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DECONTAMINATION AND CORROSION RESISTANCE PROPERTIES OF SELECTED LABORATORY SURFACES

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Foreword

This report presents decontamination and corrosion resistance data on various industrial materials tested on a laboratory scale to aid in the selection of materials for the construction and maintenance of radiochemical laboratories at Oak Ridge National Laboratory.

These materials were acquired (1) by accepting samples from some vendors who solicited Oak Ridge National Laboratory, and (2) by a non-exhaustive scanning of industrial publications and inquiring of those vendors whose products appeared to be of interest. The limited scope of the testing program did not justify ascertaining and contacting all possible sources of acceptable materials. Doubtless there are many useful materials which were not tested. Accordingly, this report does not present a comprehensive comparison of all materials in the general groups tested.

It is not the purpose or intent of this report to endorse or condemn any of the products so tested or to implicate in any way a manufacturer or distributor of such products, but rather to present data compiled during the course of laboratory operations which may be of interest to others working on similar problems.

Materials that apparently exhibited poor decontamination and corrosion resistance properties in these tests need not be considered inferior products, because slight variations according to composition (such as the nature or content of plasticizers, binders, fillers, pigments, etc.) may affect decontamination and corrosion resistance properties quite drastically. Although a detailed study of varying composition was not made, it was fairly evident that in all probability a poorly rated product could easily be made to test higher by a slight change in raw materials or processing procedure.

The tests presented in this report are empirical tests which have been developed only for immediate comparison purposes. Standard methods have not been established for decontamination tests, and because of the variety and number of samples involved there is reason to believe that a few products may have received incorrect ratings.

The authors believe, however, that this report presents data adequate for empirical purposes and that it contributes heretofore unpublished data that may be of general interest to users of radioactive isotopes in the selection of materials for radiochemical facilities.

The tests presented herein fulfill Oak Ridge National Laboratory's immediate needs, and an extension of this test program is not planned.

The Authors

1.0 Abstract

A selection of fifty materials has been compared for decontaminable surfaces applicable to radiochemical laboratories. The susceptibility of these materials to contamination with a fission product mixture, their subsequent ease of decontamination with various reagent washes, and resistance to common laboratory reagents are presented.

2.0 Introduction

Experience has shown that structural materials used in standard chemical laboratories are not always applicable to radiochemical laboratories. Unfortunately there is but little backlog of user history on other materials that could possibly be applied to radiochemical facilities; therefore, a method was needed whereby various materials could be compared with suitable tests and their usefulness in the field predicted under radioactive conditions. For this purpose, Tompkins and Bizzell(1) have developed simple empirical tests to measure the susceptibility of a material (surface) to radioactive contamination and its subsequent ease of decontamination. Data on three widely-used radioisotopes were reported(2) using these tests.

This paper reports the results of a joint investigation undertaken by the Analytical Chemistry Division* and Chemical Technology Division to determine the contamination susceptibility, ease of decontamination, and corrosion resistance properties of 50 materials considered for application in the new Building Program H at Oak Ridge National Laboratory. (These properties were determined with a fission product mixture and common laboratory reagents.) The effectiveness of Versene, acidic, alkaline-citrate, and neutral-citrate washes as decontamination reagents were also compared.

3.0 Summary

Fifty different materials were selected for testing, and these were divided into six general groups (detailed test results for which are presented in the appendix). The number tested in each group is as follows:

	Group	Number Tested
(1)	Uncoated Reference Materials (for control purposes)	5
(2)	Baked Interior Panels	10
(3)	Protective Plastic Coatings (air dried)	11
(4)	Laboratory Bench Top Materials	7
(5)	Floor Tiles	11
(6)	Disposable (strippable) Plastic Films	6

(1) Tompkins, P. C., and Bizzell, O. M. *Radioactive Decontamination Properties of Laboratory Surfaces. I. Glass, Stainless Steel and Lead*, ORNL-381 (Sept. 21, 1949).

(2) Tompkins, P. C., Bizzell, O. M., and Watson, C. D., *Radioactive Decontamination Properties of Laboratory Surfaces. II. Paints, Plastics and Floor Materials*, ORNL 382 (Sept. 26, 1949).

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A selection of the best materials in each group was made considering the combined results of (a) corrosion tests, (b) susceptibility to contamination, and (c) decontamination tests. The listing of best materials in each group is as follows:

(1) Uncoated Reference Materials

Polyethylene outstanding material of this group and a so superior to materials classified under other groups

(2) Baked Interior Panels

Laboratory Furniture panels X-127 and X-119

(3) Protective Plastic Coatings (air dried)

a. Corrosite 22
b. Nukemite-40
c. Amercoat-33

(4) Laboratory Bench Top Materials

a. Saran sheet
b. Alberene stone coated with VMCH (vinyl-type plastic coating)

(5) Floor Tiles

Sanitile vinyl flooring

(6) Disposable (strippable) Plastic Films

a. Brevon
b. Gordon Lacey A89A
c. Monsanto D-1000

The vinyl base protective coatings (all those listed in group 3 are of this type) are, in general, more corrosion resistant and decontaminate better than the other groups studied.

In general, Versene, acidic or neutral citrate-detergent washes decontaminate a given surface much better than alkaline-citrate or plain water washes. The Versene and acidic washes were equally effective.

4 0 Experimental

Test placques (2½ × 2½ in.) of each material were used for the susceptibility and decontamination tests and compared to uncoated reference placques of Polyethylene, Teflon, lead, plate glass and stainless steel. Immersion rods were selected for the corrosion tests and watch glasses coated with strippable plastic film for the penetrability tests.

4.1 Preparation of Test Placques. Aluminum or wooden placques (2½ × 2½ in.) were coated on all edges and one side with a protective coating according to the manufacturers' recommendations. In some cases steel placques (2½ × 2½ in., 16 gauge) were supplied by the vendor with the coating factory applied. Test placques for materials such as floor coverings and bench top materials were made by sawing a section (2½ × 2½ in.) from the parent material. The maximum placque thickness that could be properly handled and counted was 2 in.

4.2 Preparation of Immersion Rods. Immersion rods for determining the corrosion resistance of protective coatings against common laboratory reagents were prepared from wooden or aluminum dowels (3/8 in. diameter × 5 in.) rounded on one end and suitably coated according to the vendors' recommendations.

For materials other than protective coatings, strips (½ in. wide and 5 in. long) were sawed from the parent material. Still other materials such as the baked panels were factory coated on one side only, prohibiting immersion; therefore, the test was made directly on the surface of such panels.

4.3 Preparation of Plastic Coated Watch Glasses. Watch glasses (25 mm diameter) were overlaid with pre-sprayed strippable films in comparable thicknesses based on six thorough passes (9-33 mils thick) of a spray gun. The film was applied in each case as a dry single plastic film glued to the watch glass with liquid parent material.

4.4 Test Method.

4.41 *Susceptibility Test.* The susceptibility tests were designed primarily to determine that quantity of activity trapped or held on a given surface after a simple flushing procedure with water. This quantity of activity has been called "true contamination."[3] A typical stepwise testing procedure follows:

(1) The center of each placque was contaminated with a 100 λ (0.1 ml, 1.53×10^6 counts/min) aliquot of 3-year old mixed fission product solution (see page 20 in Appendix for fission product analysis) of *p*H 2 in nitric acid and allowed to evaporate to dryness overnight in a hood without heating. Air velocity through the open face of the hood was approximately 100 ft/min.

(3) Hawes, W. W., and Leventhal, L., *Naval Radiological Defense Laboratory Report*, ADC-64 (Jan. 1949).

(2) Placques were then uniformily flushed with tap water for 1 min. Jet effect of wash stream was *not* utilized to aid in removal of activity.

(3) Step 2 was followed by air drying the flushed placque, mounting on a counting card and counting[4] with an end-window Geiger-Müller tube suitably arranged in a lead pig, with standard shelf-type holder for counting cards.

Each sample was counted at the same shelf geometry. The results were reported as percentage differences or as ratios; therefore, the counting rates were not corrected for such factors as back-scattering, self-absorption, and counter efficiency because absolute disintegration rate values were not required.

(4) The susceptibility of the placque to contamination was expressed by the ratio:

$$\frac{\text{Counts/min remaining (after flushing)}}{\text{Counts/min applied } (1.53 \times 10^6)} \times 100 = \text{Percent retained or adsorbed}$$

4.42 *Decontamination Test.* Decontamination is concerned with removing that portion of activity remaining after a simple water wash; therefore, the placques from the susceptibility tests were used for the decontamination tests. The decontamination reagents selected for these tests were as follows:

Reagent	Composition
Versene	5% Versene, 1% Triton, *p*H 8-9
Caustic	1% trisodium citrate, 5% sodium hydroxide
Neutral	2.5% trisodium citrate, 0.2% Aerosol OT, *p*H 7.0 ± 0.1
Acidic	0 3 *M* Citric Acid, 0.1% Aerosol OT, 0.5 *M* HCl
Water	Distilled water (23°C)

Each placque was covered with reagent in a pyrex tray and scrubbed with a Fuller hair brush* for 2 min. This was followed by a brief rinse in tap water, air drying, mounting on a counting card, and counting as explained in Section 4.4 [see Ref. (4)]. All tests were made in duplicate.

The amount of contaminant removed was a measure of decontamination. This was expressed as a ratio or decontamination factor (DF):

$$\frac{\text{Initial counts (counts remaining from susceptibility test)}}{\text{Counts remaining (after reagent scrubbing)}} = \text{Reagent DF}$$

(4) Simpson, J. A., Jr., "A Precision Alpha-Proportional Counter," *Rev. Sci. Instruments* 18, 884 (Dec., 1947); see also Oak Ridge National Laboratory Drawings Q227, Q937, Q762 and Q844.

*"Platers style," black bristle trim 5¾ x 1 in , Catalogue No. 4168.

Similarly the overall decontamination factor was expressed as the ratio of:

$$\frac{\text{Initial counts/min applied } (1.53 \times 10^6)}{\text{Counts/min remaining (after reagent scrubbing)}} = \text{Overall DF}$$

4.43 *Corrosion Resistance Test.* Immersion rods prepared according to Section 4.2 were immersed in five separate beakers. Each beaker contained one of five laboratory reagents which were 3 *M* HNO_3, 3 *M* H_2SO_4, 3 *M* HCl, 3 *M* NaOH, and methyl isobutyl ketone. Rods remained immersed until failure occurred or until one week had elapsed. Failure of a coating or material was judged by (1) discoloration of reagent, (2) a tacky or slimy surface, (3) appearance of pin holes or blisters, and (4) wetting of wooden test dowel above coated surface. A rating for each material was assigned as follows:

Method of Rating	Corrosion Rating
E - Excellent - No attack in 168 hr (1 week)	4
G - Good - Failure in 120-167 hr	3
F - Fair - Failure in 48-119 hr	2
P - Poor - Failure in less than 48 hr	1

The letter system was used to evaluate specific corrosion resistance to each reagent and the number system to determine a composite rating for all reagents. The highest and poorest complete composite rating possible was 20 and 5, respectively.

4.44 *Penetrability of Strippable Plastic Films Test.* Disposable (strippable) plastic films were tested to determine the amount of fission product activity transmitted through such films in the presence of concentrated H_2SO_4, HNO_3, HCl, and distilled water. The distilled water was selected as a control or reference reagent. Concentrated reagent (approximately 1 ml) was pipetted onto the surface of the coated watch glass followed by a 100 λ (0.1 ml, 1.97×10^7 counts/min) aliquot of mixed fission product solution. Fresh reagent was added every 24 hr when needed. The sulfuric acid test was conducted in a desiccator to prevent dilution of the acid by water absorption.

After a period of one week, each watch glass was carefully blotted free of reagent and the plastic film removed by stripping. The watch glasses were then counted and the penetrability determined by

$$\frac{\text{Counts on watch glass}}{\text{Counts applied}} \times 100 = \text{Percent transmitted}$$

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These tests served as a measure of two properties: (1) corrosion resistance; and (2) an estimate of activity transmitted through each film (the greater the activity transmitted, the more porous and/or less chemically resistant the film).

5.0 Discussion and Results

For test purposes, the materials were collected into the six general groups: (1) Uncoated reference materials; (2) baked enamel panels (interior partitions); (3) air dried protective coatings; (4) bench top materials; (5) floor tiles; and (6) strippable disposable plastic films.

Susceptibility tests were not determined for Group 6 because these films are stripped from a surface to effect decontamination.

5.1 Susceptibility. The susceptibility of the materials tested to mixed fission product contamination are presented in Fig. 1. With the exception of Polyethylene, many surfaces were superior to the uncoated reference surfaces which were used as a standard for comparison purposes. Polyethylene retained the least quantity (0.8%) of mixed fission product activity and uncoated Alberene stone the most (86%).

The baked panels adsorbed 13% to 61% of the contacting activity. Six panels were outstanding; Browne-Morse 65 MV, Hamilton 1-H, Browne-Morse 51 MV, Masterwall-8739, Laboratory Furniture X-127, and Kewaunee-3. Average retention for these panels was approximately 15%.

Considered as a group, the air dried protective coatings were superior to the baked panels and other groups. This was surprising because baked coatings are usually considered to be smoother and less porous than air dried coatings. Four coatings, Nukemite-40 (1.3%), Carbo-B-Resin (2.1%), Amercoat-33 (5.9%), and Corrosite-22 (7.4%), excelled the others.

Three bench top surfaces compared favorably with Polyethylene and the best air dried coatings: (1) Saran sheet (2.1%); (2) Alberene stone (coated with vinyl VMCH) (7.3%); and (3) Saran rubber (7.3%).

The floor tiles uniformly retained the most activity (approximate average 48%) and was the poorest of all groups tested. Best materials in this group were (1) rubber tile, (2) Goodyear Vinyl, (3) Flexacrome, (4) Plascor, (5) Tuff-Tex, and (6) Sanitile. Average retention for these tiles was 41%.

Assuming that each group of materials could be applied in the field under ideal conditions (unscratched surfaces, properly applied and cured), Fig. 1 predicts a reasonable approximation of the fission product activity remaining on each surface when hosed down under field conditions. Surface marring is probably the controlling factor, so a less accurate predication from Fig. 1 could be expected under severe prolonged abrasion conditions.

5.2 Decontamination. In general, those materials with low susceptibility values decontaminated better than those with high susceptibility values. The results of the decontamination tests for each group of materials with the selected decontamination reagents are presented stepwise below.

Group I: Uncoated Reference Materials. This group of materials was selected as standard decontaminable surfaces (see Fig. 2) to which all other materials were compared. The group includes:

Name	Code	Decontamination Factor
Polyethylene	P	10,000
Teflon	T	5,963
Plate Glass	G	783
Lead Sheet	L	501
Stainless Steel (347 mirror finish)	S	6

Decontamination factors (DF) for the above materials were determined with Versene, acidic, neutral and caustic reagents. The Versene DF was chosen for comparison purposes with the other groups because it appeared to be superior to the other reagents.

The acid (HCl) wash was more efficient for decontaminating stainless steel but was not listed here because the surface of the stainless steel was visibly (harshly) attacked.

The code (P,T,G,L,S) presented above, has been superimposed on the graphical decontamination results for the other groups, Figs. 3, 4, 5 and 6, for easy comparison purposes.

Group II: Baked Enamel Partitions None of these panels decontaminated as well asPolyethylene (see Fig. 3). Four panels, Browne-Morse 65 MV, 51 MV and

Laboratory Furniture X-119 and X-127, decontaminated almost as well as Teflon. For this group Versene appeared to be a superior decontaminant to the other reagents but was closely followed by the acid wash.

Group III: Air Dried Coatings. The air dried coatings decontaminated about the same as the baked enamel coating. None were as good as Polyethylene, but two, Corrosite-22 and Nukemite-40. decontaminated almost as well as Teflon (see Fig. 4). All coatings were superior to stainless steel. Two other coatings exceeded plate glass, (1) Amercoat-33 and (2) Truscon. For the air dried coatings, the acid wash was the superior decontaminant.

Group IV: Bench Top Materials. Saran sheeting and Alberene stone (coated with vinyl VMCH) were the superior materials of this group (see Fig. 5). They too approached the decontamination properties of Teflon. Note particularly the superiority of coated Alberene stone over uncoated Alberene stone.

The last two columns VMCH 1 and VMCH-4 present four successive contaminations and decontaminations with Versene, acidic and neutral-citrate reagents. It is interesting to note that the fourth decontamination factor was as good or better as the initial decontamination factor. This shows that successive spills on a smooth essentially non-porous surface can be properly cleaned up (decontaminated) as well as an initial spill. For this group, Versene appears to be the superior decontaminant.

Group V: Floor Tiles. The floor tiles decontaminated the poorest of all groups (see Fig. 6). Sanitile (vinyl laminated flooring) was the best material, exceeding lead and approaching the decontamination properties of glass. A desirable floor tile should decontaminate as well as Polyethylene or Teflon.

Rubber tile and rubber runner (see columns 2 and 3, Fig. 6) were checked for two successive contaminations and decontaminations. The second contamination was not removed as well as the initial one, indicating that a gradual build-up of activity can be expected from a succession of radioactive spills on the more porous surfaces.

Group VI: Strippable (Disposable) Plastic Films. The penetrability of six plastic strippable films by fission product contamination in the presence of common laboratory reagents is presented in Table 2. A surprisingly small quantity of activity (less than 0.1%) was transmitted in the worst case. For this reason, penetrability was expressed as counts/min rather than as a percentage in order to avoid very small percentage values. An arbitrary level of 200 counts/min was selected to determine usable coatings. On this basis, Brevon, A89A and D-1000 were the outstanding coatings. In practice, however, all coatings are probably safely usable because they would seldom be subjected to reagent immersion for long periods of time.

5.3 Corrosion Resistance. The air-dried coatings group was superior to the other groups in resisting chemical attack (see Fig. 7 for composite corrosion ratings and Table 1 for specific ratings against each reagent). An arrangement of groups in a decreasing order of chemical resistance with the best materials in each group are presented below:

(1) Air Dried Coatings Corrosite, Amercoat, Nukemite-40, J299J and Carbo-B-Resin

(2) Bench Top Materials Saran B 115 Sheet and Formica

(3) Floor Tile: Sanitile, Rubber Tile and Flexachrome

(4) Baked Enamel Panels Kewaunee-2, 358 Plastic Enamel, Laboratory Furniture X 119

The uncoated reference materials were not subjected to chemical resistance tests because their corrosion properties are generally known.

6.0 Conclusions

Polyethylene and Saran sheet plastic rated high in decontamination properties as well as resistance to acids, caustic, and ketone solvent. Three "vinyl base" paints showed high decontamination and good resistance to aqueous solutions. These paints were attacked by methyl isobutyl ketone, but are relatively cheap and very good for general use. Strippable coatings of the "vinyl base" type are also very generally useful and cheap. The more expensive glass, lead, and stainless steel surface materials in common use are decidedly *inferior* to these plastics and paints from the standpoint of decontamination.

None of the baked enamel panels were outstanding in both decontamination and chemical resistance, so the panels having the highest combined rating were selected.

The floor tiles were generally very poor in both decontamination and chemical resistance. The best of the group is said to be relatively expensive, and rates well below Polyethylene or Saran.

Other incidental conclusions are as follows:

(1) Decontamination properties of surfaces cannot be correlated with corrosion resistance properties.

(2) The Versene and the acidic reagent washes were superior decontaminants. Decontamination factors of the two reagents indicated an approximately equal overall efficiency.

(3) The neutral citrate-detergent wash excelled water and was equal to or better than the alkaline-citrate wash for removing contamination.

(4) Smooth, non-porous surfaces can be expected to decontaminate with the same efficiency after a succession of radioactive spills and decontaminations if the degree of attack is *not* severe, whereas rough porous surfaces decontaminate with decreasing efficiency.

(5) Air dried "vinyl base" paints are best for general application in radiochemical facilities. Solvent spillage would be harmful and should be prevented by providing metal trays or by other suitable means.

(6) The commercial floor tiles tested cannot be adequately decontaminated by *reagent methods* to warrant their use in radiochemical laboratories subject to spills of 10^6 counts/min or above. Decontamination of these tiles by surface grinding methods might be feasible.

(7) Strippable (disposable) coatings present perhaps the best means of protecting walls and ceilings from contamination. Their use on floors, however, is limited to approximately two weeks under relatively heavy foot traffic conditions, because of their inherently low adhesion and/or tensile strength.

7.0 Recommendations

Based solely on the laboratory tests performed, certain materials simultaneously possessing outstanding decontamination and corrosion resistance properties are recommended for possible general use in radiochemical facilities.

A list of materials with suggested areas of application follows:

Material	Suggested Area of Application — Remarks
Uncoated Reference Materials	
Polyethylene Sheet	"Hot" sinks, bench tops, trays, interior of cells and hoods, drain lines, duct work, and process lines and vessels
Air Dried Vinyl Coatings	
Corrosite 22 Nukemite-40 Amercoat-33	General use such as floors, walls, ceilings, and equipment surfaces
Strippable (Disposable) Coatings	
Brevon A89A Monsanto D-1000	Interior of hoods and cells, exterior and interior walls of barricades and floor areas most likely to receive spills
Interior Baked Panels	
Laboratory Furniture X 127 and X 119	Laboratory furniture and removable partitions
Floor Tile	
Sanitile	Best of group tested' better tile desired
Bench Top Materials	
Alberene Stone (coated with vinyl VMCH) Saran Sheeting	Bench tops

8.0 Appendix

8.1 Analysis of Fission Product Mixture. Conditions: Slug was cooled three years before dissolution. Time in ORNL pile unknown. Sample counted with an end-window Geiger-Müller tube with standard shelf-type holder for counting cards. Counting geometry 6.43%. No adsorber added.

Element	Counts/min/ml
Gross Beta	1.53×10^6
Ruthenium Beta	2.77×10^4
Zirconium Beta	2.07×10^3
Columbium Beta	no value
Cerium Beta	4.49×10^5
TRE Beta*	9.35×10^5
Strontium Beta	2.44×10^5
Cesium Beta	2.85×10^5

*Total Rare Earths

TABLE 1

Chemical Resistance Tests of Various Protective Coatings

Test Conditions:

(1) Wood dowels, 3/8 × 5 in., coated and dried according to manufacturer's specifications.

(2) Immersion in hexone and 3 *M* HNO_3, HCl, H_2SO_4 and NaOH for 7 days.

(3) Reagent temperature 19-25°C.

Method of Rating

E = Excellent - No attack in 168 hr

G = Good - Failure in 120-167 hr

F = Fair - Failure in 48-119 hr

P = Poor - Failure in less than 48 hr

Method of Judging Failure

(1) Pronounced discoloration of reagent or test rod.

(2) Blistering or cracking.

(3) Tacky or slimy surface.

(4) Appearance of pin holes.

MANUFACTURER	TRADE NAME	COLOR	3 *M* HNO_3	3 *M* NaOH	3 *M* H_2SO_4	3 *M* HCl	HEXONE	REMARKS
				AIR DRIED COATINGS				
Corrosite Corporation	Corrosite-22	Gray	E	E	E	E	P	Vinyl base
Corrosite Corporation	Corrosite-22	Green	E	E	E	E	P	Vinyl base
Corrosite Corporation	Corrosite-22	Black	E	E	E	E	P	Vinyl base
American Pipe and Construction Company	Amercoat-33	Gray	E	E	E	E	P	Vinyl base
Nukem Products Corporation	Nukemite-40	Gray	E	E	F	E	P	Vinyl base
Carboline Company	Carbo-B-Resin	Gray	E	E	F	F	P	Base unknown, probably vinyl
Carboline Company	Carbo-B-Resin	Black	E	F	E	E	P	Base unknown
Gordon Lacey Chemical Products Company	J-299J	White	E	E	E	E	P	Base unknown
Truscon Laboratory	Truscon	Clear	F	G	E	F	P	Base unknown
Miracle Adhesive Corporation	R-Mir Dek	Gray	F	P	P	P	P	Phenolic urea base-floor paint
Miracle Adhesive Corporation	R-Mir-Dek	Gray	F	P	P	P	E	"Non-slip" coating
			BAKED COATINGS (Prefabricated Interior Panels)					
Kewaunee Manufacturing Company	Kewaunee-2	Brown	F	E	E	E	P	Vinyl base
E. H. Sheldon Company	358 Plastic Enamel	Gray	P	E	E	E	P	Base unknown
Laboratory Furniture Company	Laboratory Furniture X-119	Brown	P	E	E	E	P	Base unknown

TABLE 1 (Cont'd)

MANUFACTURER	TRADE NAME	COLOR	3 *M* HNO_3	3 *M* NaOH	3 *M* H_2SO_4	3 *M* HCl	HEXONE	REMARKS
Laboratory Furniture Company	Laboratory Furniture X-127	Gray	P	E	E	G	P	Base unknown
Kewaunee Manfacturing Company	Kewaunee-3	Tan	P	P	G	G	E	Base unknown
Browne-Morse Company	51 MV	Gray	P	E	G	P	P	Alkyd
Browne-Morse Company	65 MV	Brown	P	E	F	P	P	Alkyd
Hamilton Manufacturing Company	Hamilton Enamel	Gray	P	E	G	P	P	Base unknown
E. F. Houserman Company	Masterwall-8739	Tan	P	P	F	P	F	Alkyd urea
E. H. Sheldon Company	750 Enamel	Gray	P	P	P	P	P	Base unknown
				FLOOR TILE AND BENCH TOP MATERIALS				
Saran Lined Pipe Company	Saran B-115*	Green	E	E	E	E	E	
Saran Lined Pipe Co.	Saran B-115*	Black	E	E	E	E	E	
Standard Coated Products, Division of Interchemical Corporation	Sanitile	Cream	E	E	E	E	P	Vinyl topping
Saran Lined Pipe Company	Saran Rubber*	Black	E	E	E	E	P	
Plastic Fabricators	Formica*	Black	G	P	E	E	E	Hexone attacked backing only
(ORNL Stock)	Rubber Tile	Brown	G	G	E	E	P	
Tile-Tex Company	Flexacrome	Gray	G	G	E	E	P	Plastic pounded asbestos
Tile-Tex Company	Flexacrome	Red	G	G	E	E	P	Plastic pounded asbestos
Bakelite Corporation	VMCH (vinyl resin)*	Clear	P	E	E	E	P	Applied on Alberene stone
Goodyear	Vinyl Flooring		G	G	G	E	P	Vinyl topping
Armstrong Cork Company	Rubber Runner	Red	F	G	G	F	G	
U. S. Stoneware	Plastile-22	Tan	G	F	G	F	P	Plastic tile — Base unknown
U. S. Stoneware	Plastile-22	Yellow	F	P	G	F	P	Plastic tile — Base unknown
U. S. Stoneware	Plascor	Brown	P	P	G	P	P	Plastic tile — Base unknown
U. S. Stoneware	Plascor	Red	P	P	G	P	P	Plastic tile — Base unknown
Hercules Flooring	Tuff-Tex	Brown	P	P	P	P	P	Plastic tile — Base unknown
Hercules Flooring	Tuff-Tex	Red	P	P	P	P	P	Plastic tile — Base unknown

*Bench Top Materials

TABLE 2

Penetrability of Strippable Plastic Films by Fission Product Contamination

1. Contaminant: Fission products cooled three years
2. Activity Applied: 1.98×10^7 counts/minute
3. Reagent Contact Time: 1 week
4. Temperature: 23°C

NAME	FILM THICKNESS (mils)	ACTIVITY TRANSMITTED BY CONCENTRATED			
		H_2SO_4 (counts/min)	HNO_3 (counts/min)	HCl (counts/min)	DISTILLED WATER (counts/min)
Brevon	18	162	23	11	11
A89A	9	175	25	0	6
L3X173	24	1,600	124	5	0
Amercoat	10	0	890	176	0
D-1000	33	*	19	26	3
Tygofilm	13	2,204	583	33	10

*Watch glass contaminated during film removal.

Fig. 1

Susceptibility of Selected Laboratory Surfaces to Fission Product Contamination

1. Contaminant - Fission products cooled three years
2. Activity Applied - 1.53×10^6 counts/min
3. Fission products applied and permitted to dry at room temperature in a hood
4. Placques gently flushed with water (no impingement) for 1 min - dried and counted

$$\text{Susceptibility} = \text{Percent adsorbed} = \frac{\text{counts remaining (after water wash)} \times 100}{\text{counts applied}}$$

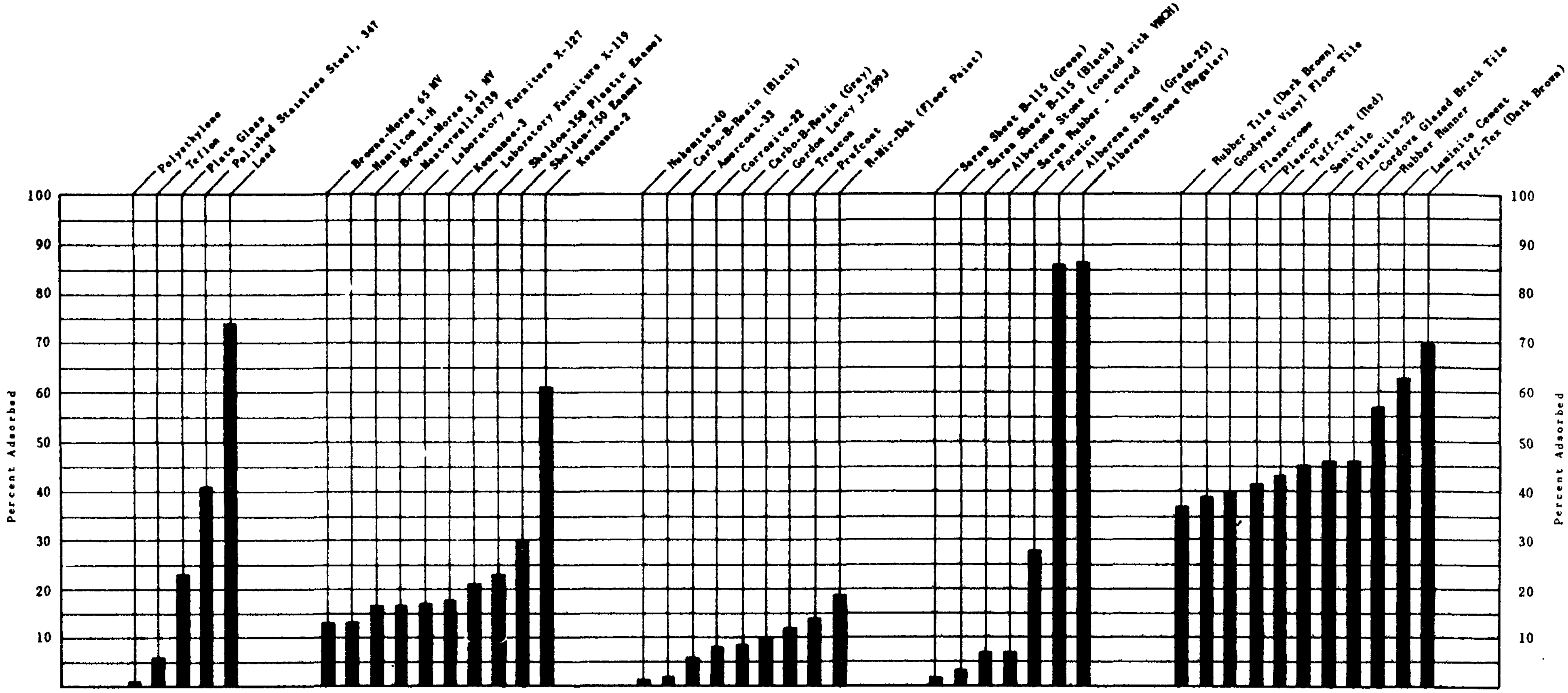

Fig. 2

Uncoated Reference Materials

Decontamination with Various Reagent Washes

1. Contaminant - Fission products cooled 3 years
2. Activity Applied - 1.56×10^6 counts/min
3. DF (Decontamination Factor) = $\frac{\text{counts applied}}{\text{counts remaining (after reagent wash)}}$

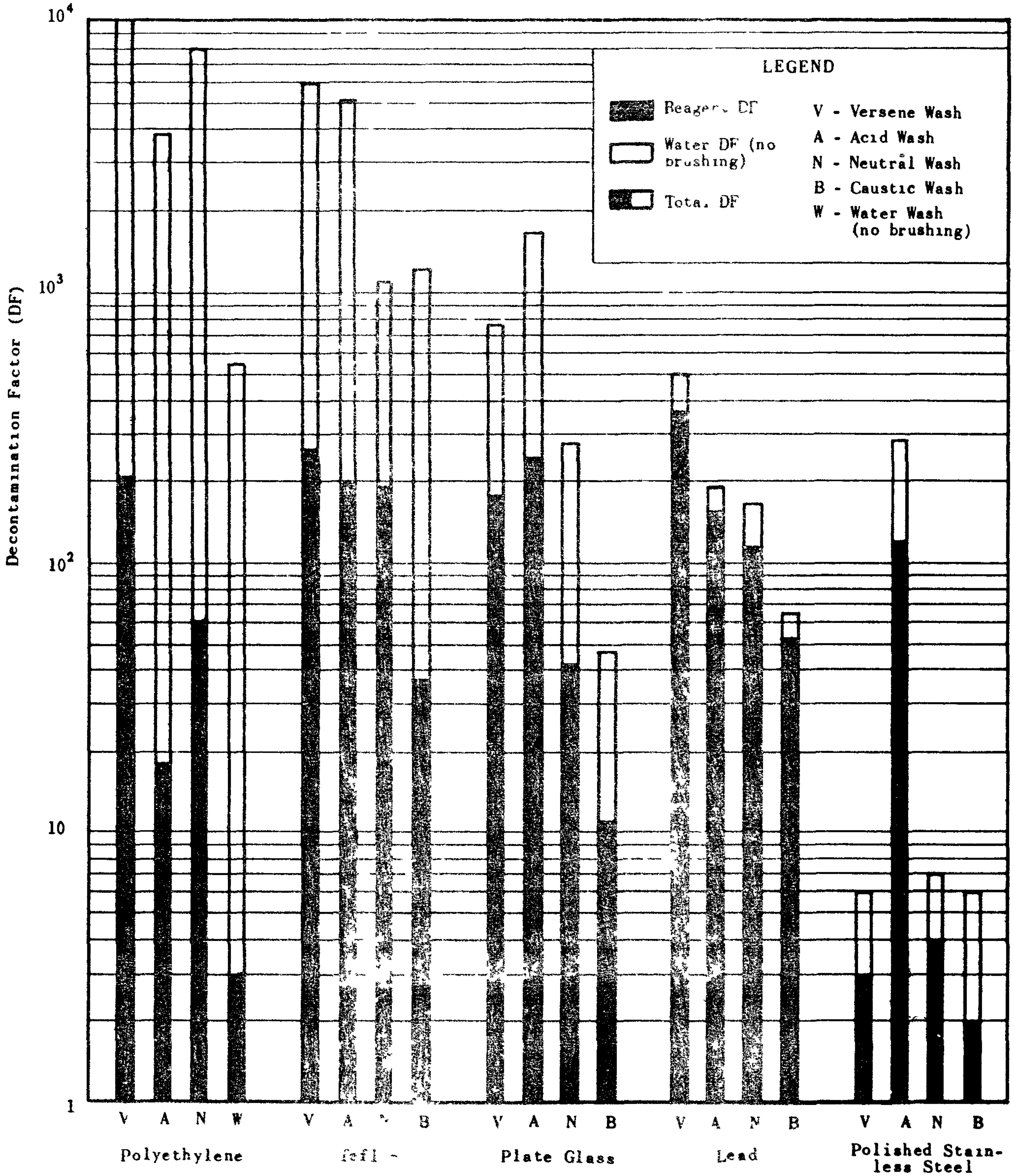

Fig. 3

Baked Enamel Partitions

Decontamination with Various Reagent Washes

1. Contaminant - Fission products cooled three years
2. Activity Applied - 1.56×10^6 counts/min
3. DF (Decontamination Factor) = $\frac{\text{counts applied}}{\text{counts remaining (after reagent wash)}}$

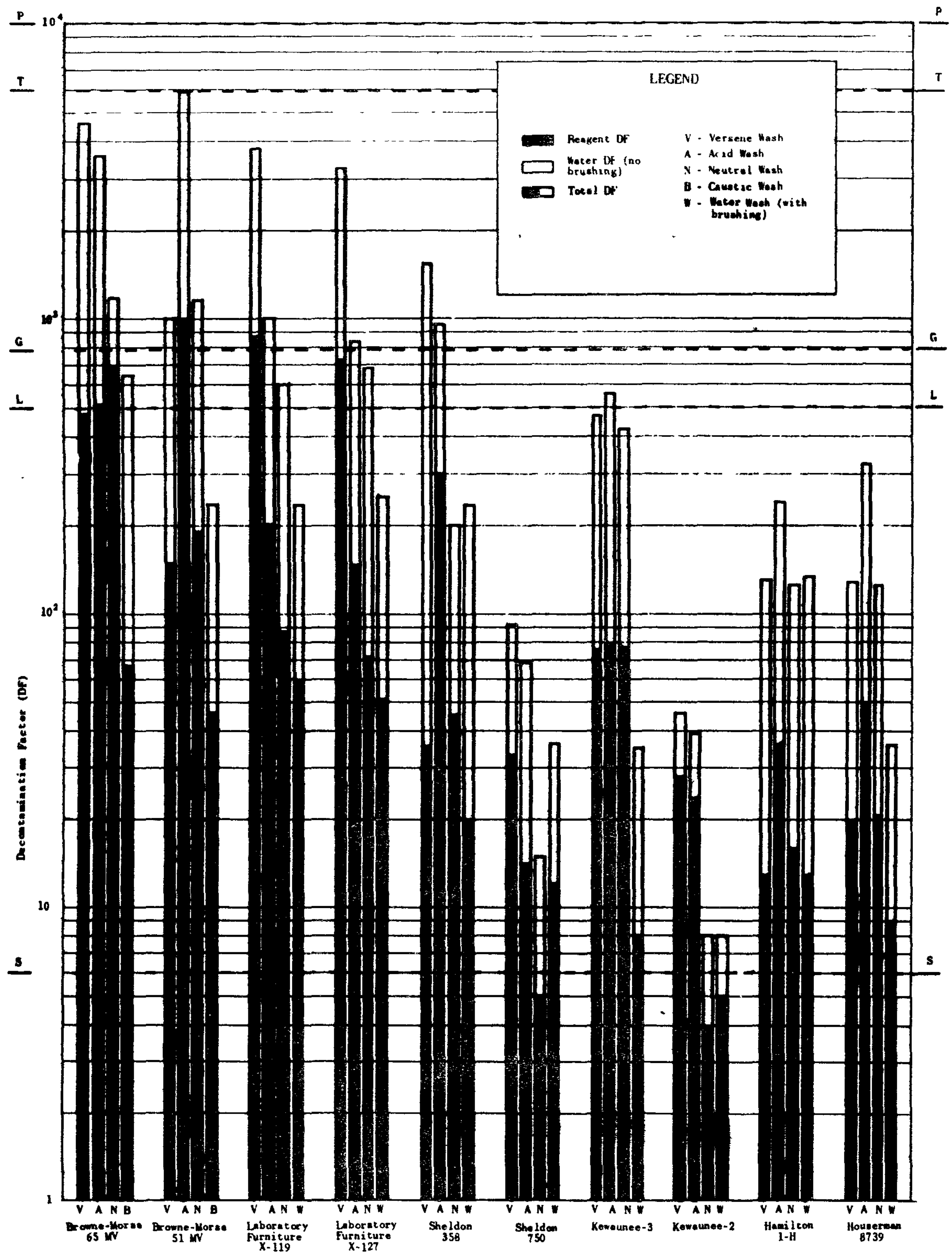

Fig. 4

Air Dried Coatings

Decontamination with Various Reagent Washes

1. Contaminant - Fission products cooled three years
2. Activity Applied - 1.56 × 10^6 counts/min
3. DF (Decontamination Factor) = $\frac{\text{counts applied}}{\text{counts remaining (after reagent wash)}}$

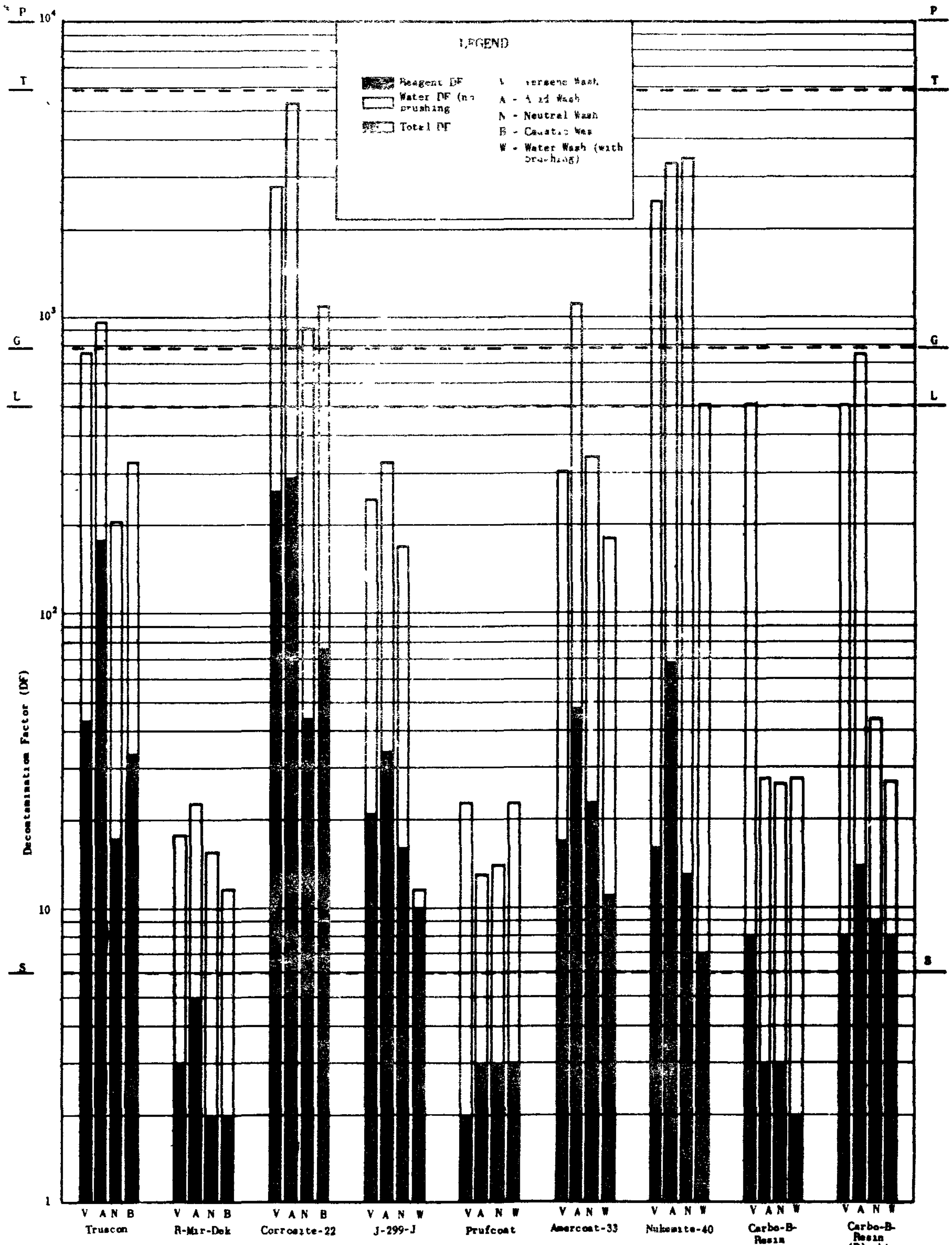

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Fig. 5

Laboratory Bench Top Materials

Decontamination with Various Reagent Washes

1. Contaminant - Fission products cooled years
2. Activity Applied - 1.56×10^6 counts/min
3. DF (Decontamination Factor) = $\frac{\text{counts applied}}{\text{counts remaining (after reagent wash)}}$

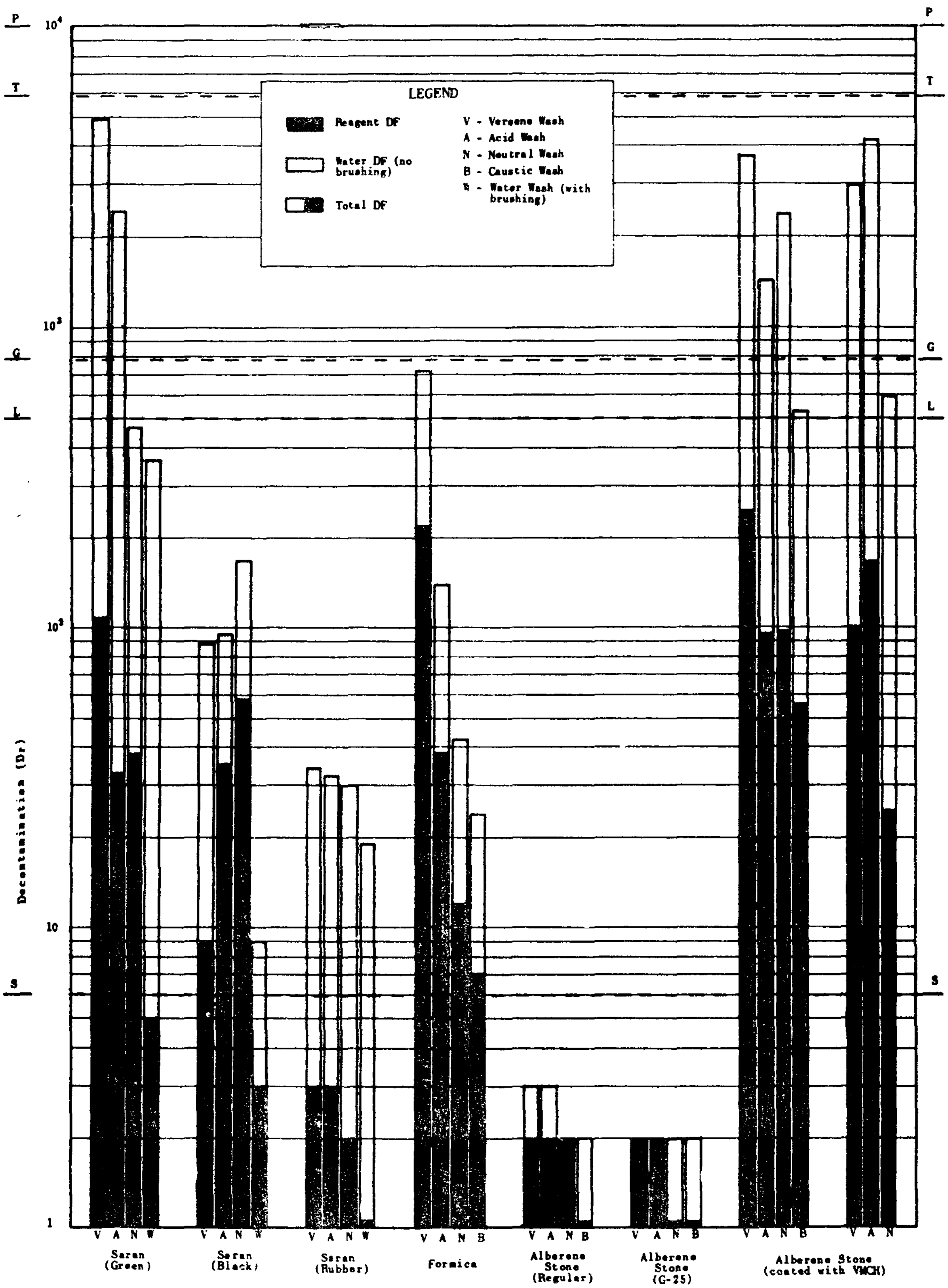

Fig. 6

Laboratory Floor Tiles

Decontamination with Various Reagent Washes

1. Contaminant - Fission products cooled 3 years
2. Activity Applied - 1.56×10^6 counts/min
3. DF (Decontamination Factor) = $\frac{\text{counts applied}}{\text{counts remaining (after reagent wash)}}$

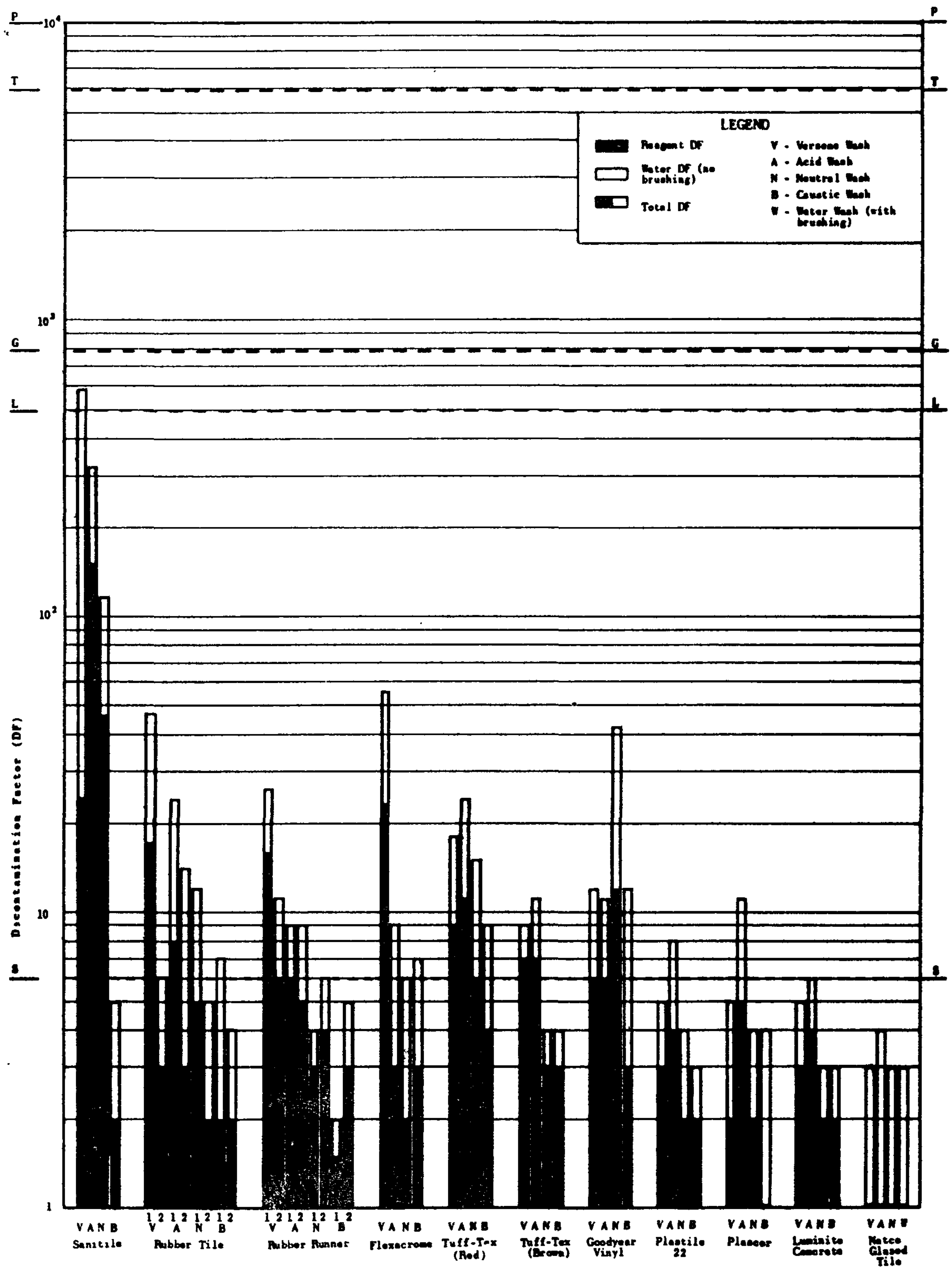

Fig. 7

Chemical Resistance Index

Test Conditions:
Wood dowels coated and immersed in hexone and 3 *M* HNO_3, HCl, H_2SO_4 and NaOH for 7 days. Room temperature (21°C)

Method of Rating	Chemical Index
E - Excellent - No attack in 168 hours	4
G - Good - Failure in 120-167 hours	3
F - Fair - Failure in 48-119 hours	2
P - Poor - Failure in less than 48 hours	1

Maximum Possible Rating - 20
Lowest Possible Rating - 5