discharged with the other water effluent from the plant. Waste which exceeds specified limits of radioactivity is processed. Processing consists of concentration, filtration, or ion-exchange. The radiation intensity of solids varies between a fraction of a mr per hour on surface-contaminated solids to several hundred r per hour. All solid radioactive wastes can be classified as combustibles or non-combustibles. Radioactive combustibles are reduced to ash in a specially designed incinerator and sent to sea for burial. Radioactive non-combustible wastes are sealed in concrete inside 55-gallon drums and sent to the ocean for burial. The discharge of air which might contain radioactive dusts, fumes, and mists from plant processes is carefully controlled. Wet collectors, electrostatic precipitators, high efficiency filters, and various dry filter media are used to remove the radioactive particulates from the air before it is discharged to the atmosphere. Discharges of air are sampled on a routine basis. (auth)

WASTE CHARACTERISTICS 8.06.07

11438 CF-59-1-106
Oak Ridge National Lab., Tenn.
NATURE OF RADIOACTIVE WASTES. F. L. Culler, Jr. Jan. 26, 1959. 27p. Contract [W-7405-eng-26]. $4.80 (ph), $2.70(mf) OTS.

The integrated processes of nuclear industry are considered to define the nature of wastes. Processes for recovery and preparation of U and Th fuels produce wastes containing concentrated radioactive materials which present problems of confinement and dispersal. Fundamentals of waste treatment are considered from the standpoint of processes in which radioactive materials become a factor such as naturally occurring feed materials, fission products, and elements produced by parasitic neutron capture. In addition, the origin of concentrated fission product wastes is examined, as well as characteristics of present wastes and the level of fission products in wastes. Also, comments are included on high-level wastes from processes other than solvent extraction, active gaseous wastes, and low- to intermediate-level liquid wastes. (J.R.D.)

10523 CF-58-4-45
Oak Ridge National Lab., Tenn.
MANUAL FOR THE PREPARATION OF SIMULATED FUEL REPROCESSING WASTE SOLUTION. William J. Lacy. June 20, 1958. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Preparation of synthetic wastes from the processing of aluminum-clad natural uranium, aluminum-enriched uranium alloy, zirconium-uranium, stainless steel-UO_2, and stainless steel-UO_2-MgO fuel elements is described. These preparations will be used in waste disposal studies. (auth)

10525
CHARACTERISTICS OF REACTOR FUEL PROCESS WASTES. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 44, Session 16. J. O. Blomeke, E. D. Arnold, and A. T. Gresky (Oak Ridge National Lab., Tenn.). New York, American Institute of Chemical Engineers, 1958. 14p.

The various types or high-level radioactive liquid wastes currently produced as effluents from reactor fuel processing plants are reviewed. Wastes expected from processes under development for power reactor fuels are also discussed. The wastes are characterized according to their chemical compositions, physical properties, and fission product activity levels. (auth)

21662
NATURE OF RADIOACTIVE WASTES GENERATED BY PROCESSING SPENT REACTOR FUEL AT THE IDAHO CHEMICAL PROCESSING PLANT. p.135-9 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

Spent fuel from reactors is dissolved in acid, and usable fissionable material is recovered by a three-stage liquid-liquid extraction process. The remaining solutions, containing fission products and dissolved metals, are highly radioactive (1500 c/gal) and must be stored. 750,000 gallons of such waste have been placed in storage. The chemical compositions, isotopic compositions, and activities of the solutions are tabulated. (C.J.G.)

21663
NATURE OF WASTE FROM RADIOISOTOPE USES. Lester R. Rogers (U. S. Atomic Energy Commission, Oak Ridge, Tenn.). p.140-59 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

The Commission's primary radioisotope supplier, ORNL, ships active isotopes to 4400 institutions in the U. S. for use in medicine, industry, agriculture, and research. These shipments represent 437,000 curies of radioactivity. At this rate, it is estimated that 100 to 200 curies of waste with a half life greater than 30 days and 400 to 500 curies with a half life less than 30 days are being generated. This amount of waste is exceedingly small when compared with that from the national nuclear energy program. (D.E.B.)

FUTURE PROBLEMS 8.06.08

9352
WHAT IS SAFE WASTE DISPOSAL? Wallace de Laguna (Oak Ridge National Lab., Tenn.). Bull. Atomic Scientists 15, 35-43(1959) Jan.

The nature of radioactive wastes and their hazards is considered, and present and future methods of disposal are discussed. It is concluded that in the forseeable future the cumulative effect can lead to serious contamination of large sections of the globe. Even without genetic damage the ~~potential~~ hazard is considerable.

SURVEYS AND BIBLIOGRAPHIES 8.06

FUTURE PROBLEMS 8.06.08

Present practice is satisfactory for present needs. The problem of locating waste processing plants close to power reactors versus sites close to waste disposal areas is discussed. (T.R.H.)

See also, under SURVEYS (GENERAL),

FUEL CYCLE--General (7.03.03).

3253

RADIOACTIVE WASTE MATERIALS. I. THE ORIGIN OF RADIOACTIVE WASTE MATERIAL. H. J. Wervers. Atoomenergie 1, 161-6(1959) Oct. (In Dutch)

A survey is given of the origin and magnitude of the radiowaste problem. The quantity of fission products to be expected in the future was discussed more fully. Consideration was also given to activation products. (tr-auth)

11437 CF-59-1-38

Oak Ridge National Lab., Tenn.

WASTE TREATMENT AND DISPOSAL PROBLEMS OF THE FUTURE NUCLEAR POWER INDUSTRY. F. R. Bruce. Jan. 28, 1959. 15p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

The elements of waste treatment and disposal are assessed which are expected to become important in the development of the nuclear power industry of the future. Growth of the nuclear power economy is considered along with composition and quantities of anticipated waste. In addition, the economic implications of waste disposal are considered. It is concluded that research should be concentrated on decontaminating off-gases and on conversion of wastes to a more suitable form than liquid for storage. (J.R.D.)

WASTE MATERIALS IN THE UNITED STATES ATOMIC ENERGY PROGRAM. Abel Wolman and Arthur E. Gorman. Jan. 12, 1950. 20p. (WASH-8). Dep. Lib.

A review of the problem of disposal of waste containing radioactive materials is presented. The problem is discussed as being analogous to other problems of industrial waste disposal. Possibility of radioactive materials becoming dangerously concentrated in algae of streams and in sewer systems is indicated. It is noted that no gaseous material containing radioactivity may be released to the atmosphere. It is concluded that the future growth of this new industry from the developmental stage to that of applied use of its products may well hinge on its ability to find increasingly effective and reasonably economical methods of disposal of its hazardous waste products. 23 references.

EFFECT OF RADIOACTIVITY ON THE BIOCHEMICAL OXIDATION OF DOMESTIC SEWAGE; FINAL REPORT. William E. Dobbins, Gail P. Edwards, Werner N. Grune, and Richard Ehrenreich. Oct. 1951. 84p. (NYO-1567). Dep. Lib.

This study has been devoted to the effect of P^{32} and I^{131} on the course of the biochemical oxidation of fresh domestic sewage. The results indicate that P^{32} exerts no measurable effect with initial activity levels of 0.1 and 1.0 mc/l but effects a very small reduction in the rate of oxygen utilization at the 10.0 mc/l level. The presence of I^{131} with initial activities of from 0.01 to 10.0 mc/l appears to produce a decrease in the rate of oxygen utilization, which results in a reduction in the total oxygen demand of about 10% by the seventh day.

VOLUME REDUCTION 8.07

See also, these processes, under

PROCESS CHEMISTRY AND ENGINEERING.

MODERN METHODS FOR THE CONCENTRATION, NEUTRALIZATION, AND STORAGE OF RADIOACTIVE WASTE. II. Viktor Iwanowitsch Spitsyn (Mitglied der Akademie der Wissenschaften der UdSSR, Moscow). Prak. Chem. 10, 128, 130, 133-4 (1959) Apr. (In German)

The review of the methods used by various nuclear energy installations to process and store radioactive wastes is concluded. The results of studies on the absorption of fission products by the soil are reported. Radioactive gases and aerosols are briefly discussed. 36 references. (J.S.R.)

VOLUME REDUCTION 8.07

MODERN METHODS FOR THE CONCENTRATION, NEUTRALIZATION, AND STORAGE OF RADIOACTIVE WASTES. [PART] I. Viktor Iwanowitsch Spitsyn (Akademie der Wissenschaften der UdSSR, Moscow). Prak. Chem. 10, 86, 88, 91-6, 98(1959). (In German)

A review is presented on the methods used by various nuclear energy installations to process and store radioactive wastes. The chief fission products and the sources of waste are discussed. The processing of both liquid and solid wastes is considered. (J.S.R.)

NUCLEAR-REACTOR WASTES FROM SMALL POWER REACTORS. A. L. Medin. Ind. Wastes 1, 278-81, 1956.

Methods for reducing the quantity of radioactive wastes or for their dispersal are discussed.

21678

MANAGEMENT OF RADIOACTIVE WASTE AT ARGONNE NATIONAL LABORATORY. p.708-43 of "Hearings on Industrial Radioactive Waste Disposal. Volume 1."

The radioactive waste disposal system is described. No wastes are stored permanently on the site and all fluid wastes are reduced to solids to be shipped off-site. Cost and safety measures of the system are explained. (C.J.G.)

CALCINATION 8.07.01

See also, under PLANTS AND EQUIPMENT,

CALCINERS (5.02).

SURVEY ON THE MEASUREMENT OF THERMAL CONDUCTIVITY OF SOLIDS PRODUCED BY EVAPORATION AND CALCINATION OF SYNTHETIC FUEL REPROCESSING SOLUTIONS. H.W. Goodbee and J. T. Roberts. (ORNL-2769) Aug. 10, 1959.

Heat problems, waste disposal, evaporation, calcination survey.

13992 IDO-14462

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

DESIGN BASES FOR ICPP WASTE CALCINATION FACILITY. D. K. MacQueen and J. I. Stevens. Apr. 22, 1959. 22p. Contract AT(10-1)-205. $0.75 (OTS).

A demonstrational, semi-works scale, waste calcination unit is being constructed at the Idaho Chemical Processing Plant. This unit will convert the fission product-containing aluminum nitrate solutions now being stored in underground stainless steel tanks to granular alumina and fission product oxides. This change in phase of the wastes, and the concomitant reduction in volume, may result in significant reductions in waste storage costs and increase radiological safety during the long storage period required for decay of the fission products. The facility has been designed as a 60 gallon per hour semi-works unit to permit evaluation of the process in full-scale equipment. The potential reduction in the quantity of ICPP liquid wastes in storage is, however, an important objective of this unit. The process design was based primarily on laboratory and pilot plant studies made at both the Idaho Chemical Processing Plant and the Argonne National Laboratory. The basic process is the injection of the waste solutions into an air-fluidized bed maintained at 400°C. The water and nitric acid in the feed appear in the overhead off-gas stream; the aluminum and fission product nitrates decompose to the corresponding solid oxides and are continuously withdrawn as a bottoms product. The solid product will be pneumatically conveyed to air-cooled underground bins for retention. The off-gas will be cleaned and released to the atmosphere. (auth)

8316 IDO-14484

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

VENTURI SCRUBBER EVALUATION FOR WASTE CALCINATION OFF-GAS FACILITIES. B. R. Wheeler. Dec. 18, 1959. 26p. Contract AT(10-1)-205. OTS.

Development studies concerned with treatment of off-gas from the waste calcination facilities currently being installed at the Idaho Chemical Processing Plant are described. Fission products contained in dust from the calciner make an essentially 100 per cent gas-solid separation mandatory. Calcination conditions determine the size and concentration of solids in the off-gas. Data from the evaluation of Venturi scrubbers on a pilot plant calciner show

VOLUME REDUCTION 8.07

CALCINATION 8.07.01

that all but 1.6×10^{-3} grains of solids per cubic foot of gas can be removed. The tests with a Venturi scrubber independent of the cold calciner indicate that a gas containing only 7.5×10^{-5} grains of solids per cubic foot of gas may be attained at the expense of 18 inches Hg pressure drop across the Venturi scrubber. Evaluation of Venturi scrubber data indicated that scrubbing efficiency is principally dependent upon over-all pressure drop, rather than upon high scrub volume in relation to aerosol volume in itself. (auth)

20633

DEVELOPMENT STUDIES ON THE SOLIDIFICATION OF RADIOACTIVE WASTE BY FLUID BED CALCINATION. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-48. J. W. Loeding, E. L. Carls, and A. A. Jonke (Argonne National Lab., Lemont, Ill.). New York, Engineers Joint Council, 1959. 14p. $0.50.

Recent experimental results on the calcining of radioactive waste by the use of a fluidized bed technique are presented together with conclusions and a brief description of the process and equipment. Particular emphasis is placed on clean-up of volatile ruthenium and nonvolatile particulate from the calciner off-gas. (auth)

5108 IDO-14446

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

ATTRITION TEST ON CALCINED IDAHO CHEMICAL PROCESSING PLANT WASTE. Paul N. Kelly. Dec. 1, 1958. 6p. Contract AT(10-1)-205. $0.50(OTS).

An attrition test made on calcined simulated Idaho Chemical Processing Plant waste showed an excessive fines build-up. Calcine below 60 Tyler mesh increased from 2.5 to 19.1 percent in a 189-day test. The calcine was circulated in a manner to approximate a proposed cooling scheme. (auth)

Metallic Corrosion during Calcination of Radioactive Wastes, E. J. Tuthill and R. F. Domish, Ind. and Eng. Chem., 51, 12, p.1471, Dec. 1959.

12239 BNL-535

Brookhaven National Lab., Upton, N. Y.

CALCINATION OF HIGH LEVEL ATOMIC WASTES AS A STEP IN ULTIMATE DISPOSAL. R. F. Domish, E. J. Tuthill, and L. P. Hatch. Dec. 1958. 14p. $0.50 (OTS).

Safe and permanent disposal of high-level wastes includes two basic objectives: immobilization of the fission products by incorporation in stable solids, and reduction of the stored product to the minimum practical volume. Calcination is a desirable first step in the processing of radioactive waste solutions containing relatively large amounts of aluminum nitrate and zirconium fluoride because thermal decomposition and steam hydrolysis convert these substances to insoluble solid oxides which, after a preliminary leaching to remove the unfixed portion of the activity are suitable for burial. Over the past four years a calcining apparatus of the rotary ball kiln type with dust controlled by condensa-

CONVERSION OF LIQUID WASTES TO SOLIDS. Nuclear Energy Engr. 12, 430-3(1958) Dec.

A method for the conversion of liquid wastes to solids, which makes use of the process of fluid-bed calcination, is described. The calciner consists of a cylindrical vessel containing a bed of granular oxide, consisting of the product obtained from the evaporation and calcination of the waste solution. For aluminium-nitrate-bearing waste, the granular bed would consist of aluminium oxide together with other minor constituents including fission product oxides. The bed could consist of almost any inexpensive, inert, porous solid for wastes of low solid content. In order to study the process, a unit was constructed at Argonne National Laboratory for semi-remote operation. The unit was designed to use diluted radioactive waste, and is capable of handling about 100 curies of 1 Mev gamma radiation. A schematic of the facility is shown. (J.H.M.)

CHEMICAL ENGINEERING DIVISION SUMMARY REPORT FOR APRIL, MAY, AND JUNE, 1955. July 27, 1955. Decl. Feb. 7, 1957. 92p. Contract W-31-109-eng-38. (ANL-5466)

Studies of the calcination of reactor fuel processing wastes are given on p. 81-5. Information includes data on operating conditions for waste calcination runs and the effect of variations of Al_2O_3 particle size in waste calcination runs. Both bench scale and pilot scale experiments were run.

VOLUME REDUCTION 8.07

CALCINATION 8.07.01

10838 BNL-510
Brookhaven National Lab., Upton, N. Y.
STUDY OF CORROSION ON VARIOUS METALS IN THE CALCINING OF AQUEOUS RADIOACTIVE WASTES CONTAINING ZIRCONIUM FLUORIDE AND ALUMINUM NITRATE AS BULK SALTS. E. J. Tuthill and R. F. Domish. May 1958. 48p. $1.50(OTS).

The calcination of bulk salts of Zr and Al in high level radioactive wastes to their stable oxides is a logical step toward ultimate disposal. The outstanding objectives here are to achieve maximum chemical stability and minimum volume. Since Zr wastes contain the bulk salts zirconium fluoride, aluminum fluoride, and aluminum nitrate, the calcination which requires temperatures up to 700°C obviously presents a serious problem with respect to corrosion of the container materials. The present study was undertaken for the purpose of measuring the resistance of certain selected materials to the corrosive conditions encountered in the calcination of simulated Zr waste solutions in rotary ball kilns. Two separate investigations were made: the first centered on the use of two kilns in series, and the second involved a single kiln. The purpose of using two kilns in the first investigation was to separate the oxides of nitrogen from the hydrogen fluoride in the off-gases. Denitration was accomplished largely in the first kiln at temperatures below 400 and defluorination in the second kiln at temperatures above 700°C. The second investigation involving a single-kiln unit was made because several alloys had alrady shown favorable resistance to conditions encountered in the high temperature (defluorination) unit of the double-kiln apparatus. Results of the study indicated that no advantage with respect to corrosion was realized by using the double-kiln apparatus, and that with either the single unit or the double unit design at least four alloys are probably suitable as materials of construction for calciner vessels. (auth)

REPORT OF WORKING MEETING ON FIXATION OF RADIOACTIVITY IN STABLE, SOLID MEDIA AT THE JOHNS HOPKINS UNIVERSITY JUNE 19-21, 1957. March 1958. 102p. (TID-7550)

The following papers were presented: Waste Characteristics Governing Fixation in Soils; Chemical Processing of the Alumina Fluid Calciner Product into Alumina Silicates; Fixation of Fission Products in Stable Compounds; Résumé of Ceramic Section of the Oak Ridge National Laboratory; Fixation of Fission Products in Ceramic Glazes; Fission Product Disposal in Glass; Leaching Studies on Fired Clays Containing Radionuclides; Evaluation of Experimental Clinkers; Fixation of Active Wastes in Solid Form Using Natural Soils as Media for Glass Formation; Separation of Cs and Sr from Calcined Metal Oxides as a Process in Disposal of High Level Wastes; Fixation of Radioisotopes on Hanford Type Soils; Tests of Stability; Calcination of Aqueous Reactor Fuel Wastes in a Fluidized Bed; Experiments on Fluidized Bed Calcination of Idaho Chemical Processing Plant Wastes Using Radioactive Feed Material; Preliminary Design of Fluidized Bed Calciner for Idaho Chemical Processing Plant Wastes; Ball Kiln Calcination of Alloy Fuel Element Wastes; Incorporation of Fission Products Into Glass; Ultimate Disposal of Long-Lived Fission Products; High-Temperature Gas Cleaning Problems; Heat Evaluation and Dissipation; Problems Associated with the Formation of Ceramic Clinkers; and Storage of Reactor Fuel Wastes in Salt Formations.

21653
USE OF SILICATES IN THE REFINING OF HIGHLY ACTIVE WASTES. J. Beranek and K. Lustig. Sklar a keram. 8, 102-6(1958). (Translated from Referat. Zhur. Khim. No. 24, 1958, Abstract No. 82338.)

A study of possiblities of radioactive isotopes conversion from the liquid into the solid phase is presented. Stability of the inorganic ion exchange materials (mainly morillonites and bentonites) is such that upon calcination, an irriversible fixation of cations occurs. Such products, when saturated with the radioactive ions, are not subject to decomposition and may be safely stored. However, the clays have low exchange capacities (not greater than 100 mg/equiv for 100 g of ionite), and they do not adsorb ruthenium. A great portion of the processed solutions contain considerable concentrations of HNO_3, that destroys the structure of clays and lowers their ion exchange characteristics. **The inorganic ion exchange materials may be employed in those cases when it is necessary to decontaminate the already separated isotopes of Cs and Sr, or to utilize ionites, saturated with radioactive isotopes as the source of irradiation. Laboratory and pilot plant work indicated the possibility of effective utilization of silicates for the fixation of active material. The method consists in the mixing of active wastes with the silicates followed by drying and calcining. (auth)**

VOLUME REDUCTION 8.07

CALCINATION 8.07.01

DEVELOPMENT OF A WASTE CALCINER. Progress Report on WASTE PROCESSING DEVELOPMENT PROJECT. B. Manowitz and S. Zwickler. Apr. 1957. 11p. (BNL-447)

The work of the Waste Processing Development Project at BNL has led to the development of a piece of equipment capable of substantially reducing the volume of high activity aqueous waste streams. This equipment, known as a "continuous calciner," is a heated-tube auger-agitated concentrator which dehydrates and fuses the various aqueous salt solutions to an anhydrous free-flowing melt on a continuous basis. A pilot plant model of this equipment has been operated successfully with an attendant decontamination factor of ~1000. The corrosion rate of mild steel in neutralized solutions and in the fused salt product was studied. No corrosive effects were detected, which indicated that mild steel is a safe storage container material. An economic evaluation was also made to compare relative costs of processing and storing an acid waste solution in a raw, neutralized, or anhydrous state

RECOVERY OF FISSION PRODUCTS FROM CALCINED FIRST CYCLE SOLVENT EXTRACTION WASTES. E. S. Grimmett. June 26, 1956. 28p. (IDO-14408; PTR-86)

A study of the fission products present in reactor fuel wastes indicate that at a calcination temperature of 400°C, the long-lived radioactive elements such as Sr^{90}, Cs^{137}, Pm^{147}, and Ce^{144} will remain with the inert calcined portion of the fuel. This study also indicates that if these calcined solid wastes were leached with suitable reagents a rough separation of valuable fission products could be achieved with a minimum of process equipment. For example, if 120-day cooled MTR element first cycle waste is calcined at 400°C, a cold water leach of this material would extract a mixture of fission product oxides, which when evaporated to a solid would have a specific γ activity of 20.5 c/g of oxides.

14384 BNL-381
Brookhaven National Lab., Upton, N. Y.
CALCINING OF WASTES; PROGRESS REPORT ON WASTE PROCESSING DEVELOPMENT PROJECT.
S. Zwickler and B. Manowitz. Jan. 1956. Decl. June 8, 1959. 15p. $3.30(ph), $2.40(mf) OTS.

The calciner concept of waste processing is based on the idea of incorporating into radiochemical waste solutions a salt that melts at a reasonable temperature, has an appreciable fluid range, and is not too viscous. This salt serves as a transport fluid for fission products after the original fluid, water, has been removed. $NaNO_3$ was found to be such a salt. Its melting point is 585°F, it flows as freely as water, and remains fluid up to 700°C. Experimental work is described on the treatment of the acid aluminum, STR, and SIR wastes by calcining. In these experiments, acid waste solutions were fed, either raw, in a neutralized state, or in an alkaline state, to a calcining apparatus. After dehydration in the calciner, the apparatus discharged either a molten salt solution or a dry salt powder. The chemistry of the process and equipment used in the pilot plant calciner is described. Results are tabulated. Results are also reported from a study of the corrosion of 1020 mild steel, 304 SS, and 347 SS by neutralized and dehydrated samples from a number of waste streams. A cost analysis was made for processing Arco Chemical Plant wastes by various methods. Spray drying was investigated as a means of converting aqueous Arco waste solutions into dry, relatively insoluble powders. (C.H.)

CHEMICAL 8.07.02

6069
A METHOD FOR TREATING RADIOACTIVE NITRIC ACID WASTES USING PARAFORMALDEHYDE. Warren H. Adams, Eric B. Fowler, and C. W. Christenson (Los Alamos Scientific Lab., N. Mex.). Ind. Eng. Chem. 52, 55-6(1960) Jan.

A method for treating radioactive nitric acid wastes with paraformaldehyde (HCHO) is described. The method is direct and the products, carbon dioxide, water, and oxides of nitrogen, can be exhausted through filters to the atmosphere. The reaction is not violent and can be controlled by the rate of addition of HCHO. Experimental results on a waste solution, 8 N in HNO_3 with 400 ppm of iron, and a molecular ratio of HNO_3 to HCHO of 1.7 to 1, indicate a reduction of 40% in the final volume. (C.J.G.)

PROPERTIES OF NEUTRALIZED AND CONCENTRATED AQUEOUS WASTE — LOW ACID FLOWSHEETS TBP-HW-NO. 4 AND NO. 5. M. H. Curtis, M. K. Harmon, and V. R. Cooper. July 18, 1950. Decl. Apr. 4, 1957. 13p. (HW-18404(Rev.))

In order to determine the maximum reduction in waste volumes that may be realized after neutralization of RAW, an experimental determination of freezing point versus degree of concentration is required. The ability of the plant to handle and transfer the wastes of the desired degree of concentration requires information on such physical properties as pH, density, viscosity, and heat capacity.

VOLUME REDUCTION 8.07

CHEMICAL 8.07.02

First Step in Ultimate Waste Disposal: Concentrating Fission Products. L.P.HATCH, W.H.REGAN, JR. Nucleonics 13, 12, Dec 1955, p 27-9.

Reference made to 500-Mw reactor which yields about 1 lb per day of fission products; only part of these are long lived, separating fission products from bulk wastes is essential pre-treatment before attempting final fixation; methods of doing this for wastes from unalloyed, and Al- and Zr-alloyed fuels; equipment design and plant layout diagram.

10524 WAPD-CDA(AD)-383
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
BATCH TREATMENT PROCEDURE FOR WASTES CONTAINING CHROMATE AT INHIBITOR CONCENTRATIONS. R. Lloyd. [195?]. 26p. [Contract AT-11-1-GEN-14.] $4.80(ph OTS); $2.70(mf OTS).

A study was made of the parameters involved in the reduction-flocculation procedure for treating chromate-bearing wastes and optimum parameters were established for batch treatment of wastes containing as high as 1000 ppm chromate ion as potassium chromate effecting a reduction of CrO_4^{2-} to 0.05 ppm and Cr^{3+} to 1.0 ppm. A detailed waste treatment procedure was outlined, which is applicable over the entire range of chromate concentration in the chromate-inhibited systems of the PWR plant at Shippingport. (auth)

3591 AEC-tr-3513
VOLUME CHANGES DURING NEUTRALIZATION. J. J. Saslawsky, E. G. Standel, and W. W. Towarow. Translated by K. S. Bevis (Savannah River Lab.) from Z. anorg. u allgem. Chem. 180, 241-51(1929). 12p.

The volume change which occurs during neutralization of acid and base solutions was experimentally determined in the five systems $KOH-CH_3COOH$, $NaOH-CH_3COOH$, $NaOH-HNO_3$, NH_3-HNO_3, and $NaOH-H_2SO_4$ at different concentrations and with various precentages of the components. (W.L.H.)

14413
TREATMENT OF AMMONIUM NITRATE SOLUTIONS. T. W. Boyer, J. G. MacHutchin, and L. Yaffe (to U. S. Atomic Energy Commission). U. S. Patent 2,838,368. June 10, 1958.

The treatment of waste solutions obtained in the processing of neutron-irradiated uranium containing fission products and ammonium nitrate is described. The object of this process is to provide a method whereby the ammonium nitrate is destroyed and removed from the solution so as to permit subsequent concentration of the solution. In accordance with the process the residual nitrate solutions are treated with an excess of alkyl acid anhydride, such as acetic anhydride. Preferably, the residual nitrate solution is added to an excess of the acetic anhydride at such a rate that external heat is not required. The result of this operation is that the ammonium nitrate and acetic anhydride react to form N_2O and acetic acid.

ELECTROLYSIS 8.07.03

See also, under PROCESS CHEMISTRY AND ENGINEERING, ION TRANSFER (MEMBRANES) (6.13).

7215 KAPL-1721
Knolls Atomic Power Lab., Schenectady, N. Y.
ELECTROLYTIC RECYCLE METHOD FOR THE TREATMENT OF RADIOACTIVE NITRIC ACID WASTE. A Status Report at the Termination of the Project at KAPL. H. W. Alter, D. L. Barney, J. K. Davidson, A. C. Schafer, Jr., and F. J. Witt. June 26, 1957. 81p. Contract W-31-109-Eng-52. $2.00(OTS).

A method is described for the treatment of radioactive neutralized nitric acid waste solutions. The process consists of electrolysis of sodium nitrate solutions and recycle of the caustic formed to neutralize incoming nitric acid waste. Removal of a large fraction of the bulk inert substances by this method allows greater reductions in waste volume than conventional treatment by evaporation alone. Process chemistry studies show that a large fraction of the nitrate ion in alkaline solution can be electrolytically reduced to gaseous nitrogen reduction products at reasonable current efficiencies. Process engineering studies have resulted in the development of a prediction equation for the design of electrolysis cells used in the process. Pilot plant studies using "cold" nitric acid waste have demonstrated the feasibility of the electrolytic recycle method. A preliminary cost estimate was performed which indicates a cost of from $2.75 to $2.95 per initial gallon of waste processed. Basis for this estimate is a conceptual design of a plant capable of handling the high-level waste produced in reprocessing one ton of uranium

metal per day. These costs are considered reasonable in a nuclear power economy, and indications are that ultimate disposal of the concentrated waste in clay may be possible. (auth)

MEMBRANE ELECTRODIALYSIS OF SIMULATED PRESSURIZED WATER REACTOR COOLANT. Paul Cohen (Westinghouse Bettis Plant, Pittsburgh). Ind. Eng. Chem. 51, 66-7(1959) Jan.

A membrane electrodialyzer can purify the coolant of a pressurized water reactor at influent concentrations as low as 0.5 to 3.0 megohm-cm specific resistance. Such a unit can be operated without difficulty at 1500 psi. Under conditions of constant flow, purification efficiency is independent of influent concentration; current efficiency decreases with decrease of influent concentration. (auth)

EVAPORATION AND DISTILLATION 8.07.04

See also, under PLANTS AND EQUIPMENT, DISTILLATION (5.07),

and,

under PROCESS CHEMISTRY AND ENGINEERING, SPECIAL PROCESSES--Diban Ion Exchange (6.17.06).

8320

VAPORIZATION AS A METHOD FOR THE DECONTAMINATION OF RADIOACTIVE WASTES. [PART] I. S. Krawczynski (Kernreaktor Bau- und Betriebsgesellschaft m.b.H., Karlsruhe, Ger.). Kerntechnik 1, 15-21(1959) July. (In German)

The preliminary research on the decontamination of radioactive aqueous concentrates with a rotary blade evaporator is described. The evaporator is sketched, and the research arrangement, results, materials, and operation monitoring are considered. (tr-auth)

8319

THE LIQUID ENTRAINMENT AND ITS REMOVAL FOR A LARGE SCALE EVAPORATION UNIT. EVAPORATION OF RADIOACTIVE LIQUID WASTE. N. Mitsuishi, S. Sakata, Y. Matsuda, and Y. Yamamoto (Atomic Energy Research Inst., Tokyo and Univ. of Tokyo). J. Atomic Energy Soc. Japan 1, 363-9(1959). (In Japanese)

A large scale evaporation unit consisting of evaporator, cyclone, and packed tower was constructed, with which studies were made of the liquid entrainment and its removal. The results obtained are as follows: (1) the decontamination factor of the evaporator lies between 10^4 and 10^5; (2) that of the cyclone is in the range of 10 to 10^2; (3) the over-all decontamination factor of the evaporation unit lies between 10^6 and 10^7; (4) the optimum vapor mass velocity in the vapor space of the evaporator is about 2000 kg/m^2hr. With this optimum vapor mass velocity, the maximum over-all decontamination factor is obtained. The results obtained by the large scale evaporation unit were compared with that obtained by the small scale evaporation unit. (auth)

8321

VAPORIZATION AS A METHOD FOR THE DECONTAMINATION OF RADIOACTIVE WASTES. [PART] II. S. Krawczynski (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.). Kerntechnik 1, 60-6(1959) Aug. (In German)

Typical evaporators used in the decontamination of radioactive wastes are described with a discussion of the pot evaporator, the Robert evaporator with a thermosyphon system, a modified Vogelbusch evaporator, and a forced circulation evaporator. Methods for the reduction energy and operating costs are also discussed. (J.S.R.)

16149 IGO-R/W-70

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

A REMOTELY CONTROLLED SHIELDED EVAPORATOR FOR LABORATORY USE. A. J. Howarth. [Nov. 14, 1958]. 10p. $0.25(BIS).

An evaporator is described for the concentration of, and removal of chloride from, waste liquors arising from the analysis of high activity samples. The entire unit may be assembled, operated and disassembled remotely and requires no attention other than the removal of its product. Nitric acid is also removed from active liquors during the process. The possible use of the unit for evaporation of highly active plant waste solutions is considered. (auth)

EVAPORATION AND DISTILLATION 8.07.05

19945
TREATMENT OF AQUEOUS FISSION PRODUCT SOLUTIONS. T. W. Boyer, J. G. MacHutchin, and L. Yaffe. British Patent 805,361. Nuclear Eng. 4, 324(1959) July-Aug.-Sept.

Solutions after solvent treatment to extract the uranyl nitrate and the plutonium exhibit considerable radioactivity due to the presence of fission products. As these solutions usually comprise considerable volumes, the storage problem is serious. Therefore, it is proposed to treat the solution with a carboxylic acid anhydride, such as acetic anhydride, to react with and destroy the ammonium nitrate. Subsequently, the solution can be concentrated by evaporating the liquid resulting in the fission products remaining in a small volume of acetic anhydride-acetic acid mixture.

22988
A CONCENTRATOR FOR RADIOACTIVE WASTES. Nuclear Power 4, No. 41, 107(1959) Sept.

A design is given for an evaporator which could be used to solve the problem of large-scale concentration of highly active separation plant raffinate. (C.J.G.)

4806
HIGH-PURITY EVAPORATOR FOR WASTE CONCENTRATION. T. C. Carnavos and J. W. Hagen (Griscom-Russell Co., Massillon, Ohio). Nucleonics 16, No. 2, 125-7(1958) Feb.

A remotely operated evaporator for processing radioactive material was designed which accomplishes a threefold reduction in waste volume with concentration to 70% salt content. The evaporator, with sloped sides to prevent accumulation of solids and a concentrate discharge line located at the lowest point of the bottom, has a low-vapor disengaging rate and high headroom to promote natural separation of water and vapor. The mist eliminator is capable of reducing entrainment by factors of 10^3 to 10^4. A bowed tube heating section permits scale shedding by thermal shock. (J.S.R.)

21825
IMPROVEMENTS IN OR RELATING TO EVAPORATORS. Peter Waine and Derek Edmund Abel (to United Kingdom Atomic Energy Authority). British Patent 820,424. Sept. 23, 1959.

An evaporator arrangement is described. A liquid-gas cyclone separator is located above the boiler and returns liquid to the boiler. Boiler concentrate is removed through a valve controlled by return liquid strength. The concentration sensor utilizes a radioisotope gamma source and detector. (T.R.H.)

Physical Characterization of Acidic and Neutralized Fuel Reprocessing Waste Solutions on Evaporation and Recalcination. F.M. Empson, I.R. Higgins. ORNL-2566, 1958.

Volume reduction of wastes from Purex, TBP-25, STR, Darex; SIR. CaOH neutralization better than that with NaOH.

WASTE STUDIES. p.53-6 of CHEMICAL DEVELOPMENT OF THE 25-TBP PROCESS. J. R. Flanary, J. H. Goode, A. H. Kibbey, J. T. Roberts, and R. G. Wymer. Apr. 9, 1957. Decl. with deletions Sept. 18, 1957. 72p. (ORNL-1993(Rev.)(Del.))

A discussion of the evaporation of IAW wastes is presented and laboratory corrosion data in the evaporation step using both neutralized and unneutralized simulated IAW wastes with stainless steel are listed.

13882 AECU-3791
Griscom-Russell Co., Massillon, Ohio.
FINAL REPORT ON E. I. DU PONT de NEMOURS RADIOACTIVE WASTE CONCENTRATION PROJECT. Job 10522. Theodore C. Carnavos. Oct. 15, 1956. 55p. (RT-19-56). $9.30(ph OTS); $3.60(mf OTS).

An evaporator system was developed and tested which will concentrate two types of non-radioactive wastes. The wastes were of the slurry type with an initial concentration of 32% solids and a final concentration of 70% solids by weight. Information concerning design practices for this type of evaporator, startup and operating procedures, methods of recovery from unexpected shutdown, and procedures for descaling was gained. The test waste was synthetic and not radioactive; however, the procedures were evolved for application to radioactive materials. In addition, over-all heat transfer rates as a function of temperature difference and the relationship between percent concentration and boiling point for the two wastes were obtained. (J.R.D.)

VOLUME REDUCTION 8.07

EVAPORATION AND DISTILLATION 8.07.04

933 WAPD-PWR-PMF-311
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
DESCRIPTION OF THE DECONTAMINATION ROOM WASTE EVAPORATION UNIT. [May 1956]. 5p. Contract [AT-11-1-GEN-14]. $1.80(ph OTS); $1.80(mf OTS).

An evaporator unit with auxiliaries is described which is capable of evaporating continuously an average of 50 gph of radioactive waste over a prolonged period without blowdown. The concentrate is allowed to accumulate and is finally concentrated by means of a steam coil in the evaporator chest. The thick liquor, which is 1 to 2% of the feed volume, is cooled and pumped to a drumming station where it is mixed with cement in 55 gallon drums for sea burial. (C.H.)

1773
CHEMICAL OPERATIONS WITH FISSION PRODUCT SOLUTIONS. E. Glueckauf and T. V. Healy (Atomic Energy Research Establishment, Harwell, Berks, England). Atomics 6, 370-9, 385(1955) Dec.

A number of chemical operations are described which are designed to reduce the volume and acidity of waste streams from solvent extraction plants and to remove long-lived fission products from the solutions. In general the operations include concentration by evaporation, deacidification, and separation processes for recovery of Cs^{137} and Sr^{90}. Several methods are described for each operation. (M.P.G.)

7234 CF-55-11-143
Oak Ridge National Lab., Tenn.
STUDY OF HRT-CP WASTE EVAPORATOR, ENTRAINMENT SEPARATOR, CONDENSER AND RELATED PIPING. W. L. Carter, P. S. Lindsey, and G. W. Gray. Nov. 25, 1955. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

A design check was made to determine the feasibility of making design modifications in the HRT-CP waste evaporator, entrainment separator, condenser, and related piping. (C.H.)

PRECONCENTRATION OF HIGH ACTIVITY ACID WASTE FOR THE OAK RIDGE CHEMICAL PROCESSING PLANT. J. L. Dodson. May 17, 1954. Changed from OFFICIAL USE ONLY Dec. 21, 1956. 6p. (CF-54-5-89)

A preliminary process and cost analysis for the preconcentration of the high activity waste from the Oak Ridge Chemical Processing Plant has been prepared. These data show that it is considerably cheaper to continuously evaporate the raffinate as it comes from the (1A) extraction column rather than evaporate batch wise in waste hold tanks. In addition continuous evaporation appears to be a much more attractive process. On the basis of these data it is recommended that continuous evaporation be used if preconcentration is required.

2252 AECD-3777
Brookhaven National Lab., Upton, N. Y.
PROGRESS REPORT ON WASTE PROCESSING DEVELOPMENT PROJECT. THE CONCENTRATION OF WASTE. B. Manowitz and R. Isler. Dec. 1, 1953. Decl. with deletions Dec. 2, 1955. 13p. $3.30(ph OTS); $2.40(mf OTS).

This report describes experimental and pilot plant development work and enlarges upon two schemes: the concentration of dilute waste solutions to 60 to 70% solids slurries in a batch slurry evaporator, removal of the residual water from the waste by evaporation, and fusion in the final waste container; accomplishment of the complete concentration and fusion cycle in one piece of equipment on a continuous basis. (auth)

4263 ORNL-1513
Oak Ridge National Lab., Tenn.
ORNL RADIOCHEMICAL WASTE EVAPORATOR PERFORMANCE EVALUATION, DECEMBER 1949 THROUGH DECEMBER 1950. E. M. Shank. June 26, 1953. Decl. Jan. 6, 1956. 32p. Contract W-7405-eng-26. $4.80(ph OTS); $2.70(mf OTS).

The evaporator is described briefly, the operating procedure outlined, and the effect of feed composition discussed. A description is given of the instrumentation for condensate activity monitoring and the foam-level indicator. The proposed condensate resin column layout plan is included. (L.M.T.)

EVAPORATION AND DISTILLATION 8.07.04

7235 GEL-67
General Electric Co. General Engineering Lab., Schenectady, N. Y.
UTILIZATION OF THE GROSS FISSION PRODUCTS. Progress Report No. 2 for the Period January 3, 1952 to January 14, 1953. E. L. Mincher and R. M. Lichtenstein. Mar. 20, 1953. Decl. Dec. 2, 1955. 46p. Contract W-31-109-Eng-52. (R53GL91) $0.30(OTS).

Two methods of evaporating mixed-fission-product waste process solutions to dryness are discussed. Direct evaporation under reduced pressure with some added heat was found superior to the freeze-drying method. A β source of ~50 mc was prepared by the former method and activity calculations are presented. (K.S.)

2408 CF-51-10-138
Oak Ridge National Lab., Tenn.
DESIGN CALCULATIONS FOR THE WASTE SYSTEM EVAPORATOR REBOILER WL-300, WASTE EVAPORATOR CONDENSER WL-301, AND EJECTOR EXHAUST CONDENSER WL-302. A. F. Arruzza. Oct. 16, 1951. Changed from OFFICIAL USE ONLY Oct. 3, 1956. 31p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

DEVELOPMENT OF THE FLOW SHEET FOR THE MOUND LABORATORY LIQUID WASTE EVAPORATION SYSTEM. ENGINEERING RESEARCH FINAL REPORT. G. W. Frink, R. L. Bates, and M. McEwen. Dec. 8, 1950. Changed from OFFICIAL USE ONLY July 30, 1956. 9p. (MLM-532)

The development of a flowsheet for the decontamination of radioactive liquid wastes is described. The entire liquid waste handling system is grouped and discussed under the headings: collection, neutralization, evaporation and condensation, distillate storage, instrumentation, sampling, and shielding. A drawing showing the recommended design of a large liquid waste evaporator is included.

CONCENTRATION OF RADIOACTIVE LIQUID WASTE BY EVAPORATION. G. E. McCullough. Sept. 22, 1950. Changed from OFFICIAL USE ONLY June 26, 1956. 43p. (KAPL-391)

This report reviews the progress made since this facility has been in operation, explains how the service building is operated and why it is done this way, and provides a record for reference. In order to segregate and separate Redox wastes and to prepare them for storage and future treatment, five neutralizers have been provided. The neutralizer equipment, duplicated five times in various sizes, consists of a jacketed vessel equipped with an agitor or recirculating pump, a packed column, a condenser, and a receiving tank. The function of this equipment is to remove solvent from Redox waste solution by distillation. The overhead passes through the packed column and is condensed and collected. If the distillate contains the normal solvent used in the Redox Process, it is returned to that process. If there is any other solvent, it may be removed from the system. The material remaining in the neutralizer is adjusted to the proper pH and removed for storage and future treatment. Its concentration may also be adjusted by distillation or addition of water.

2407 BNL-59
Waste Processing Committee, AEC.
CONFERENCE ON WASTE PROCESSING, [HELD AT BROOKHAVEN NATIONAL LABORATORY], MARCH 27-28, 1950. SECTION 2. EVAPORATION. Changed from OFFICIAL USE ONLY Oct. 3, 1956. 43p. $7.80(ph OTS); $3.30(mf OTS).

A process involving evaporation and de-entrainment for concentrating large volumes of slightly contaminated liquid wastes of low solid content. The requirements of such a process are that it give a concentrate which was investigated may be stored economically and a condensate sufficiently low in activity that it may be discharged directly to the sewer. The ease with which this latter requirement

5152 K-493
Carbide and Carbon Chemicals Corp. K-25 Plant. Oak Ridge, Tenn.
PILOT PLANT EVAPORATION OF UAP PROCESS WASTES J. C. Barton and G. J. Vogel. Aug. 29, 1949. Decl. Jan. 6, 1956. 13p. Contract [W-7405-eng-26]. (KLO-140). $3.30(ph OTS); $2.40(mf OTS).

Radioactive, uranium-free waste from the UAP process was concentrated by evaporation on a pilot plant scale to a volume equal to about 120% of that occupied by the metal waste processed. This concentrated process waste is a saturated solution at approximately 20°C. The maximum allowable radioactivity in solutions discharged through normal sewage channels was tentatively set at 100 disintegrations per minute per milliliter. Evaporator condensate which met this specification was produced by each of two techniques: (1) passage of the condensate from a single-effect evaporator through a cation exchange column, and (2) use of a reflux column on a single-effect evaporator. (auth)

VOLUME REDUCTION 8.07

SINTERING 8.07.05

See also, under PROCESS CHEMISTRY AND ENGINEERING, SINTERING (6.18).

8324

SELF SINTERING OF RADIOACTIVE WASTES. T. N. McVay, J. R. Johnson, E. G. Struxness, and K. Z. Morgan (to U. S. Atomic Energy Commission). U. S. Patent 2,918,717. Dec. 29, 1959.

A method is described for disposal of radioactive liquid waste materials. The wastes are mixed with clays and fluxes to form a ceramic slip and disposed in a thermally insulated container in a layer. The temperature of the layer rises due to conversion of the energy of radioactivity to heat boiling off the liquid to form a dry mass. The dry mass is then covered with thermal insulation, and the mass is self-sintered into a leach-resistant ceramic cake by further conversion of the energy of radioactivity to heat.

22991

FIXATION AND ULTIMATE DISPOSAL. E. G. Struxness (Oak Ridge National Lab., Tenn.). p.1852-5 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

A process of mixing radioactive waste with clay and certain common fluxes and heating the mixture to form a brick or sinter is proposed. The possibility of using heat from the decay of fission products in the waste to form the sinter is described. A design of a pilot plant for self-sintering is given. (C.J.G.)

22994

TREATMENT OF HIGH-LEVEL WASTES BY SINTERING. T. Tamura (Oak Ridge National Lab., Tenn.). p.1938-50 of "Hearings on Industrial Radioactive Waste Disposal. Volume 3."

The effect of alumina, different clay materials, and the use of boric acid as a fluxing agent in cesium retention by sinters is discussed. Strontium retention by sinters of different clay materials is also treated. (C.J.G.)

4580 AERE-C/R-1862

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE POSSIBILITY OF SELF-FIXATION OF HIGHLY ACTIVE WASTES. C. B. Amphlett. Feb. 1956. 8p. (FPSD/P-12).

This report summarizes the uses of siliceous minerals to absorb activity either by ion exchange or by firing to produce mixed silicates. It is concluded that ion-exchange methods are best suited to fairly pure active materials in solution, but that the alternative process offers promise for absorption and fixation in solid form of bulk highly active wastes containing large proportions of inactive contaminants and of acid. It may also be applicable to solid wastes and suspensions. (auth)