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Standard Specification for Materials to Mitigate the Spread of Radioactive Contamination after a Radiological Dispersion Event[1]

This standard is issued under the fixed designation E2731; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification is intended to provide a basis for identification of materials used to immobilize radioactive contamination, minimize exposure, and facilitate subsequent decontamination.[2]

1.2 This standard provides a set of specifications describing a stabilizer (coating or coating system) to be used to prevent the spread of radioactive contamination. Some of these specifications may prove difficult to meet. A product that meets some, but not all, of the performance specifications herein may have value, and this specification may be used as a guide by which to evaluate such products.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting

D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

E108 Test Methods for Fire Tests of Roof Coverings

3. Terminology

3.1 *Definitions:*

3.1.1 *stabilizer, n*—film-forming product used to physically or chemically hold or bind radioactive particulates. In the case of a muti-part material (for example, compounded) or multi-step process, the term stabilizing system may be used interchangeably with stabilizer.

3.1.1.1 *Discussion*—Stabilization does not mean affecting the radioactivity or the decay process of the radioactive contamination.

3.1.2 *stabilizing agent, n*—active ingredient or compound within the stabilizer that immobilizes radioactive particulates.

3.1.3 *stabilizing film, n*—material that results from the application of the stabilizer.

3.1.4 *stabilizing system, n*—one or more products or procedures, or both, that, when used together, form a stabilizing film to hold or bind particulates that may be radioactive.

3.1.5 *immobilize, v*—to fix in place; to prevent movement or reaerosolization of particulates due to mechanical or environmental forces such as by tracking, precipitation, or wind.

4. Significance and Use

4.1 This specification establishes performance specifications for a stabilizer that is intended to immobilize dispersible radioactive contamination deposited on buildings and equipment as might result from a radiological dispersal device (RDD) event.

4.2 The intended use of the stabilizer addressed in this specification is primarily in an urban environment; however, it may be used in other environments such as suburban or rural areas.

4.3 The stabilizer is intended to be removable during subsequent decontamination and recovery operations. It is intended to reduce: (*1*) migration of the contamination into or

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[2] A list of the radionuclides of interest for the purposes of this specification can be obtained from the U.S. Department of Health and Human Services (HHS) at http://www.remm.nlm.gov/rdd.htm#isotopes. Additional information is available from the Department of Homeland Security (DHS), Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents (PDF - 481 KB) (DHS/FEMA draft document, published in Federal Register January 3, 2006, Z-RIN 1660-ZA02).

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

along buildings, equipment, and other surfaces; (*2*) resuspension of contamination into the air; and (*3*) the spread of contamination as a result of external forces such as vehicular or pedestrian traffic without unduly limiting access to the site.

4.4 An additional feature that would be desirable, but is not a requirement of this specification, would be the ability to act as a decontamination agent when it is subsequently removed. It is expected that a certain amount of contamination will be removed from the treated surface as a function of removing the stabilizing film, thereby accomplishing some degree of decontamination.

4.5 An additional feature that would be desirable, but is not a requirement of this specification, would be the ability to attenuate beta or gamma, or both, radiation.

4.6 The stabilizer is intended to be used as soon as possible after a dispersal event to minimize the spread of contamination and maximize the effectiveness of subsequent remediation activities.

4.7 The stabilizer is intended to reduce the airborne intake hazards of the radioactive contamination.

4.8 The stabilizer shall be applicable to both vertical and horizontal surfaces.

4.9 The stabilizer shall be able to work within a wide range of weather conditions.

4.10 The stabilizer may include constituents that will chemically bind and hold radioactive contamination.

4.11 Depending on the specific formulation used, the stabilizer may be harmful to vegetation.

4.12 The stabilizer shall allow for controlled removal from the site or equipment either through decomposition or physical detachment to decontaminate the site. The stabilizer and the method for controlled removal should result in minimal or no destruction or disfigurement of the substrate.

4.13 The stabilizer is not intended to be used by first responders immediately after an incident.

4.14 The stabilizer is not intended to extinguish fires that may be present at the site of a radiological dispersal.

5. Physical Properties

5.1 The stabilizer shall be compatible with conventional spray, foam, brush, or roll application systems.

5.2 The stabilizer shall also possess properties that allow massive scale-up of application such as by helicopter deployment[4] or long-range land-based deployment (for example, foam cannons or high-reach robotic manipulators).

5.3 The stabilizer is intended for deployment over large outdoor areas and shall be able to be transported to and deployed at a site using conventional vehicles (for example, flatbed truck or fire truck).

5.4 The stabilizing film shall not attract or be a foodstuff for animals, insects, pests, or undesirable bacteria.

5.5 The stabilizing film shall be chemically nonhazardous as defined by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation (DOT).

6. Mechanical Properties

6.1 The stabilizer shall trap radioactive contamination, physically or chemically, or both.

6.2 The stabilizer shall not generate hazardous by-products during preparation, application, or removal under normal conditions.

6.3 The stabilizer shall form a film when applied to vertical and horizontal surfaces in a variety of environmental conditions (for example, wet, dry, freezing, or hot). The range of environmental conditions under which a proposed stabilizer is claimed to be effective shall be specifically stated for each environmental condition (for example, temperature range in °C, relative humidity in %RH, wetness, such as dry, damp, wet, or immersed). Performance under these environmental conditions shall be separately addressed for both the process of application as well as the stabilized period (see 6.4).

6.4 The stabilizing film shall have sufficient mechanical properties to withstand foot traffic, incidental abrasion, and abrasive traffic conditions that are likely to be present in an emergency environment or a decontamination site, or both, to prevent resuspension or tracking of the stabilized contaminant or adherence to responder assets, such as responder personal protective equipment (PPE).

6.5 The stabilizer in its reacted form shall be stable (maintain film integrity) under a variety of outdoor environmental conditions (for example, ultraviolet (UV) exposure, water, high and low temperatures, and common bacteria) for a minimum of one year.

7. Performance Requirements

7.1 *Shelf Life*—The stabilizer shall have a shelf life (see 9.1) which is sufficient to allow cost-effective staging in quantities required by a reasonable municipal protection plan.

7.2 *Working Life*—The stabilizer shall exhibit a working life sufficient to meet a realistic application rate. Working life is defined as the time period between the opening of the material storage container or mixing of components until the prepared material can no longer be successfully applied to the contaminated surface. Working life is heavily dependent on the method of application. The application method is purposely left unconstrained and it is up to the manufacturer to prescribe.

7.3 *Cure Time*—The stabilizer shall form a film that meets the physical, mechanical, and other requirements listed in Sections 5-8 of this specification within 2 h after application.

7.4 The stabilizing film shall immobilize radioactive particles when applied to the following surfaces commonly found in an urban environment: concrete, asphalt, granite, limestone, brick, aluminum, stainless steel, painted and unpainted steel, painted and unpainted wood, glass, and plastic.

[4] International Atomic Energy Agency, Technical Report Series No. 300, "Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident," Vienna, 1989 (all of Chapter 9 and p. 113 of Annex A).

7.5 The stabilizing film shall be nonflammable (Test Methods E108) after curing.

8. Other Requirements

8.1 Personnel applying the stabilizer may be required to wear PPE including respiratory and dermal protection, but the potential for inadvertent exposure to members of the public shall be minimized. Once applied and cured, the stabilizer shall be nontoxic. Any interaction with environmental materials (for example, sunlight, water, soil, or concrete) or subsequently applied chemicals (for example, solvents) shall not leave a hazardous residue, both during the stabilized period as well as after decontamination and removal.

8.2 The stabilizing film shall be readily removable, either physically or chemically, to facilitate site decontamination.

8.3 The stabilizing film shall remain intact for the time period specified in Section 6.

9. Minimum Performance Criteria

9.1 *Shelf Life*—Minimum of 5 years.

9.2 *Tensile Strength (Test Methods D412)*—500 psi (3447 kPa).

9.3 *Adhesion (Test Method D4541)*—>50 psi (345 kPa) on concrete.

9.4 *Abrasion Resistance (Test Method D4060)*—<0.002-oz (50-mg) loss.

9.5 *Tear Strength (Test Method D1004)*—200 psi (1379 kPa).

9.6 *Flammability (Test Methods E108)*—Does not burn.

9.7 *Weatherability*—Stabilizer film meets the above criteria for a minimum of one year under weather conditions as described in 6.5.

9.8 *Dry/Cure Time*—Forms film satisfying the above mechanical criteria within 2 h of application.

9.9 *Toxicity*—Nontoxic as an aerosol, vapor, liquid, or solid after application and curing. A Material Safety Data Sheet (MSDS) must be provided so that appropriate Personal Protective Equipment (PPE) can be selected, if needed, that will provide adequate protection to the personnel handling the uncured stabilizer.

9.10 *Decontamination Factor (DF)*—No minimum, however, a desirable decontamination factor would be >25.0 when applied to urban construction materials contaminated with any of the Department of Homeland Security (DHS) radionuclides of interest. (DF = initial contamination/final contamination measured in standard terms, for example, dpm/100 cm^2).

9.11 *Hazardous Material Category*—Nonhazardous after curing (see 9.8) and removal as waste (see Section 8).

10. Keywords

10.1 cleanup; contain; dirty bomb; dissolve; encapsulate; explosion; extinguish; fallout; fire; fixative; radioactive contamination; radionuclide; RDD; response; resuspension; stabilizer

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(5) U.S. Department of State, "FACT SHEET: Guidance for Responding of Radiological and Nuclear Incidents," available online at http://travel.state.gov/travel/tips/health/health_1184.html.

(6) U.S. Department of Homeland Security (DHS), "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents," available online at: http://hps.org/hsc/documents/DHS-Final_RDDandIND-PAGs.pdf.