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APPLICABILITY OF CHEMICALLY REMOVABLE COATINGS
TO REACTOR CONTAINMENT BUILDINGS

by

B. J. Newby

IDAHO NUCLEAR CORPORATION
NATIONAL REACTOR TESTING STATION
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ABSTRACT

Two methods are described for the rapid remote decontamination of coated interiors of reactor containment buildings contaminated with volatile fission products, namely, the use of chemically stripable or chemically corrodible coatings. Both methods are based on the removal of temporary coatings (containing the contamination) with chemical reagents.

SUMMARY

Two very promising methods of remotely decontaminating the coated inside surfaces of reactor containment buildings contaminated with volatile fission products have been developed; these methods depend upon the use of chemically removable coating systems. Such systems consist of a permanent undercoat to protect the substrate and a temporary outer coating which can be removed, along with sorbed fission products, by chemical reagents. In the strippable coating system the outer coating is rapidly dissolved; in the corrodible coating system the outer coating is gradually removed by prolonged spraying with conventional decontaminating reagents. The most promising strippable coating system evaluated consisted of dissolving Turco 5302 from over Amercoat 66 with isophorone. The most promising corrodible coating system evaluated consisted of a thick coating of Phenoline 368 corroded by alternate treatments with Turco 4502 and oxalic acid. Phenoline 368, which corroded quite uniformly, acted as both the permanent undercoat and temporary outer coating. The characteristics, merits, and disadvantages of these two systems are shown in the following tabulation:

COATING-DECONTAMINATION SYSTEMS FOR RAPID, REMOTE DECONTAMINATION

<u>Coating</u>	<u>Chemically Strippable Coating</u>	<u>Corrodible Coating System</u>
Permanent Undercoat	Amercoat 66	Phenoline 368
Removable Outer Coat	Turco 5302	Phenoline 368
<u>Decontamination</u>		
Reagent	isophorone	alternate treatments with Turco 4502 and oxalic acid
Conditions	70°C for 10 to 15 min.	80°C for about 40 hours
Probable Gross Gamma DF	400	>1000
Safety	isophorone used at 70°C, its flash point (open cup) is 96°C ^[1] ; its ex- plosion hazard has not been extensively inves- tigated ^[2]	any bare metal present sensitive to oxalic acid or an alkaline reagent would be ex- cessively corroded
Waste Management	organic and inorganic wastes must be kept separate or be sepa- rated prior to per- manent storage	coating is removed as small flakes which are difficult to transport to perma- nent waste storage
<u>Servicability</u>		
Chemical Resistance	satisfactory to organic acids and complexing reagents; unsatisfactory to alkaline and oxidiz- ing reagents, and to nitric acid	satisfactory to or- ganic acids, complex- ing, alkaline, and oxidizing reagents; questionable to nitric acid
Resistance to Steam	questionable	satisfactory
Resistance to Radiation	questionable	satisfactory
Durability	fragile	durable

CONTENTS

ACKNOWLEDGEMENT.	ii
ABSTRACT	iii
SUMMARY.	iv
I. INTRODUCTION	1
II. EXPERIMENTAL EQUIPMENT AND PROCEDURE	3
1. CONTAMINATION OF COUPONS	3
1.1 With Molecular Iodine	3
1.2 With Mixed Fission Products	5
2. DECONTAMINATION OF COUPONS	6
2.1 Small Coupons	6
2.2 Large Panels.	6
III. CHEMICALLY STRIPPABLE COATINGS	10
1. SCOPING STUDIES.	10
1.1 Systems Contaminated With Molecular Iodine.	10
1.2 Systems Contaminated With Mixed Fission Products.	12
2. TURCO 5302	16
2.1 Resistance to Pressurized Steam, Chemicals, and Radiation	16
2.2 Effect of Permanent Undercoat	17
2.3 Effect of Substrate	18
2.4 Effect of Strippable Coating Thickness.	18
2.5 Volume of Isophorone Required for Stripping	19
IV. CORRODIBLE COATINGS.	21
1. SCOPING STUDIES.	21
2. DECONTAMINATION BY PROLONGED IMMERSION	25
3. EFFECT OF PERMANENT UNDERCOAT OR PRIMER BETWEEN CORRODIBLE COATING AND PERMANENT UNDERCOAT.	26
4. SOLIDS REMOVED FROM CORRODIBLE COATING SYSTEMS	27
5. THE PHENOLINE 368 CORRODIBLE COATING SYSTEM.	27
5.1 Resistance to Pressurized Steam, Chemicals and Radiation	29
5.2 Coating Removal Without Using Direct Spray.	29
5.3 Solids Removed from Corrodible Coating.	29
5.4 Effect of the Volume of Corroding Solution Recirculated.	30
5.5 Decontamination from Mixed Fission Products	31

6. USE OF THIXOTROPIC STRIPPING REAGENTS	32
V. CONCLUSIONS	33
VI. REFERENCES	34

FIGURES

1. Enlarged view of a chemically removable coating system over concrete substrate	2
2. Laboratory molecular iodine contaminator showing coated steel coupons	4
3. High pressure spraying equipment for small coupons	7
4. High pressure spraying equipment for large panels	8
5. Mixed fission product contamination-decontamination behavior of chemically strippable coatings	15
6. Effect of undercoat upon iodine removal by the use of Turco 5302 stripped with isophorone	18
7. Decontamination as a function of the amount of Turco 5302 stripped from Amercoat 66 with isophorone	20
8. Spraying time needed to remove 7 mils of Phenoline 368 using various volumes of corroding solutions	30
9. Decontamination obtained from Phenoline 368 corrodible coating surface contaminated in the CDE	31

TABLES

I. Scoping Studies on Chemically Strippable Coating Systems Contaminated with Molecular Iodine	13
II. Performance of Potential Corrodible Coatings	23
III. Iodine Decontamination Using Prolonged Immersion	25
IV. Effect of Permanent Undercoat or Corrodible Coating's Primer on Decontamination Using a Corrodible Coating System	28

APPLICABILITY OF CHEMICALLY REMOVABLE COATINGS TO REACTOR CONTAINMENT BUILDINGS

I. INTRODUCTION

Studies were performed to select commercially available coating systems that would protect surfaces from contamination by volatile fission products and could be remotely decontaminated effectively from these fission products. These coatings were to be suitable for application on the interior surfaces of pressurized or boiling water reactor containment buildings with special emphasis on the conditions present during an unperturbed loss-of-coolant accident. A program designed to evaluate such an accident was designated as the Loss of Fluid Test (LOFT) (unperturbed) and has been described in detail elsewhere^[3]. Although most conditions for testing coatings in this work were selected with respect to an unperturbed nuclear accident, the results of this program will be helpful in selecting coatings for any surface where contamination with volatile fission products is possible.

Previous studies showed that surfaces covered with conventional protective coatings that had been contaminated with volatile fission products were extremely difficult to decontaminate, but that a rapid, effective way to decontaminate such a surface in LOFT or any other power reactor containment vessel was to remove a film of significant thickness from the surface^[4]. The use of chemically removable coating systems offers a promising method for remotely decontaminating surfaces by removing the contaminated outer portion of the protective coating. The concept of a chemically removable coating system (over concrete substrate containing expansion joints), as was conceived for possible use in LOFT, is illustrated in Figure 1. Such a system would consist of a permanent base coating containing glass cloth (to prevent the coating system from failing during expansion and contraction of the substrate) to protect the substrate, and an expendable outer coat which could be removed along with the contamination. The outer coating is removed remotely with a

chemical reagent. Two different chemically removable coating systems* were studied:

1. The strippable coating system in which the outer coating was rapidly dissolved by spraying with a chemical reagent,
2. The corrodible coating system in which the outer coating was gradually removed by spraying with decontaminating reagents for long periods of time.

Figure 1 Enlarged view of a chemically removable coating system over concrete substrate.

*

One coating or reagent is not considered generally superior to another because that coating or reagent happened to possess the particular characteristics of immediate interest. The experimental evaluations of protective coatings and reagents reported here were done to obtain information on the performance of these materials in the specific applications and environments described. Any conclusions as to the relative merits of the materials apply only to the specific conditions mentioned. The fact that some materials were observed to be superior or inferior to others in these tests does not imply any general findings of superiority or inferiority.

The successful performance of a protective coating depends on proper surface preparation, proper application, compatibility of the finish coat with the primer, and non-interference of the substrate. In many cases these other properties, as well as the coating, were being studied as indicated by the objectives of the test and the supporting data given. An unfavorable result under these conditions means that use of the particular total system is ill advised, but does not necessarily reflect a general inferiority of the protective coating. Due to lack of space the author has not explained the nature of each failure or the supposed mechanism, but these should be generally obvious to the reader.

II. EXPERIMENTAL EQUIPMENT AND PROCEDURE

Test coupons varied in size, shape, and substrate. Most of the coupons were painted by painters in the Maintenance Branch at the National Reactor Testing Station; some were painted by coating manufacturers. Most of the coatings tested were applied over the substrates that would be most prevalent in the LOFT containment building: carbon steel and concrete. The carbon steel coupons usually used were 1-1/2" x 3/4" x 3/16" rectangles (shown in Figures 2 and 3) or 12" x 12" x 3/16" squares (shown in Figure 4); the concrete coupons used were two-inch cubes made from one-inch slabs cemented together with an elastomer. When testing coatings for their resistance to chemicals, pressurized steam, and radiation, the appearance in moderation of surface phenomena that did not greatly decrease a coating's ability to protect its substrate was not considered to constitute failure. Such phenomena included color changes, chalking, and the appearance of a few small or medium sized unbroken blisters. The following potential defects were sought for in pre- and post-test examination of the coatings and considered in the evaluation: delamination, separation from substrate, cracking, checking, alligatoring, embrittlement, blistering, peeling, and flaking. All observations were made on at least two coupons which had received identical treatment and in most cases the responses of more than two coupons were observed to support a conclusion.

1. CONTAMINATION OF COUPONS

1.1 With Molecular Iodine

The equipment for contaminating coupons with molecular iodine is shown in Figure 2. The coupons to be contaminated were mounted on a rack in the pressurized contaminating vessel. Water was added to the vessel, the vessel sealed, and the water in the bottom of the vessel was heated by means of heating tapes wrapped around the external walls of the vessel until the desired steam pressure (and temperature) was

Figure 2 Laboratory molecular iodine contaminator showing coated steel coupons.

obtained in the vessel. Molecular iodine was generated from 5 ml of a basic sodium sulfite solution containing one millicurie of iodine tracer in the form of sodium iodide, 0.0018 g of iodine carrier in the form of sodium iodide, and 4 ml of 30 percent hydrogen peroxide. This solution was placed in the iodine generator and heated to 400°C. At 400°C the pressure in the iodine generator was much higher than the pressure (the steam pressure at which the coupons were contaminated) in the pressurized contaminating vessel, and when the valve between the iodine generator and the pressurized contaminating vessel was opened, iodine was forced into the pressurized contaminating vessel. (The iodine generator could also be flushed with high pressure air.) The pressurized contaminating vessel was then sealed off, and the coupons allowed to remain in the contaminating atmosphere for 24 hours. The initial steam pressure in the contaminating atmosphere was about 22 psig and this pressure was allowed to decay to about 3 psig over a 24-hour period by reducing the heat supplied to the pressurized contaminating vessel (conditions simulating those of the LOFT (unperturbed) experiment). Coupons were washed with water to remove condensate prior to being analyzed for radioactivity. Counting of iodine activity was done in a gas-flow beta proportional chamber.

1.2 With Mixed Fission Products

Coupons were contaminated with mixed fission products in the Contamination-Decontamination Experiment (CDE) under conditions simulating those of the LOFT (unperturbed) experiment. In the CDE, a fission product mixture is generated by melting a small, highly irradiated, short-cooled fuel capsule in the presence of steam using a radio-frequency induction furnace. The fission products released are transported by the steam to a simulated containment shell which contains materials to be contaminated, sampling devices and filters to be tested. The coupons were washed with water prior to removal from the CDE. The CDE and its operation are described in detail elsewhere^[5]. Iodine was so prominent on surfaces contaminated with mixed fission products under conditions simulating those of the LOFT (unperturbed) experiment that detection of other radioelements was relatively difficult. Thus only iodine and gross gamma activity analyses are usually reported. The principal analytical technique used was gamma spectrometry at various decay times

with correction of the results to time of fuel melting in the CDE.

2. DECONTAMINATION OF COUPONS

2.1 Small Coupons

The decontamination of 1-1/2" x 3/4" x 3/16" coupons and two-inch concrete cubes was carried out with the high-pressure spraying equipment shown in Figure 3. Ten 1-1/2" x 3/4" x 3/16" coupons or four two-inch blocks (holder not shown in Figure 2) could be sprayed at one time. The coupons were turned manually during the spraying period so that all surfaces were sprayed. There was a distance of 15-1/2 inches between the spray nozzle in one end of the spraying tank and the coupons at the other end. The decontamination solution was heated with steam in the solution reservoir to the desired temperature and was pumped from the reservoir through the spray nozzle onto the coupons, fell to the bottom of the spraying tank, drained back to the solution reservoir, and was recirculated through the spray nozzle. The spraying pressure was controlled by controlling the volume of decontaminating solution that was allowed to bypass the spray nozzle. Under normal operating conditions the equipment used a Spraying System Nozzle 1/4 GG SS 6.5 at a spraying pressure of 30 psig and recirculated five gallons of solution at a rate of 1.1 gal/min.

2.2 Large Panels

One 12" x 12" x 3/16" panel and two 1-1/2" x 3/4" x 3/16" coupons could be sprayed at the same time in the high pressure spraying equipment shown in Figure 4. The coupons were turned manually during the spraying period so that all surfaces were contacted. There was a distance of 18 inches between the spray nozzle in one end of the spraying tank and the coupons at the other end. The decontamination solution was heated to the desired temperature by means of the hot plate under the solution reservoir and heating tapes wrapped around the exterior surfaces of the solution reservoir and lines through which the decontamination solution was recirculated. The solution was pumped from the reservoir through the spray nozzle onto the coupons, and recirculated as in the spraying equipment for small coupons described earlier. The spraying pressure could be controlled by controlling the volume of decontamination

Figure 3 High pressure spraying equipment for small coupons.

Figure 4 High pressure spraying equipment for large panels.

solution that was allowed to bypass the spray nozzle, but was usually controlled by varying the speed of the recirculating pump. Under normal operating conditions a Spraying System Nozzle 1/4 GG SS 6.5 was used at a spraying pressure of 30 psig. One to three liters of solution were recirculated at a rate of 4.2 l/min.

III. CHEMICALLY STRIPPABLE COATINGS

One possible method for decontamination of the interior of a pressurized or boiling water reactor containment building is by the use of chemically strippable coatings. Such a coating system would consist of a permanent undercoat to protect the substrate from conditions that might exist in the containment building and a temporary top coat system that could be removed rapidly and dissolved with a solvent along with any contamination present in the top coat. The permanent undercoating system should be resistant to the stripping solvent as well as to the containment building environment. The top coat system should be:

- 1) impermeable to penetration by fission products (especially by iodine),
- 2) readily removable with a solvent (preferably an aqueous solvent),
- 3) resistant to steam,
- 4) comparable to conventional coatings in its contamination properties (a requirement peculiar to the LOFT experiment).

1. SCOPING STUDIES

1.1 Systems Contaminated with Molecular Iodine

Systems recommended by manufacturers, the literature, and by our own experience as having the desired characteristics were scoped in the laboratory using molecular iodine as the contaminant. The coupons were contaminated in the presence of steam at 22 psig and 125°C and allowed to remain in the presence of molecular iodine and steam for 24 hours during which time the steam pressure decayed from 22 to 3 psig. Observations were made concerning: iodine decontamination, resistance of the removable coating to steam, resistance of the permanent coating to stripping reagent, the presence of particles in the used stripping reagent, and the most effective stripping reagent for each system. All systems were stripped with perchlorethylene, isophorone, trichlorobenzene 1M sodium hydroxide, and 3M nitric acid. Many of the systems were stripped

with reagents recommended by manufacturers for their specific product. Perchloroethylene, isophorone, and trichlorobenzene were chosen because of their high flash points, superior solvent properties, availability, and relative inexpensiveness.

Table I shows the results of these scoping studies. Coating response was interpreted as follows:

- (1) Satisfactory decontamination rating if the system decontaminated at least several times better than did conventional coatings decontaminated with conventional reagents;
- (2) Satisfactory steam resistance if the system was not markedly affected when exposed to pressurized steam for 24 hours at 3 to 22 psig (contaminating conditions);
- (3) Questionable steam resistance if the system became quite sticky and runny when subjected to steam under contaminating conditions but sufficient top coat remained over undercoat to obtain an unbroken coating over the undercoat;
- (4) Satisfactory resistance of undercoat to stripping reagent if it was not markedly affected when the system was sprayed 10 minutes with the stripping reagent at the appropriate temperature.

The generic types of some coatings in Table I are not noted because it is obvious or regarded as proprietary information by the manufacturer.

Paint particles were never observed in used stripping reagents, although a small amount of residue could have escaped detection. The iodine contamination on strippable coating systems can be compared to contamination on conventional coatings by noting the contamination on these systems compared with that on Amercoat 33HB (Over Amercoat 66), 3.2 μg of I_2 per in^2 , as shown in Table I. The majority of the strippable coating systems sorbed as much or more iodine than did Amercoat 33HB. In general, isophorone was the most effective stripping reagent. With few exceptions the most effective stripping reagent found for a given system removed the strippable coating from the permanent undercoat effectively under the conditions used. Poor iodine decontamination was obtained from many of the systems because the strippable coating film probably became soft and permeable in the presence of steam, making the coating thinner and a poorer barrier to iodine penetrations. Iodine

decontamination appeared to be affected by the material under the strip-pable coating. For example, iodine decontamination obtained using sodium hydroxide was higher from Beige Air Dry Synthetic LB-1500 over Polyester Isidur LB-2156 than from the same strippable coating over Polyester Isidur LB-1300 or over Epoxy S-303-50. Variation in iodine decontamination as a function of undercoating was probably caused by differences in the ability of the undercoating materials to resist attack by the stripping reagent. For example, Polyester Isidur LB-2156 was sufficiently soluble in sodium hydroxide to give it possibilities as a strippable coating. The most promising strippable coatings of those tested in these preliminary studies were: Carboline 1293, Turco Guard 200, Turco Contam Affix Rem, Turco 5299, Turco 5301, Turco 5302, Turco 5303, Noble Polycote Acid & Alkali Resisting Coating, Beige Air Dry Synthetic LB-1500, Polyester Isidur LB-2156, and Airosol Jet Lacquer. Systems containing these coatings were further evaluated in scoping studies with mixed fission products.

1.2 Systems Contaminated with Mixed Fission Products

Chemically strippable coating systems showing promise in the previous scoping studies were contaminated with mixed fission products in the CDE (CDE Run 3). The contaminated coatings were sprayed for 10 minutes at the appropriate temperatures with the appropriate stripping reagents and rinsed with water. Coupons were analyzed before and after stripping by gamma counting and by gamma scan.

The results are shown in Figure 5. Both the original and final contamination on each surface and the decontamination factor (DF)^[a] obtained for the surface are shown in Figure 5. The behavior of two conventional coatings (Phenoline 302 and Amercoat 66) contaminated in CDE Run 3 and decontaminated by a conventional method is also shown to facilitate determining which strippable coating systems offer a decontamination advantage over conventional coatings. The Phenoline 302 and Amercoat 66 coatings were sprayed for 10 minutes with 2 lb/gal Turco 4502 (an alkaline permanganate reagent) at 80°C, then for 10 minutes with 1/2 lb/gal Turco 4521 (an oxalate-citrate reagent) at 80°C,

[a] The ratio of the contamination on a surface before decontamination to the contamination remaining on the surface after decontamination.

Table I

SCOPING STUDIES ON CHEMICALLY STRIPPABLE COATING SYSTEMS CONTAMINATED WITH MOLECULAR IODINE

Chemically Strippable Coating System	Generic Type		Original Contamination (μg of I_2 per in^2)	Most Effective Stripping Reagent	Iodine Decontamination with Most Effective Stripping Reagent	Resistance of Top Coat to Pressurized Steam (24 hrs at from 3 to 22 psig)	Resistance of Undercoat to Treatment with Most Effective Stripping Reagent
	of Top Coat	Of Undercoat					
Carboline 1293 ^[a] over Carboline Epoxy 150 ^[a]	acrylic		4.0	Isophorone at 70°C	S	S	S
Carboline X1200-43 ^[a] over Phenoline 368 ^[a]		modified Phenolic	8.0	3M Nitric Acid at 80°C	U	Q	S
Carboline X1200-44 ^[a] over Phenoline 368 ^[a]		modified Phenolic	7.6	Isophorone at 70°C	U	Q	S
Carboline X1200-45 ^[a] over Phenoline 368 ^[a]		modified Phenolic	6.2	Isophorone at 70°C	U	Q	S
Turco Guard 200 ^[b] over Amercoat 66 ^[c]	siloxyl	epoxy	2.8	Isophorone at 70°C	S	Q	S
Turco Contam. Affix Rem ^[b] over Amercoat 66 ^[c]	vinyl	epoxy	1.8	Isophorone at 70°C	S	Q	S
Turco 5299 ^[b] over Amercoat 66 ^[c]	siloxyl	epoxy	4.6	Isophorone at 70°C	S	S	S
Turco 5301 ^[b] over Amercoat 66 ^[c]	siloxyl	epoxy	4.7	Isophorone at 70°C	S	S	S
Turco 5302 ^[b] over Amercoat 66 ^[c]	siloxyl	epoxy	12	Isophorone at 70°C	S	S	S
Turco 5303 ^[b] over Amercoat 66 ^[c]	siloxyl	epoxy	5.1	Isophorone at 70°C	S	Q	S
Turco 5304 ^[b] over Amercoat 66 ^[c]	vinyl	epoxy	4.9	Isophorone at 70°C	U	Q	S

[a] Carboline Co.

[b] Turco Products, Inc.

[c] Amercoat Corp.

S = Satisfactory

Q = Questionable

U = Unsatisfactory

Table I

SCOPING STUDIES ON CHEMICALLY STRIPPABLE COATING SYSTEMS CONTAMINATED WITH MOLECULAR IODINE

(cont'd)

Chemically Strippable Coating System	Generic Type		Original Contamination (ug of I ₂ per in ²)	Most Effective Stripping Reagent	Iodine Decontamination with Most Effective Stripping Reagent	Resistance of Top Coat to Pressurized Steam (24 hrs at from 3 to 22 psig)	Resistance of Undercoat to Treatment with Most Effective Stripping Reagent
	of Top Coat	Of Undercoat					
Turco 5305 ^[b] over Amercoat 56 ^[c]	vinyl	epoxy	4.8	Isophorone at 70°C	U	Q	S
Turco 5305 ^[b] over Amercoat 56 ^[c]	vinyl	epoxy	6.0	Isophorone at 70°C	U	Q	S
X-801 ^[d] over Plasite 7155 ^[e]		modified Phenolic	3.0	Isophorone at 70°C	U	S	U
Noble Polycote ^[f] over Amercoat 66 ^[c]		epoxy	1.3	Isophorone at 70°C	S	S	S
Amercoat 33WB ^[c] over Amercoat 66 ^[c]	vinyl	epoxy	3.2	Isophorone at 70°C	U	S	S
Gray Vinyl Finish S-673-19 ^[g] over wood			1.3	Isophorone at 70°C	U	S	
Beige Air Dry Synthetic LE-1500 ^[g] over Polyester Isidur LB-1300 or Epoxy Coating S-303-50 ^[g]	alkyd		0.8	1M Sodium Hydroxide at 80°C	S	S	S
Beige Air Dry Synthetic LB-1500 ^[g] over Polyester Isidur LB-2156 ^[g]	alkyd		0.8	1M Sodium Hydroxide at 80°C	S	S	U
AWRE Barrier Paint ^[h] over Amercoat 66 ^[c]	polyvinyl alcohol emulsion	epoxy	3.7	Isophorone at 70°C	U	S	S
AWRE Wax Barrier Paint ^[h] over Amercoat 66 ^[c]	wax based paint	epoxy	4.6	Isophorone at 70°C	U	S	S
Airosol Jet 8010-721-9746, Blue 15102 Lacquer ^[i] Type 1 over wood			6.8	Isophorone at 70°C	S	S	

[b] Turco Products, Inc.

[c] Amercoat Corp.

[d] Top coat cracked while curing over the permanent undercoating.

[e] Wisconsin Protective Coating Corp.

[f] Noble Paint & Varnish Co.

[g] I-SIS Chemicals, Inc.

[h] Atomic Weapons Research Establishment, U.K.

[i] Airosol Company, Inc.

S = Satisfactory

Q = Questionable

U = Unsatisfactory

Figure 5 Mixed fission product contamination-decontamination behavior of chemically strippable coatings.

with water rinses after each reagent treatment. In CDE Run 3, the concentration of particulate matter in the containment vessel atmosphere (containing coupons to be contaminated) was higher than in other CDE runs. This particulate material affected the decontamination of samples significantly. The decontamination factors obtained from conventional coatings contaminated in CDE Run 3 using the conventional decontamination method mentioned previously were greater by factors ranging from 3 to 60 (depending upon the coating and fission product) than those obtained from coatings contaminated in typical CDE runs. Thus decontamination factors obtained from strippable coatings contaminated in CDE Run 3 should be higher than obtained from these same systems contaminated under typical conditions.

Turco 5302 (over Amercoat 66) stripped with isophorone was the only potential strippable coating system giving greater decontamination factors than the best decontamination factors obtained from decontaminating a conventional coating (Phenoline 302) by conventional methods (see Figure 5). Turco 5302 (over Amercoat 66) stripped with isophorone gave decontamination factors of 1200 and 326 for iodine and gross gamma activity respectively; Phenoline 302 sprayed with Turco 4502 and 4521 gave decontamination factors of 220 and 70; all other systems gave smaller decontamination factors. Turco 5302 had about the same gross gamma and iodine-131 activity sorption as did Amercoat 66 (a conventional coating). Of the strippable coatings studied, Turco 5302 came closest to possessing characteristics desired in a chemically strippable coating as listed in the introduction of Section III. Thus the stripping of Turco 5302 with isophorone was studied in detail.

2. TURCO 5302

2.1 Resistance to Pressurized Steam, Chemicals, and Radiation

Turco 5302 became soft and runny when subjected to pressurized steam at 30 psig and 133°C for one day; within three days of exposure to these conditions sufficient Turco 5302 had run off of 1 1/2" x 3/4" x 3/16" coupons coated with 30 mils of Turco 5302 over Amercoat 66 so as to leave portions of the Amercoat 66 surface exposed.

The chemical resistance of Turco 5302 over Amercoat 66 was tested by submerging the system in 2 lb/gal Turco 4502, 1/2 lb/gal Turco 4521, 1 lb/gal Turco Alkaline Rust Remover, and 3M nitric acid at 60°C for five days (typical conventional aqueous decontamination reagents). The Turco 5302 was markedly affected within one day by Turco 4502; markedly affected between one and five days by Turco Alkaline Rust Remover and 3M nitric acid; and was unaffected by Turco 4521 after five days exposure.

Turco 5302 over an Amercoat 66 undercoat became excessively blistered and embrittled when exposed to a beta-gamma radiation dose rate of 2×10^6 R/hr in air at 45°C until receiving a total dose of 1×10^9 R.

Thus it appears that the Turco 5302 system would need extensive repairs if subjected to pressurized steam exposures of over a day's duration, high radiation fields for prolonged periods of time, and continuous exposure to typical decontaminating reagents for several hours. It is planned to use mildly basic deluge solutions for the cooling and decontamination of reactor containment atmospheres after a nuclear accident. Based on its behavior in more concentrated bases, Turco 5302 would likely deteriorate in contact with these deluge solutions.

2.2 Effect of the Permanent Undercoat

Studies were carried out to establish whether the permanent undercoat affected the decontamination efficiency of a chemically strippable coating system (as suggested by scoping studies previously described). The coating systems studied were contaminated with molecular iodine in the presence of pressurized steam and allowed to remain in the iodine-steam atmosphere for 24 hours. The steam pressure was allowed to decay from an initial pressure of 22 psig to 3 psig over the 24-hour period. The coating systems studied were 12 mils of Turco 5302 over:

- 1) Amercoat 66
- 2) Phenoline 368
- 3) Tanclene

The Turco 5302 was stripped from the coating system by spraying the system for ten minutes with isophorone at 70°C. The permanent undercoat influences the decontamination obtained when removing the Turco 5302. Better decontamination factors were obtained by stripping

Turco 5302 from over Amercoat 66 than from over Tanclene or Phenoline 368 (see Figure 6). The decontamination factors obtained from this study were much smaller than those obtained from the study described in Section III-1.2 because the concentration of radioactive particulate matter on the coated coupons used in the former study was much less than in the latter study.

2.3 Effect of Substrate

Studies were made to determine whether the decontamination behavior of a strippable coating system over concrete was similar to the behavior of the same coating system over carbon steel coupons. Chemically strippable coating systems consisting of 30 mils of Turco 5302 over Amercoat 66 containing glass fiber applied over both concrete and carbon steel coupons were contaminated in the CDE. The steel coupons were 1-1/2" x 3/4" x 3/16" rectangles; the concrete coupons were two-inch concrete blocks containing a silicone elastomer joint. The glass fiber is necessary in the permanent undercoat to prevent the coating system from failing during expansion and contraction of the elastomer joint in the concrete coupon. The contaminated coupons were sprayed for 15 minutes at 70°C with isophorone. The average gross radiation decontamination factor obtained from the coated concrete blocks was 260; the average gross radiation decontamination factor obtained from the coated steel coupons was 180. Thus, the decontamination behavior of a coupon coated with Turco 5302 over Amercoat 66 is essentially independent of whether the substrate is concrete or carbon steel.

2.4 Effect of Strippable Coating

Thickness

Turco 5302 and many of the

Figure 6 Effect of undercoat upon iodine removal by the use of Turco 5302 stripped with isophorone.

other coatings studied possessed most of the characteristics desirable in chemically strippable coatings; however, all of the coatings studied were insufficiently resistant to iodine penetration. Iodine penetrated the strippable coating and contaminated the permanent undercoat; even though the strippable coating was readily removed by a stripping reagent, poor iodine decontamination was obtained from the system. Experiments were carried out to determine if greater decontamination could be obtained by stripping a thicker layer of Turco 5302 from over the Amercoat 66. Unfortunately only two to three mils of Turco 5302 can be applied per coat with a spray gun. Thus, to apply, say, 30 mils of Turco 5302 with a spray gun requires 12 coats which is impractical except for very special applications. One attempt was made by the manufacturer to prepare a special coating which could be applied in thicker layers, but this was not successful.

Systems consisting of 12 mils (6 coats) and 30 mils (12 coats) of Turco 5302 over Amercoat 66 (containing glass cloth) were contaminated in the CDE. The Turco 5302 was stripped by spraying the system for 10 minutes with isophorone at 70°C. Increasing the thickness of Turco 5302 stripped from over Amercoat 66 from 12 to 30 mils increases decontamination considerably (see Figure 7). The iodine decontamination factor of 440 obtained by stripping 30 mils of Turco 5302 from over Amercoat 66 should be considered the maximum that could be expected from such a system contaminated with excessive quantities of gaseous iodine since applying thicker coatings would be completely impractical.

2.5 Volume of Isophorone Required for Stripping

The approximate volume of isophorone needed to strip a given thickness of Turco 5302 from a given surface area of Amercoat 66 was determined. Panels (12" x 12" x 3/16") coated with 30 mils of Turco 5302 over Amercoat 66 (containing glass fiber) were sprayed with various volumes of isophorone at 70°C for 15 minutes. It was found that a gallon of isophorone at 70°C would readily remove 30 mils of Turco 5302 from five square feet of Amercoat 66 within 15 minutes. The Turco 5302 was completely dissolved in the isophorone; i.e. no solids were present.

Figure 7 Decontamination as a function of the amount of Turco 5302 stripped from Amercoat 66 with isophorone.

IV. CORRODIBLE COATINGS

It was found that coatings (together with fission products) could be removed from their substrate in a controlled manner by alternately spraying with an alkaline permanganate reagent and one of several other reagents for long periods of time. This process is not entirely an erosion process since spraying the coatings with water at 80°C for greater than 16 hours did not erode away surfaces of the coatings tested. This process has been called a corrosion process and coatings that are the most readily removed by this process, corrodible coatings. A corrodible coating system applicable to containment buildings would consist of a permanent undercoat (to protect the substrate) covered with a corrodible coating. If it was adequately resistant to steam and radiation, the same coating could be used both as the corrodible outer coat and as the permanent undercoat. The undercoat would contain glass fiber if the system were applied over concrete containing elastomer joints. The corrodible coating (outer coating) should have the following characteristics:

1. Be readily removable with corroding reagents
2. Be removed as small particles so that the particles could be readily slurried out of the containment building to waste storage
3. Be impermeable to penetration by fission products (especially to iodine)
4. Be resistant to steam.

1. SCOPING STUDIES

Studies using conventional techniques to decontaminate conventional coatings showed that some coatings decontaminated better than others^[4]. Perhaps coatings giving the best decontamination results did so because they were less resistant to attack by the decontamination reagents (although not visually so) than other coatings. Therefore the most

decontaminable conventional coatings should be potential corrodible coatings. Scoping studies were made to select coatings having the most desirable characteristics for use as corrodible coatings from among conventional coatings that were most effectively decontaminated with conventional techniques. Since other studies^[4] showed that 1/2 lb/gal oxalic acid, 1 lb/gal Turco Alkaline Rust Remover, 1/2 lb/gal sodium bisulfite, 3M nitric acid, and 1/2 lb/gal Turco 4521 gave about equally good decontamination results when used in combination with Turco 4502, these reagents--used in combination with 2 lb/gal Turco 4502--were studied as corroding reagents. A special effort was made to note the approximate particle size of the various coating particles corroded away from their substrate.

Coated carbon steel coupons were contaminated with molecular iodine under conditions described in Section II-1.1. The coupons were decontaminated by alternately spraying for four-hour periods at 80°C with 2 lb/gal Turco 4502 and then with one of the other reagents previously mentioned under the same conditions until the coupons had been sprayed for a total of 16 hours. The coupons were counted for iodine activity after each four-hour spraying period with Turco 4502 and after each two-hour spraying period with the other reagent. The appearance of the coatings was noted every time the coupons were counted, and the used decontamination solutions were examined for particles of the coating. The coating systems studied were: the Amercoat 66 system, the Amercoat 66 system using Phenoline 368 Primer, the Phenoline 302 system, the Phenoline 368 system, the Chemfast MP White (converted with Catalyst #46802) system using Chemfast E.P. Primer, the Chemfast MP White (converted with catalyst #46802) system using Chem Zinc Primer, the Plasite 7155 system, the Epoxy S-303-50 system, the Tanclene system using an aluminum primer, the Tanclene system using Phenoline 368 Primer, the Phenoline 302 system over the Amercoat 66 system containing glass fiber, and the Tanclene system over the Amercoat 66 system containing glass fiber. The last two systems are representative of a complete corrodible coating system; the other systems are representative of only the outer corrodible coating portion of a complete system.

Results are summarized in Table II. All reagents used in combination with Turco 4502 gave about the same decontamination factor for

Table II

PERFORMANCE OF POTENTIAL CORRODIBLE COATINGS

Coatings were alternately sprayed for 4-hour periods at 80°C with 2 lb/gal Turco 4502 and then with another reagent^[a] until sprayed a total of 16 hours.

Coating System	Generic Type of Coating	Manufacturer	Average Decontamination Factor obtained from all Decontaminating Reagent Combinations	Resistance of Coating System to Prolonged Pressure Spraying
Epoxy S-303-50	epoxy	I-SIS Chemicals, Inc.	18,000	b
Plasite 7155	modified phenolic	Wisconsin Protective Coating Corp.	15,000	b
Phenoline 368	modified phenolic	Carboline Corp.	5,000	c
Phenoline 302	modified phenolic	Carboline Corp.	2,000	c
Chemfast M.P. White using Chemfast E.P. Primer	epoxy	Celanese Coatings Co.	325	d
Chemfast M.P. White using Chem Zinc Primer	epoxy using an inorganic primer	Celanese Coatings Co.	320	d
Tanclene using Phenoline 368 Primer	epoxy using a modified phenolic primer	Red Hand Compositions Co., Inc. - finish coats Carboline Co. - primer	180	d
Amercoat 66 using Phenoline 368 Primer	epoxy using a modified phenolic primer	Amercoat Corp. - finish coats Carboline Co. - primer	100	d
Tanclene using an Aluminum Primer	epoxy using an inorganic primer	Red Hand Compositions Co., Inc.	90	d
Amercoat 66	epoxy	Amercoat Corp.	70	d
Phenoline 302 over Amercoat 66	modified phenolic over an epoxy	Carboline Co.-top coat system Amercoat Corp.-undercoat system	50	c
Tanclene over Amercoat 66	epoxy	Red Hand Compositions Co.,-top coat system Amercoat Corp.-undercoat system	10	d

[a] Other reagents used in combination with Turco 4502 were 1/2 lb/gal oxalic acid, 1 lb/gal Turco Alkaline Rust Remover, 1/2 lb/gal Turco 4521, 1/2 lb/gal sodium bisulfite, and 3M nitric acid.

[b] Coating was readily corrodible, but appearance of coating on coupon at various times during decontamination indicated coating peeled off in larger particles although only small particles were found in used decontamination reagents.

[c] Coating was readily corrodible--appearance of coating on coupon at various times during decontamination indicated coating came off as granules.

[d] Coating was relatively resistant to being corroded from coupon.

equivalent spraying periods for any given coating system. Nitric acid was inferior to the other reagents because it mutilated the coating systems rather than corroding them uniformly and producing small flakes. Large paint particles were found in used nitric acid solutions but not in spent solutions of other reagents (the majority of particles found in the other reagents measured less than 1/16" across their longest dimensions). Spraying the coatings for four hours with a given reagent did not increase the decontamination factors obtained compared to spraying for two hours with the same reagent. Thus, the same decontamination factors could be obtained in a shorter period of time by spraying for shorter periods of time with each reagent, and by alternating treatments with Turco 4502 and the other reagent more frequently. Phenoline 302 and 368, Epoxy S-303-50, and Plasite 7155 had the most desirable corrosion properties, and these were selected for more detailed study. The highest decontamination factors were obtained from Plasite 7155 and Epoxy S-303-50 with Epoxy S-303-50 decontaminating the most rapidly; although, large particles of these coatings were never found in spent reagents other than nitric acid, observations of these coatings remaining on coupons during different phases of decontamination indicated that larger flakes of these coatings could have been formed.

Observations of the Phenoline 302 and 368 coatings remaining on coupons during various phases of decontamination indicated that these coatings came off as small granules. Tanclene was the most durable of the coatings tested. The system of Tanclene over Phenoline 368 looked relatively unaffected even after being sprayed for 16 hours (the combination including nitric acid being an exception). Amercoat 66 was less durable than Tanclene, while Chemfast MP white was less durable than Amercoat 66. The systems of Phenoline 302 and Tanclene over Amercoat 66 were corroded to the point where the Amercoat 66 was showing through the Phenoline 302 and Tanclene, yet very poor decontamination factors were obtained from these systems as compared to Phenoline 302 and Tanclene over carbon steel.

2. DECONTAMINATION BY PROLONGED IMMERSION

There are many areas in the interior surfaces of a containment building that would probably be protected from direct spraying during decontamination. For the corrodible coating system to be effective, surfaces not subjected to direct spray must be decontaminated by indirect spray or runoff. The phenomenon of a solution running over a coating surface was simulated by immersing coated coupons in a decontamination solution which was being stirred gently. Carbon steel coupons (1-1/2" x 3/4" x 3/16") coated with Phenoline 302 were contaminated with molecular iodine as described in Section II-1.1. In one experiment the coupons were alternately immersed for 4-hour periods in a solution of 2 lb/gal Turco 4502 at 80°C and a solution of 1/2 lb/gal Turco 4521 at 80°C until a total exposure time of eight hours with Turco 4502 and eight hours with Turco 4521 had been obtained. In another experiment coupons of the same type were alternately exposed in the same reagents under the same conditions for one-hour periods. Coatings were decontaminated much more effectively in a given period of time by prolonged spraying than by prolonged submersion, other conditions being the same. However, as shown in Table III, prolonged submersion became effective when treatment with decontamination solutions was alternated more rapidly.

Table III

IODINE DECONTAMINATION USING PROLONGED IMMERSION

<u>Basic Decontamination Cycle</u>			<u>Number of Times Basic Cycle Used</u>	<u>Total Immersion Time (hrs)</u>	<u>Average DF for Phenoline 302</u>
<u>Turco 4502</u>	<u>Turco 4521</u>	<u>Turco 4502</u>			
4			1	4	2.0
1	1		2	4	4.3
4	4		1	8	6.2
1	1		4	8	79
4	4	4	1	12	10
1	1		6	12	181
4	4		2	16	9
1	1		8	16	389

Thus, if coated surfaces can be kept wet with a decontamination solution, prolonged spraying could decontaminate that surface even though the surface is protected from direct spraying.

3. EFFECT OF PERMANENT UNDERCOAT OR PRIMER BETWEEN CORRODIBLE COATING AND PERMANENT UNDERCOAT

Studies were carried out to determine how the permanent undercoat or a primer between the permanent undercoat and the corrodible coating affects decontamination by the use of the corrodible coating technique. These studies were also designed to indicate which of the corrodible coatings gave the best decontamination results when applied over a permanent undercoat and roughly the amount of coating removal necessary for a given decontamination factor. The systems studied are indicated in Table IV. These were contaminated with molecular iodine as discussed in Section II-1.1. Coupons were decontaminated by alternately spraying them for 1/2-hour periods at 80°C with 2 lb/gal Turco 4502 and then with 1/2 lb/gal oxalic acid. Coupons were sprayed (with one exception) until the corrodible coating portion of the complete system and the primer (if present) between the corrodible coating and permanent undercoat had been removed. The thickness of coating removed, spraying time used, and decontamination obtained were noted. The spraying was then continued (again with one exception) until a decontamination factor >500 was obtained. The thickness of coating removed and spraying time necessary to obtain a decontamination factor >500 was also noted (see Table IV).

To obtain iodine decontamination factors >500 generally required the removal of the corrodible coating, the primer (if present) between the corrodible coating and permanent undercoat, and a portion of the permanent undercoat. As might be expected, greater decontamination factors were obtained faster from systems having Phenoline 368 as a permanent undercoat, since this was the least resistant to the stripping reagents of the permanent undercoats tested. This fact along with the facts that Phenoline 368 is quite resistant to pressurized steam and radiation and corrodes from a substrate as small particles makes Phenoline 368 a preferred permanent undercoat for a corrodible coating system. The influence on decontamination exerted by the primer located

between the permanent undercoat and the corrodible coating varied with the coating system (see remarks on Table IV). Table IV shows that corrodible coatings must be of the order of 20 mils thick before their removal will give an iodine decontamination factor of 500 without affecting the permanent undercoating. The 20 mils is considered a maximum value since contaminating conditions in the equipment described in Section II-1.1 causes iodine to penetrate much deeper into coatings than conditions present in the CDE or expected in the LOFT (unperturbed) experiment. The system giving the most satisfactory performance consisted of Plasite 7155 over Phenoline 368 with or without a primer between the two coatings. In the latter system, the primer had little influence on decontamination efficiency. Additional corrodible coating studies were not made with Phenoline 302 because this coating came in black and dark green colors only, making it unsuitable for use inside the LOFT containment building where photographs will be taken during the test.

4. SOLIDS REMOVED FROM CORRODIBLE COATING SYSTEMS

Phenoline 368, Epoxy S-303-50, and Plasite 7155 were corroded from 12" x 12" x 3/16" panels with Turco 4502 and oxalic acid while observing the particle size generated from each corrodible coating. Confirming earlier studies using small coupons, Epoxy S-303-50 and Plasite 7155 were corroded from the panels as particles too large to be slurried from containment buildings to waste storage; Phenoline 368 was removed as suitably small particles (of the order of 1/16" across their longest dimension). Thus the corrodible coating tested in greater detail was Phenoline 368.

5. THE PHENOLINE 368 CORRODIBLE COATING SYSTEM

The preceding studies suggested the following corrodible coating system for application to the interior surfaces of boiling and pressurized water containment buildings:

1. Permanent undercoat consisting of:
 - a. 1 coat of Phenoline 368 Primer

Table IV

EFFECT OF PERMANENT UNDERCOAT OR CORRODIBLE COATING'S PRIMER ON DECONTAMINATION
USING A CORRODIBLE COATING SYSTEM

System contaminated with molecular iodine in presence of 3 to 22 psig steam and decontaminated by alternately spraying for 1/2 hour periods at 80°C with 2 lb/gal Turco 4502 and 1/2 lb/gal oxalic acid for long total spraying times.

Corrodible Coating	Primer Between Corrodible Coating and Permanent Undercoat	Permanent Undercoat	Removal of Corrodible Coating Portion of Complete System ^[a]			Total Corrosion Necessary for a DF > 500 ^[b]			Remarks
			Mils of Coating Removed	Spraying Time Necessary (hrs)	Iodine DF Obtained	Mils of Coating Removed	Spraying Time Necessary (hrs)	Iodine DF Obtained	
4 coats Plasite 7155	None	4 coats Phenoline 368	14	8	220	18	13	1042	
3 coats Plasite 7155	1 coat Plasite 7155 Primer	4 coats Phenoline 368	15	8	200	18	13	1990	
4 coats Epoxy S-303-50	None	4 coats Phenoline 368	17	14	430	18	16	1675	Difficult to remove Epoxy S-303-50 uniformly from Phenoline 368 since Epoxy S-303-50 became almost glazed to Phenoline 368.
4 coats Phenoline 302	None	4 coats Phenoline 368	16	12	53	21	16	674	
4 coats Phenoline 302	None	4 coats Amercoat 66	13	11	174	>22	>17	356	
3 coats Phenoline 302	1 coat Phenoline 300	4 coats Tanclene	21	16	704	--	--	--	The Phenoline 300 was quite durable and adhered tightly to Tanclene and Amercoat 66 and thus was difficult to corrode off. A DF > 500 was not obtained until the systems were corroded to the permanent undercoat.
3 coats Phenoline 302	1 coat Phenoline 300	4 coats Amercoat 66	23	17	566	--	--	--	
3 coats Phenoline 302	1 coat Phenoline 300	4 coats Phenoline 368	--	--	--	21	16	562	Difficult to remove Phenoline 300 from Phenoline 368, since Phenoline 300 became almost a part of the Phenoline 368 system; thus was never able to corrode off Phenoline 300.

[a] Includes removal of primer between corrodible coating and permanent undercoat except for system consisting of Phenoline 302 - Phenoline 300 - Phenoline 368.

[b] In most cases this consists of removal of the corrodible coating, the primer between the corrodible coating and permanent coating (if present), and a portion of the permanent undercoat.

- b. 2 to 3 coats of Phenoline 368 Finish containing glass fiber
- c. 1 coat of Phenoline 368 Gloss
- 2. Corrodible outer coating consisting of:
 - a. 3 coats of Phenoline 368 Finish
 - b. 1 coat of Phenoline 368 Gloss

5.1 Resistance to Pressurized Steam, Chemicals, and Radiation

The suggested Phenoline 368 corrodible coating system was unaffected or only slightly affected when subjected to the following conditions:

- (1) Pressurized steam at 30 psig (133°C) for three days
- (2) Submersion at 60°C for five days in 2 lb/gal Turco 4502, 1 lb/gal Turco Alkaline Rust Remover, and 1/2 lb/gal Turco 4521
- (3) Beta-gamma radiation dose of 2×10^6 R/hr in air at 45°C for a total dose of 1×10^9 R.

The system became markedly affected after being submerged in 3M nitric acid at 60°C between one and five days.

In other work it has been shown that Phenoline 368 is resistant to the mildly basic deluge solutions which will be used for the cooling and decontamination of reactor containment atmospheres after a nuclear accident^[4].

5.2 Coating Removal Without Using Direct Spray

Panels (12" x 12" x 3/16") covered with the recommended Phenoline 368 corrodible coating system were alternately sprayed for four-hour periods with 2 lb/gal Turco 4502 and 1/2 lb/gal oxalic acid at 80°C in the equipment described in Section II-2.2. During the entire spraying period one side of the panel was faced toward the spray nozzle and the other side was faced away. The coating on the side of the panel facing away from the nozzle was removed by solution falling on it from the walls of the spraying vessel at a rate greater than 1/2 the rate of coating removal from the face receiving direct spray. This indicates that the corrodible coating could be removed by contact only with the corroding solution and need not necessarily be sprayed directly.

5.3 Solids Removed from Corrodible Coating

Seven mils of coating removed from one square foot of surface area coated with the suggested Phenoline 368 corrodible coating system weighed 0.034 lbs when using Turco 4502 and oxalic acid as the corroding

solutions. All particles removed from this system measured less than 3.3 mm across their longest dimension.

5.4 Effect of the Volume of Corroding Solution Recirculated

The spraying time needed to remove a given amount of corrodible coating from a given surface area increases as the volume of fresh corroding solutions used (recirculated) for each four-hour spraying period is decreased. The removal of an arbitrary thickness of seven mils was used as a reference in a series of tests on the suggested Phenoline 368 corrodible coating system. Figure 8 shows the spraying time needed to remove seven mils of Phenoline 368 from one square foot of substrate recirculating various volumes of corroding solution for each spraying cycle (a four-hour treatment with Turco 4502 plus a four-hour treatment with oxalic acid). The system was sprayed alternately for four-hour periods at 80°C with equal volumes of fresh 2 lb/gal Turco 4502 and fresh 1/2 lb/gal oxalic acid. The total volume of corroding solution needed to remove seven mils of coating from one square foot of substrate was 93, 7.9, and 8.4 gallons when using 46.5, 1.6, and 0.5 gallons, respectively, of corroding solution per spraying cycle which in turn

Figure 8 Spraying time needed to remove 7 mils of Phenoline 368 using various volumes of corroding solution.

took 20, 40, and 130 hours, respectively, of spraying time (see Figure 8). Using less than 0.79 gallons of Turco 4502 and less than 0.79 gallons of oxalic acid for each four-hour spraying period to spray one square foot of Phenoline 368 surface area resulted in a larger total volume of each reagent being used to remove seven mils of coating from one square foot of surface area (greater than 3.95 gallons of Turco 4502 and 3.95 gallons of oxalic acid).

5.5 Decontamination from Mixed Fission Products

A test was made to verify the information learned from the studies discussed in preceding paragraphs concerning the decontamination of coated surfaces using the Phenoline 368 corrodible coating system. A 12" x 12" x 3/16" panel coated with the suggested corrodible coating system was contaminated in CDE Run 5. One side of the panel was alternately sprayed for four-hour periods at 80°C with 0.79 gallons of 2 lb/gal Turco 4502 and 0.79 gallons 1/2 lb/gal oxalic acid until it had been sprayed for a total of 40 hours; the other side of the panel was sprayed in the same manner. This procedure removed seven mils of coating from each side of the panel, and reduced the gross radiation reading from each side of the panel from about 2.2 R/hr at 6" to 0.05 mR/hr at 0.3". Gross radiation readings were taken at various times during the decontamination procedure. Figure 9 shows decontamination factors as a function of spraying time obtained during this decontamination procedure. Thus effective decontamination can be obtained from coated surfaces contaminated with volatile mixed fission products by the use of the Phenoline 368 corrodible coating system.

Figure 9 Decontamination obtained from Phenoline 368 corrodible coating surface contaminated in the CDE.

6. USE OF THIXOTROPIC STRIPPING REAGENTS

A modified version of the corrodible coating system that has some potential consists of spraying a thixotropic stripping reagent (such as Turco EPO-GON Thick or Turco Jet Strip 5292) on a corrodible coating system; allowing the reagent to remain on the coating system for a short time; and rinsing off the reagent, a layer of coating, and fission products with hot water. In actual tests it was difficult to control coating removal with the two Turco stripping reagents mentioned. If the reagents were allowed to remain on the coatings sufficiently long to obtain acceptable iodine decontamination ($DF > 10$ per application), the reagents would penetrate to the substrate and remove large sections of undercoat as well as corrodible coating; if the reagents were allowed to remain on the coating a short time to control coating removal, poor iodine decontamination was obtained ($DF = \sim 2$). These reagents also left a slime on the coatings which would require removal prior to repainting.

V. CONCLUSIONS

The use of chemically strippable coatings offers considerable future potential for rapid remote decontamination of the coated interior surfaces of reactor containment buildings contaminated with volatile fission products. Although the studies described in this report did not demonstrate a chemically strippable coating suitable for containment buildings housing the large pressurized and boiling water reactors of the present and future, such a system can undoubtedly be developed. The most promising strippable coating system tested in the work described in this report, Turco 5302 stripped with isophorone, could be used on an experimental basis or in small installations. In a more ideal strippable coating system an aqueous stripping reagent would be preferred over an organic one since special problems in safety and waste handling are always present with large-scale use of organics. All chemically strippable coatings tested had poor resistance to iodine penetration. The incorporation in these coatings of a substance highly reactive with iodine might be advantageous.

A coating system recommended in containment buildings where there may be repeated steam releases or a release of long duration is the Phenoline 368 corrodible coating system. This system has good resistance to pressurized steam and radiation. Good decontamination factors can be obtained from this system contaminated with volatile fission products by spraying this coating with the appropriate corroding reagents for about 40 hours. Surfaces protected from contact with direct spray can also be decontaminated. The disadvantage of such a system is the disposal problem created by coating solids generated during decontamination. The individual coating particles generated are quite small and could be slurried from containment buildings. However, there is always the possibility of pipe line plugging during transportation to permanent waste storage.

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