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OPERATIONS DIVISION

REPORT FOR MAY 1955

By

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OAK RIDGE NATIONAL LABORATORY
Operated by
CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
Post Office Box P
Oak Ridge, Tennessee

[redacted]

TABLE 1

GRAPHITE REACTOR OPERATIONS

Period 5-1-55 to 5-31-55

	This Month	Last Month	Year to Date
Total energy, Mwd	97.8	97.0	484.6
Average power, kw/operating hour	3482	3492	3491
Time operating, %	90.6	92.6	91.9
Excess reactivity, inhr	74	82	
Slugs charged	94	119	404
Slugs discharged	77	31	339
Input air temperature (av), °F	67	62.1	
Exit air temperature (av), °F	178	173.9	
Exit air filters, Δp, in. H_2O	4.8	4.7	
Canal water radioactivity, counts/min/ml	5019	4800	
Total facilities assigned, %	82	80	
Facilities in use for research, %	51	47	
Facilities in use for radioisotopes, %	25	22	
Research samples	151	149	654
Radioisotope samples	272	232	1225

GRAPHITE REACTOR

Only one slug rupture was found in May; there may be some correlation with a number of scrams which occurred just prior to the time the rupture was found. Six scrams occurred from May 23 to May 29, most of them due to instrument trouble in an experiment at Hole 11.

The PAT controller gave some trouble during the month due to a faulty relay. When the relay was replaced, the replacement relay proved to be so sensitive that it was difficult to adjust the controller. Efforts are being made to obtain a relay with the proper characteristics. A study is being made to learn why the PAT controller gets out of adjustment after operating satisfactorily for several weeks. The speed of No. 5 shim rod is now being checked each week to determine if this remains constant.

A representative from the Nalcite Corporation visited the Laboratory on May 10 and suggested that difficulties experienced with the canal demineralizer may be due to the improper design of the bottom distributor.

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES

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The blockout system is being revised so that only certain safety circuits can be blocked out at one time. In addition, a number of scram switches have been located at various areas around the reactor so that the reactor may be scrammed from several places inside the building.

A test was made by chipping three 1/8"-thick sections from the canal wall to determine how deeply the radioactivity had soaked into the concrete. Comparative gamma ray measurements on the chippings were as follows.

1/8" deep	200 mr/hr
1/4" deep	20 mr/hr
3/8" deep	2 mr/hr

It appears from this that it may be feasible to chip away about 3/8" of the canal wall and replace it with fresh concrete which could be painted or coated with some impervious material to prevent the water soaking into the concrete. This will have to await the processing of the old slugs in the canal so that the remaining material may be concentrated in the deep pit, permitting the rest of the canal to be drained.

TABLE 2

LITR OPERATIONS

Period 5-1-55 to 5-31-55

	This Month	Last Month	Year to Date
Total energy, Mwd	77.9	75.0	364.6
Average power, kw	2969	2974	2975
Time operating, %	84.6	84.1	81.2
Excess reactivity, %	2.8	3.3	
Unscheduled shutdowns, hr	3.567	9.432	23.565
Regular shutdowns, hr	34.767	23.650	169.383
Research shutdowns, hr	75.985	81.398	489.730
Inlet water temperature (av), °F	94.7	93.1	
Outlet water temperature (av), °F	110.2	109.7	
Cooling water reactivity, counts/min/ml	50,000	60,000	
Cooling water resistivity, ohms	500,000	450,000	
Fuel pieces charged	1	1	4
Fuel pieces discharged	0	1	2
Total facilities assigned, %	100	100	
Facilities in use for research, %	55	67	
Facilities in use for radioisotopes, %	25	22	
Research samples	8	17	92
Radioisotope samples	34	27	180

LOW-INTENSITY TEST REACTOR

Downtime at the LITR was again high due to a large number of shutdowns required by the experiments. The number of scrams increased considerably, and it is planned to change the Log N chamber and cable as soon as possible.

The Geneva Conference Reactor fuel element inserted on May 3 has operated without any sign of trouble and appears to be quite satisfactory.

An unusual failure in the control system occurred on May 17. After a setback, while the power was at N_L, the power suddenly began to rise. The trouble was traced to a faulty selsyn transmitter which acted as a motor to drive the log potentiometer. This happened on two separate occasions before the trouble was located. If the setback had been caused by some critical experiment, serious trouble might have resulted.

Most of the material needed for remote control of the LITR has been ordered and conduit is being installed in the Graphite Reactor building preparatory to running cable to the LITR.

RADIOISOTOPE PRODUCTION AND SALES

Radioisotope Shipments are shown below.

	May 1955	April 1955	May 1954	Since August 1946
Processed Material	950	862	846	55,501
Irradiation Units	265	209	207	14,520
Total	1215	1071	1053	70,021
Domestic	1121	986	954	
Foreign	9	10	12	
AEC Projects	85	75	87	
Total	1215	1071	1053	

Detailed radioisotope production and sales data are given in Tables 3 and 4.

Decanning operations on all irradiated Be_3N_2 slugs on hand was continued; 463 were processed, with 206 remaining to be decanned during June.

Nineteen test cans of cobalt wafers were fabricated and sent to Savannah for approval.

The rubidium content of 5000 curies of crude Cs^{137} now awaiting final purification were determined to be ~10%.

A broken agitator shaft caused a shutdown of operations in the Fission Product Semi-Works; decontamination required before repairing can be done is in progress.

Cerium-144 separated in the F.P. Semi-Works was analyzed and found to have a specific activity of 20 curies/g Ce.

Approximately 48 curies of mixed rare earths remaining after Ce^{144} separation are being processed to produce Pm^{147} and Eu^{155}. The $Eu^{155}:Eu^{152,154}$ ratio will be determined on the Eu^{155} product.

The Kr^{85} purification system was completed, but it was found that three, of four cylinders of crude Kr^{85} gas shipped from Arco were empty. Examination of the valves showed that the Teflon valve seats had disintegrated, apparently as a result of irradiation. The fourth cylinder has the valve frozen shut and preparations are being made to drill through the valve seat to salvage the 300 curies of Kr^{85} contained in the cylinder.

Approximately 400 curies of cesium-137 was fabricated into the form of pelleted sources ranging in activity from 5 curies to about 100 curies. All of this material has been sold and there are orders for additional sources.

A letter has been received from the AEC approving and permitting us to go ahead with the carbon-14 compound sale. Mailing lists are being made up of those people who desire to receive bid forms. The bid form itself will be reproduced and distributed during the first two weeks of June. It is hoped that the sale will be finished by August 1.

Information and approval have been requested for the insertion of cobalt wafers 1 centimeter in diameter into the MTR to obtain Co^{60} with a specific activity of approximately 20 curies per gram. There is occasional extra space in the reactor in which miscellaneous cans could be placed, and Phillips Petroleum Company has therefore been requested to specify the number of cans that can be handled, as well as the dimensions of such cans.

A partial shipment of cobalt wafers has been received from Kulite Tungsten Company and it is hoped that the balance of the material will be received in time to fabricate and load cans for insertion in the Savannah River reactors during June.

New shipping documents, modified to fit into the IBM system, were received during the month and put into use. During June it will be possible to make a sample monthly report which can be checked against our usual report. Account descriptions have been written and forwarded for official approval.

A decision has been made to issue the new radioisotope catalog without waiting for changes in the AEC's method of licensing users or for completion of their study on radioisotope pricing. A study is being made by the Operations Division to price certain processed materials which will be offered routinely for the first time. The Isotopes Division, Oak Ridge, has informed us that they would be in a position to approve interim prices.

Approval was requested for the use of 3 tons of depleted uranium in shipping containers for radioactive materials. This would provide enough shielding for approximately 6 containers. The over-all weight saving on these containers could result in approximately 50% savings in transportation cost to our customers.

The Reactor Department has designed a new antimony-beryllium source utilizing 10-mil thick stainless steel as an outer covering, and with a slightly different size to permit irradiation in the LITR. The amount of antimony and beryllium remains the same as in our standard source. A flux of approximately 10^7 neutrons per second is anticipated from the source after irradiation in the LITR.

RADIOISOTOPE DEVELOPMENT

A 100-millicurie Cd^{109} source was fabricated by plating the radioisotope onto a 0.5-cm diameter Pt disc. The surface will be covered by evaporated SiO_2, using a method described in the Appendix of this report. The X-ray output will be measured by the Health Physics Division, after which it will be used for research by ORINS Medical Division.

Iodine-129 was obtained from W $AgNO_3$ gas scrubbing towers. The washing of such towers with dilute nitric acid yields a solution of $AgNO_3$, AgI^{129} and corrosion products from stainless steel. The solution obtained was cloudy and dark brown in color. However, the AgI^{129} was probably in solution because of the high concentration of $AgNO_3$. Experiments indicated that it was not possible to carry down AgI or filter it out of the solution, but the iodine could be distilled from the $AgNO_3$-AgI solution by adding sulfuric acid to raise the oxidation potential of the nitric acid solution.

A synthetic solution was prepared and the yield determined by adding I^{131}. Iodine distillation from a 20% H_2SO_4 solution began when the temperature of the vapor reached 105° C. Some IO_3^- is formed, but by diluting the solution slightly with water and adding H_2O_2 the IO_3^- was reduced to I^- and the process of distillation repeated as many times as desired. This technique was repeated three times, which resulted in an over-all yield of 90.6%. This method did not produce a product free from nitrates. However, the final purification method used in the regular I^{131} process will be used to produce a product free from nitrates.

Comparative radiation intensity measurements were made on an Eu_2O_3 pellet (345 mg) which had received 567 days of activation in the LITR and a Co^{60} wafer (1.4 grams) which contained 4 curies of activity. All measurements were made in air at a distance of 1 meter.

$Eu^{152+154}$

1/4-inch Al absorber	6.0 rhm
1/2-inch Pb absorber	3.0 rhm

Co^{60}

1/4-inch Al absorber	5.5 rhm
1/2-inch Pb absorber	3.2 rhm

Fabrication of the Shielded Transfer Tank was completed. A test of the lead shielding was made by suspending a 50-curie Co^{60} source at the center of the tank. No weak spots were found, and a reading of 14 mr/hr was obtained at the surface. When the tank was filled with water, a reading of 1 mr/hr was obtained at the surface of the sphere. This checks well with the design calculations.

Fission Product Pilot Plant (F3P)

Engineering

All drawings (181) and specifications (31 sections) necessary for Phase 1 construction were checked and approved during the month. The drawings were delivered to the AEC on June 3 (to be used for bids to be returned by July 7).

Only minor design modifications were made during the month.

Relocation of underground services and removal of contaminated earth on the building site will be done by ORNL because of the existing radiation hazard in this area.

The scale model of the process cell bank (cells 1-9) was completed.

F3P Development

The Annin pneumatically-actuated valve under test was operated through 27,000 cycles without noticeable wear or leakage.

A 1-inch NPS, C. W. Dahl, air-actuated diaphragm valve was operated through 15,000 cycles (65 psi steam flowing through for 1 minute in every 2-minute period). There was no leakage or wear of the seat. This type of valve, costing about $33 each, will be adaptable to control on-off services, such as steam to jets and jackets, in the service tunnel.

Exploratory corrosion tests on two Duriron samples were run at the boiling temperature of the solutions noted. The solutions are simulated Redox-type crystallizer effluent at various stages of concentration, and results are shown in inches/year.

	Sample 1	Sample 2
Solution 1 - 0.25 M NH_4 alum, 2 M HNO_3, 0.2 M H_2SO_4		
Test A - 2.8 days	0.0115	0.0100
Test B - 1.0 day	0.0115	0.0101
Solution 2 - 0.5 M NH_4 alum, 4 M HNO_3, 0.4 M H_2SO_4		
Test A - 2.0 days	0.0135	0.0126
Test B - 21 hours	0.0091	0.0090
Solution 3 - 0.75 M NH_4 alum, 6 M HNO_3, 0.6 M H_2SO_4		
Test A - 3.0 days	0.00186	0.00194
Test B - 1.0 day	0.00074	0.00069
Solution 4 - 1.0 M HN_4 alum, 5 M HNO_3, 0.8 M H_2SO_4		
Test A - 0.7 day	0.00273	0.00219

It was noted that crystals formed at room temperature on cooling solution No. 2, and that crystals formed in the boiling solution in solution No. 4.

Two stainless steel samples, Type 316 and Carpenter 20, were tested in solution No. 3 (0.75 M NH_4 alum, 6 M HNO_3, 0.6 M H_2SO_4).

	Type 316	Carpenter 20
Test A - 1.0 day	0.0225	0.0068
Test B - 1.0 day	0.0150	0.005

The corrosion rate of Carpenter 20 is about 15 times greater than that of Duriron in this solution.

TABLE 3.
RADIOISOTOPE PRODUCTION AND SALES

Period 5-1-55 to 5-31-55

Symbols: I = irradiated unit; P = processed material; HSA = high specific activity; LSA = low specific activity; CF = carrier-free; E = enriched target; X = ORNL Graphite Reactor; FP = fission product

C-86 = 86" Cyclotron; W = Hanford; L = LITR; M = Arco; S = Scrup

Product	Type	Source	*Specific Activity	This Month		Year to Date	
				Produced	Sold	Produced	Sold
Antimony-122	I						
Antimony-124	I						1
Antimony-124	P-HSA				5		58
Antimony-125	I						1
Antimony-125	P-CF				4.5		5
Argon-37	P-CF			2,500		5,000	11
Arsenic-73,74	P-CF						
Arsenic-76	I				4		14
Arsenic-77	I				2		4
Barium-131	I				2		4
Barium-133	P-HSA	M	0.65	17.43		25.08	8
Barium-140	P-CF				40.011	651	535.011
Beryllium-7	P-CF						7
Bismuth-210	I				2		2
Bromine-82	I				4		18
Cadmium-115	I						
Cadmium-115*m*	I						
Cadmium-115	P-HSA				10	12.48	14.2
Calcium-45	I						
Calcium-45	P-LSA				10		149.1
Calcium-45	P-HSA				30		400
Calcium-45	P-E				3		33.5
Calcium-45	P-CF						0.008
Carbon-14	P	W	831	2,516	545	4,262	2,323.901
Cerium-141	I						1
Cerium-141	P-CF				15	1,300	177.5
Cerium-144	P-CF	S	18,500	~20,000	236	22,249	746
Cesium-134	I						
Cesium-134	P-HSA				35	3,094	835
Cesium-137	P-CF				2,120		4,903
Chlorine-36	I				1		8
Chlorine-36	P	M	0.59	67.58	0.247	67.58	1.543
Chromium-51	I				2		4
Chromium-51	P-HSA	L	2,537	2,324	695	8,676	3,759
Cobalt-57	P-CF						10
Cobalt-58	P-CF						2
Cobalt-60	I						1
Cobalt-60	P-HSA				17	588	453
Copper-64	I				1		9
Europium-152,154	I				1		2
F. P. (gross)	P	W		1,450	25	2,230	278
Gallium-72	I				3		14

*Specific activity is in mc/gram.

Amounts produced and sold are in mc for processed material and in units for irradiated material.

TABLE 3 (continued)
RADIOISOTOPE PRODUCTION AND SALES

Product	Type	Source	Specific Activity	This Month		Year to Date	
				Produced	Sold	Produced	Sold
Gold-198	I				77		325
Gold-199	I						
Hafnium-181	I				1		4
H^3 (tritium)	P-CF				5,460		101,588
Indium-114	I						1
Indium-114	P-HSA				11	385	21
Iodine-129	P						0.001 g
Iodine-131	I				1		27
Iodine-131	P-CF	X,W	CF	51,191	61,378	430,691	269,409
Iridium-192	P-HSA				192	1,102	297
Iridium-194	I						
Iron-55,59	I						2
Iron-55,59	P-HSA				2		26
Iron-55	P-E				1	620	42.55
Iron-59	P-E	L	1,600	66.75	48.2	219.45	187.61
Krypton-85	P-CF				1		2,601
Lanthanum-140	I				1		6
Manganese-54	P-CF				0.1	48.8	17
Mercury-197	I						
Mercury-203	I						6
Mercury-203	P-HSA				64	8,680	359.1
Molybdenum-99	I				7		14
Neodymium-147	P-CF					19	3
Nickel-63	I						4
Nickel-63	P-HSA				6	310	26
Niobium-95	P-CF	W	CF	60		170.5	18
Osmium-191	I						
Palladium-109	I						1
Phosphorus-32	I				28		109
Phosphorus-32	P-HSA	W	40,000	19,625	14,744	82,117	68,507
Phosphorus-32	P-CF	X	CF	93	13	503	162
Potassium-42	I				19		102
Potassium-42	P-HSA	L	297	117.4	34	153.9	41
Praseodymium-142	I						
Praseodymium-143	P-CF						
Promethium-147	I						
Promethium-147	P-CF	S	CF	2,790	2,000	3,848	5,077
Rhenium-186	I						
Rubidium-86	I				1		15
Ruthenium-97	I						
Ruthenium-103	P-CF				9	834	149
Ruthenium-106	P-CF				40		278
Samarium-153	I						
Scandium-46	I						
Scandium-46	P-HSA				21		63
Selenium-75	I						
Selenium-75	P-HSA				200		291

TABLE 3 (continued)
RADIOISOTOPE PRODUCTION AND SALES

Product	Type	Source	Specific Activity	This Month		Year to Date	
				Produced	Sold	Produced	Sold
Silver-110	I						
Silver-110	P-HSA				60	2,301	311
Silver-111	I				6		13
Silver-111	P-CF						
Sodium-22	P-HSA	C-86	523	27.2	3	27.2	10.7
Sodium-22	P-CF				11.1		27.45
Sodium-24	I				27		129
Sodium-24	P-HSA	L	2,200	1,207	195	4,764.5	529
Strontium-85	P-CF	*	CF	7.49	6.5	7.49	6.5
Strontium-89	I				1		3
Strontium-89	P-CF	W	CF	275	47	1,160	630.5
Strontium-90	P-CF				8,574		55,856
Sulfur-35	I				1		2
Sulfur-35	P-CF (SO_4^{--})				996		6,162
Sulfur-35	P-HSA (sulfide)				50		133
Sulfur-35	P-HSA (element)						1
Tantalum-182	I						
Tantalum-182	P-HSA					75	55
Technetium-99	I						
Technetium-99	P						0.1
Thallium-204	I				1		1
Thallium-204	P-HSA				21		331
Tin-113	P-HSA				1	39.2	6.05
Tungsten-185	I						
Tungsten-185	P-HSA				6	540	54
Tungsten-187	I						1
Yttrium-90	I						2
Yttrium-91	P-CF				20	1,057	130
Zinc-65	I						1
Zinc-65	P-HSA				163		688
Zinc-65	P-CF				0.3	49.15	6.8
Zirconium-95	I						5
Zirconium-95	P-CF				123	1,076	333
Chromium-51	P-E	L	27,500	82.6	65	82.6	65
Service Irradiations					96		338
TOTALS	Processed Material, mc			104,417.45	98,356.988	589,035.93	529,208.124
	Irradiated Material, units				193		856
	Service Irradiations				96		338

*Brookhaven Cyclotron.

TABLE 4
RADIOISOTOPE PRODUCTION AND SALES – SOURCES AND MISCELLANEOUS PRODUCTS

Period 5-1-55 to 5-31-55

Symbols: VHSA = very high specific activity*
HSA = high specific activity
MSA = medium specific activity
LSA = low specific activity

CF = carrier-free
T = teletherapy
R = radiography
IR = irradiator

Product	Type	Number of Sources	Use	Size of Sources		Sales	
				Minimum	Maximum	Month	Year
Antimony-beryllium	Neutron	2		0.9 c	3.5 c	4.4 c	11.4 c
Cesium-137	CF		T				1500.6 c
Cesium-137	CF	26	R	5 c	100 c	286 c	313 c
Cesium-137	CF		IR				
Cobalt-60	VHSA	2	T	1,501 c	1,504 c	3005 c	5183 c
Cobalt-60	HSA		T				1927 c
Cobalt-60	MSA		T				1182.4 c
Cobalt-60	HSA		R				
Cobalt-60	MSA		R				30.65 c
Cobalt-60	LSA	5	R	46 c	55 c	241 c	527.3 c
Cobalt-60	HSA		IR				413.0 c
Cobalt-60	MSA		IR				
Cobalt-60	LSA	58	IR	1 mc	2.39 c	27.3 c	5174 c
Iridium-192	HSA		R				
Iridium-192	MSA	21	R	4 c	20 c	288 c	1131.4 c
Iron-55	HSA						21 mc
Phosphorus-32	Plaques, 1 in.		IR				
Phosphorus-32	Plaques, 3 in.		IR				
Strontium-90	CF		IR				9.05 c
Tritium-zirconium	Evaporated target	3		656 mc	1.9 c	4.4 c	5.7 c
Tritium-zirconium	Fused target						24.1 c
Cobalt-60	LSA	1	T	55 c	55 c	55 c	578 c
Helium	Ampoules	2		20 cc	20 cc	40 cc	245 cc
Tritium	Ampoules	5		1 c	1.46 c	5.46 c	**
Deuterium	Fused target						4.8 cc
Argon-37	Ampoules						**

*Ranges of specific activity used for Co^{60}: VHSA - > 40 c/g
HSA - 25-40 c/g
MSA - 10-25 c/g
LSA - Up to 10 c/g.

**See Table 3.

TABLE 5

WASTE DISPOSAL – WATER DEMINERALIZATION – HYDROGEN LIQUEFACTION SHIFT OPERATIONAL SERVICES – EQUIPMENT DECONTAMINATION ACTIVATION ANALYSIS – SF ACCOUNTING

Period 5-1-55 to 5-31-55

	This Month	Last Month	Year to Date	Total Last Year
Water through settling basin, gal	15,700,000	16,100,000	83,700,000	158,200,000
Activity through settling basin, curies	9.1	22.9	94.4	237.3
Water through retention pond, gal	590,000	630,000	3,430,000	6,090,000
Activity through retention pond, curies	1.5	4.9	9.7	17.2
Waste to lagoons, gal	85,000	157,000	681,000	997,000
Activity to lagoons, curies	1,742	4,543	12,282	7,224
Total activity in lagoons 2 and 3, curies	28,175	26,433	28,175	15,893
Demineralized water produced, gal	491,000	330,340	1,972,340	4,416,250
Liquid hydrogen produced, liters	21	10	49.6	135
Shift services for research division, man-hours	411	412	1,879	
Equipment decontamination services, man-hours	388	254	1,284	
Activation analyses completed	3	7	22	31
SF and special material receipts, number of lots	51	47	185	338
SF and special material shipped, number of lots	48	52	223	480
Number of research issuances	5	3	15	62
Materials requests issued	9	16	65	196
SF and special materials reports issued	8	9	41	95
Internal audits and surveys	28	10	70	97

WASTE DISPOSAL

Work on the new tank farm transfer line project was resumed this month following the removal of the contaminated earth caused by the rupture of the old black iron transfer line. This project is approximately 50% completed.

WATER DEMINERALIZATION

The capacities of the resin columns have been fairly satisfactory recently, with the exception of the No. 2 anion unit and it appears that this may be due to a leaking multiport valve. However, the quality of the water has fallen considerably over the past year. A representative from the Nalcite Corporation who visited the plant on May 10 suggested that the anion resin being used can only be expected to give two or three years' service due to instability of the resin. On this basis, the anion columns are about due for replacement of resin since they have been in service almost three years and have been giving trouble for approximately eight months.

It was recommended that an activated charcoal column might be installed between the cation bed and the anion bed in an effort to remove organic impurities which may be poisoning the anion resin. It was further suggested that perhaps sulfite might be fed to the water before entering the demineralization plant in an effort to reduce impurities in the water which may have a poisoning effect on the resin.

The conductivity cell mentioned in last month's report has been installed to continuously monitor the water leaving the demineralizer. When the resistance of the water falls below a pre-set value, the exit valve closes and an alarm rings in the control room.

APPENDIX

OPERATIONS DIVISION

REPORT FOR MAY 1955

EVAPORATED QUARTZ AS A PROTECTIVE FILM ON RADIOACTIVE SOURCES

B. J. Massey

Introduction

Cadmium-109 (0.08 Mev gamma) was electroplated onto a 1-cm diameter platinum disc (H. T. Russell) and various protective coatings were considered. Among these were: aluminum (both foil and evaporated film), beryllium foil, evaporated SiO_2, and magnesium foil. It was decided to investigate SiO_2 because an extremely thin film ($<$ 1000 Å) offered protective properties, both from the standpoint of a chemically impervious layer and of providing some protection against abrasion.

Evaporated films of SiO_2 have been utilized in laboratory optical systems in protecting silver mirrors.(1)

Equipment

Several attempts were made to evaporate SiO_2 in the DPI evaporator (used to evaporate zirconium). The first test was made using tungsten filaments, but this was discontinued because SiO_2 does not wet tungsten, which, with our present equipment, resulted in erratic vaporization.

Carbon spectrographic rods were shaped into long boats and tried. Degassing of the massive carbon rods was difficult, chiefly because of the presence of a white powder. (The analysis of the carbon showed the presence of magnesium.) Also, so much heat was liberated by the carbon filament that the entire assembly was overheated.

Further work was done in the electron-bombardment equipment designed by R. E. McHenry.(2) This equipment performed satisfactorily to produce the necessary film.

Procedure

The effectiveness of the films was tested by evaporating SiO_2 onto a portion of a silver disc. The discs were "developed" by immersion in water saturated with H_2S. The effectiveness of the film was judged by the contrast in the tarnish of the two portions of the silver disc. Development was continued for several hours to obtain maximum contrast. One disc which showed a good film was bent almost double, then re-developed and even after this distortion, the SiO_2 film afforded fairly good protection.

Conclusion

A very thin film of evaporated SiO_2 forms a good protective coating against acidic chemical attack. However, the effect of gamma radiation on the film has not been considered.

(1) "Procedures in Experimental Physics," by John Strong, Prentice-Hall, 1944, p. 136.

(2) "Scientific Foundations of Vacuum Technique," by Dushman, John Wiley and Sons, 1949, p. 760.