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technical BRIEF

Removing Radiological Contamination From Concrete Using Strippable Coatings

Two technologies evaluated for their ability to remove cesium-137 contamination

A radiological attack or dirty bomb detonation might require a massive, long-term evacuation to protect human health. This could greatly interfere with economic and business activities. As a result, there is much interest in technologies that can be used to mitigate the potential damage and help with the cleanup.

The U.S. Environmental Protection Agency evaluated two strippable coating technologies for their abilities to remove cesium-137 (Cs-137) from concrete surfaces:

- Stripcoat TLC Free™ (Bartlett Services Inc.), which apparently binds radiological material only through physical interaction between the radiological material and the cured coating
- Orion™ Strippable Coating (Orion™ SC) (Isotron Corp.), which apparently binds radiological material through chemical and physical interactions when it is cured

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Concrete test coupons were contaminated with Cs-137 and aged for 7 or 30 days. The 7-day and 30-day tests were performed to determine if a rapid response would provide better decontamination efficacy. Figure 1 shows application with a paint sprayer, the method used in this evaluation. The products can also be also applied with brushes or rollers.

Figure 1. Applying the Coating With a Sprayer

The treated surfaces were allowed to cure overnight into a solid coating. The coatings were removed from the concrete surfaces of the 7-day or 30-day cured coupons based on the manufacturers' directions.

The technologies were evaluated for decontamination efficacy; labor costs and requirements; ease of use on irregular surfaces; surface damage; application and removal times; portability and secondary waste generation; utility requirements; and preparation and cleanup effort.

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Test Design

An important objective of the evaluation was to determine if the wet strippable coatings would adhere adequately to a vertical surface. Figure 2 shows several concrete coupons and a test stand loaded with the coupons. To evaluate the decontamination technologies on vertical surfaces (simulating walls), as well as horizontal surfaces (simulating sidewalks and driveways), a test stand was fabricated that held four rows of six concrete coupons to create surfaces that were approximately 90 centimeters (cm) wide × 60 cm deep (horizontal) or tall (vertical). Concrete coupons were made of standard building concrete that met the specifications for both Type I and II Portland cements. Each coupon was 15 cm square and 4 cm thick. Six of the 24 coupons used to construct each surface were contaminated with Cs-137 (approximately 53 microcuries [µCi]).

Figure 2. Concrete Coupons (left) and Test Stand With Contaminated Coupons (right) - H is horizontal and V is vertical, A–F indicate the surface positions

After the coupons were contaminated with Cs-137, some were allowed to age for 7 days and some for 30 days prior to their placement in the test stand for application and removal of the coatings. Following application, the coatings were allowed to dry overnight, and then removed by first scoring an edge with a paint scraper and then pulling the coating off the surface by hand or scraping lightly. Following the manufacturers' recommendations, this application and removal process was repeated three times. Figure 3 shows the removal processes for each coating.

Figure 3. Removal of Stripcoat TLC Free™ (left) and Removal of Orion™ SC (right)

After the final removal of the coatings, the residual radioactivity on the coupons was measured. The decontamination efficacy was determined from the difference in activity before and after application of the decontamination technologies.

Performance and Results

The decontamination efficacy calculated for each of the contaminated coupons is expressed as percent removal (%R). Table 1 gives the Cs-137 activity on the concrete coupons before and after the application of the coatings for the 7-day and 30-day tests in both horizontal and vertical orientations.

- For Stripcoat TLC Free™, the overall average %R for the 7-day and 30-day tests was 32.0 ± 9.9.
- For Orion™ SC, the overall average %R for the 7-day and 30-day tests was 76.2 ± 7.4.
- For each technology, %Rs from the 7-day and 30-day tests were not significantly different from one another.
- For each technology, %Rs from the vertical and horizontal surfaces were not significantly different from one another.

Table 1. Decontamination Efficacy Results for 7-Day and 30-Day Tests

Strippable Coating Technology (Company)	Days Following Contamination and Orientation[a]	Pre-Decontamination Cs-137 Activity µCi[b]	Post-Decontamination Cs-137 Activity µCi[b]	Cs-137 %R[b]
Stripcoat TLC Free™ (Bartlett Services Inc.)	7 H	56.8 ± 1.7	38.3 ± 4.5	32.5 ± 8.5
	7 V	53.5 ± 1.7	38.5 ± 5.3	28.0 ± 9.8
	7 Overall	55.2 ± 2.4	38.4 ± 4.7	30.3 ± 9.0
	30 H	53.2 ± 3.0	34.3 ± 5.8	35.8 ± 8.7
	30 V	55.6 ± 1.4	37.8 ± 7.0	31.9 ± 13.0
	30 Overall	54.4 ± 2.6	36.0 ± 6.4	33.8 ± 10.7
Orion™ SC (Isotron Corp.)	7 H	55.7 ± 1.3	11.3 ± 2.3	79.7 ± 4.1
	7 V	53.6 ± 1.5	12.0 ± 2.6	77.5 ± 5.2
	7 Overall	54.6 ± 1.7	11.7 ± 2.3	78.6 ± 4.6
	30 H	53.6 ± 1.8	12.9 ± 6.5	76.2 ± 11.2
	30 V	53.3 ± 1.9	15.3 ± 3.8	71.5 ± 6.3
	30 Overall	53.5 ± 1.8	14.1 ± 5.2	73.8 ± 9.0

[a] Orientation: H indicates horizontal surface, V indicates vertical surface, and Overall, the average of horizontal and vertical surfaces.

[b] Data are presented in terms of average and standard deviation.

Operational factors gathered from these evaluations are identified and summarized in Table 2.

Table 2. Strippable Coating Operational Factors

Factors	Stripcoat TLC Free™ (Bartlett Services Inc.)	Orion™ SC (Isotron Corp.)
Application and removal	Application: 12 m^2/hr Removal: 4.9 m^2/hr	Application: 4.6 m^2/hr Removal: 1.6 m^2/hr
Ease of use on irregular surfaces	Elastic coating readily peels off surface	Some scraping might be required
Labor requirements	No specialized training	No specialized training
Utility requirements	If sprayer used, 110 v; otherwise none	If sprayer used, 110 v; otherwise none
Portability	Portable	Portable
Secondary waste	Solid waste production: ~0.26 kg/m^2 Solid waste density: ~0.145 g/cm^3	Solid waste production: ~0.5 kg/m^2 Solid waste density: ~0.188 g/cm^3
Surface damage	Minimal, only loose particles removed	Minimal, only loose particles removed
Preparation and cleanup	Product used "as is"; pump rinsed with mineral spirits between applications to avoid clogging	Product requires mixing; pump rinsed with water between applications
Cost	$16.66/$m^2$ for one application	$58.84/$m^2$ for one application

Unit definitions: m^2=square meters, hr=hour, v=volt, g=gram, kg=kilogram, and cubic centimeters=cm^3

The removal rate of Orion™ SC will likely depend on the characteristics of the surface being decontaminated, because some scraping is required for removal. The Stripcoat TLC Free™ can be applied to irregular surfaces and is easily removed across the borders of the coupons.

CONTACT INFORMATION

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