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Standard Test Methods for Sorbent Performance of Absorbents¹

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1. Scope

1.1 These test methods cover the development of laboratory test data which describe the performance of absorbent materials used to remove oils and other compatible fluids from water.

1.2 *This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.* (For a specific warning statement see 10.4.)

2. Referenced Documents

2.1 ASTM Standards:²

F 726 Test Method for Sorbent Performance of Adsorbents

2.2 Federal Standard:

Fed. Std. No. 141a Paint, Varnish, Lacquer and Related Materials. Methods of Inspection, Sampling and Testing

2.2-³

2.3 Military Specification:

MIL-I-631D Insulation, Electric, Synthetic Resin Composition, Nonrigid³

3. Terminology

3.1 Definitions:

3.1 General Terminology:

3.1.1 absorption—a process where the material taken up is distributed throughout the body of the absorbing material. gellant—a material such as a colloidal network or other aggregate network that pervades and holds a liquid in a highly viscous fragile structure. Many gels may rapidly liquefy with added heat or ionic/polar addition. These materials are soluble/flowable in excess liquid.

3.1.2 adsorption—a process where the material taken up is distributed over the surface of the adsorbing material.

3.1.3 sorbent—a material used to recover liquids through the mechanisms of absorption or adsorption, or both.

3.2 Definitions of Terms Specific to This Standard:—an insoluble material or mixture of materials used to recover liquids through the mechanisms of absorption or adsorption, or both.

3.1.3 thickener—a material (usually of higher molecular weight) that is soluble in excess liquid. These materials go from dry to gummy (viscoelastic) to flowable and then soluble. The final viscosity depends only on the liquid to solid ratio.

3.1.4 universal sorbent—an insoluble material or mixture of materials that will sorb both hydrophobic and hydrophilic liquid spills.

3.2 Definitions:

3.2.1 oil, oily liquid—substantially water-immiscible organic liquids (limited water solubility) as well as liquids containing dissolved solids. These oily materials may either float, sink, or be dispersed. absorbent—a material that picks up and retains a liquid

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² Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

² 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.

³ Instron Model No. TM, available from Instron Corp., 100-A Royal St., Canton, MA 02021, or equivalent.

³ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

distributed throughout its molecular structure causing the solid to swell (50 % or more). The absorbent is at least 70 % insoluble in excess liquid.

3.2.2 *Type I absorbent (loose)*—an unconsolidated, particulate material without sufficient form to be applied in single units. This type may include particulate blends with other materials, that is, adsorbents to allow use in specific applications.

3.2.3 *Type II absorbent (roll, sheet, pad, blanket, pillow, web)*—a material that has a form and strength sufficient to be lifted and handled when saturated without tearing.

3.2.4 *Type III Absorbent (booms)*—absorbent material in a form whose length substantially exceeds other dimensions. Booms are to be provided with connector units so that they may be coupled to another boom or line. *adsorbent*—an insoluble material that is coated by a liquid on its surface including pores and capillaries without the solid swelling more than 50 % in excess liquid.

3.3 Definitions of Terms Specific to This Standard:

3.3.1 *oil*—a substantially water immiscible organic liquid that will float on water (density less than 1 g/cm³), typically with surface tension less than 40×10^{-3} .

3.3.2 *Type I absorbent (roll, film, sheet, pad, blanket, web)*—a material with length and width much greater than thickness and which has both linear form and strength sufficient to be handled either saturated or unsaturated.

3.3.3 *Type II absorbent (loose)*—an unconsolidated, particulate material without sufficient form and strength to be handled except with scoops and similar equipment.

4. Summary of Method

4.1 The absorbent material is tested using established standard methods, where applicable, and specially developed tests for performance factors.

5. Significance and Use

5.1 These methods are to be used as a basis for comparison of absorbents in a consistent manner.

5.2 These tests are not appropriate for adsorbent materials which are covered in Test Method F 726.

5.3 These methods are not useful for a comparison of absorbents with adsorbents, even though all absorbents exhibit adsorbent properties. Both types of materials have prime areas of utility.

5.4 These methods may not list all the safety and disposal options necessary for safe ultimate disposal of used sorbent material into the environment. Federal, state, and local regulatory rules must be followed.

6. Special Considerations

6.1 *Solubility*—Fluid should not dissolve the absorbent under normal recovery or handling conditions.

6.2 *Reuse*—Used absorbent materials may be recycled under certain conditions. Fluid absorbed cannot be released with squeezing. However, many of the polymeric materials will depolymerize at temperatures at or below those in a refinery pipe still. This means they are recoverable, although in a different form. Along with resource recovery, the harvestability of sorbents will become more important. Lower boiling materials may also be steam stripped from absorbents to recover both fluid and absorbent.

6.3 *Release of Volatiles*—Certain volatile materials picked up by sorbents may create a vapor hazard by increasing the exposed surface area and therefore vapor release. Depending on the material picked up, this may increase fire or health hazard (see 10.4).

6.4 *Release to an Alternative Material Such as Sand*—The tendency to release sorbed liquid to beaches, ground, clothing of personnel, and so forth, both as liquid and vapor can be determined on a basis of priority (see 11.5).

6.5 *Penetration*—Absorbents may be useful as sealing devices and the penetration test will allow a uniform means of determining the efficacy of a material for this use.

7. Apparatus

7.1 *Exterior Exposure Tester*, sufficient for use with Fed. Std. No. 141a, Method 6152 (*optional*).

7.1.1 Actual outdoor exposure in a direction averaging the maximum exposure in a sunny area, such as Southern Florida or Arizona, is desired. Exposure should be listed in months with total sun days.

7.1.2 Actual outdoor exposure for a period of three months at a testing site should be listed.

7.2 *Tension Tester*—Commercially available tester (*optional*).⁴

7.2.1 Use of actual weights suspended from test pieces in turn suspended from a continuous reading hanging scale may be used. Shock loading may be simulated by fastening one end of a unit rigidly and attaching the maximum pickup weight to the bottom end hanging free. The weight can be raised 2.5 cm and released and also 10 cm and again released. This test should be recorded as pass or fail.

7.3 *Continuous Reading Hanging Scales*—A continuous reading hanging scale fitted with a hook or clamp should be used. For testing units, weighing sensitivity shall be ± 2 %. For small samples, postal-type scales may be used (0 to 80 g).

7.4 *Top Loading Balance*, having 0.5-g resolution for samples weighing at minimum 50 g or more. An accuracy of 2 % is desired.

⁴ Instron Model No. TM, available from Instron Corp., 100-A Royall St., Canton, MA 02021, or equivalent.

7.5 *Measuring Tubes*— 10 and 100-mL graduated measuring cylinders of regular laboratory quality.

7.6 *Paper Towels*, for removing excess liquid from the absorbent.

7.7 *Oven-Dried Mason Sand*, for use in checking rate of release. Screen analysis is desired. Optionally, known screen size silica sand can be used.

8. Test Fluids

8.1 Test fluids may be used for general testing, although the actual fluid should be used where possible.

8.2 *Samples Heavier than Water* —For samples heavier than water 1,1,1-trichloroethane (available in many retail stores as nonflammable spot remover) may be used.

8.3 *Low-Viscosity Materials*—For low-viscosity material (like gasoline), use xylene which has a higher flash point. (For safety, a solution containing 10 % methylene chloride can be added to aid in raising flash point.) Materials conforming to 8.2 have a viscosity similar to gasoline but the density difference may have to be adjusted.

8.4 *Polar Solvents*— For polar solvents, use methylisobutylketone (hexone), butylacetate, and so forth.

8.5 *Medium-Viscosity Fluids*—For medium-viscosity fluids, No. 2 fuel oil, diesel fuel, JP-5, Jet A-1 (turbine fuel), or light crude oil (for example, light Arabian or Iranian crude), is recommended.

8.6 *High-Viscosity Fluids*—Nondetergent or C-10 Transformer dielectric oil (specify manufacturer and viscosity) is recommended.

8.7 *Range Finding Fluids*—Ethanol (95 %), acetone, ethylene glycol, cyclohexane, 2-nitropropane are suitable fluids.

9. Conditioning

9.1 Condition three absorbent test specimens at room temperature (21 to 26°C) (70 to 80°F) in a closed vessel with 2.5 cm of water in the bottom. Suspend specimens in vapor space without contacting water for not less than 24 h prior to testing. Condition specimens in the fully exposed state with no coverings or wrapping that would hinder the equilibration process.

9.2 Condition three absorbent test specimens totally immersed in water at room temperature (21 to 26°C) (70 to 80°F) in a vessel with a minimum of 10 cm of water covering the absorbent for not less than 24 h prior to testing. Condition specimens in the fully exposed state with no coverings or wrapping which would hinder the equilibration process.

9.3 *Alternative Temperatures*—If temperature conditions other than room temperature are expected to be important, then the sorbent should be conditioned and tested at the temperature of use in addition to those specified in 9.1 and 9.2.

10. Determination of Physical Characteristics of Absorbents

10.1 *Mildew*—The susceptibility of an absorbent to mildew under normal storage is described in MIL-I-631D. This optional test determines the expected shelf life under conditions which could lead to mildew. This test may be required when it is believed that this condition may exist prior to an emergency.

10.2 *Exterior Exposure*—This optional test may be performed in accordance with Fed. Std. No. 141a, Method 6152. Actual exposure in area of use for one month is preferable. Long-term testing is not necessary for materials that are to be used in emergency situations. For testing purposes both absorbent and adsorbent and other parts of a fabricated unit should be tested or exposed individually and reported.

10.3 *Humidity/Water Resistance*—This test is used to predict the performance of a product stored under high humidity or one that is water-soaked prior to use.

10.3.1 Condition all absorbent test specimens at room temperature (21 to 26°C) (70 to 80°F) in a closed vessel with 2.5 cm of water in the bottom. Suspend the specimens in vapor space without contacting water for 2 days (14 days optional). At the end of the exposure period, test the specimens for oil and water absorbency. Record weights before and after this conditioning.

10.3.2 Weigh specimens that are conditioned in water by being total immersed (8.29.2) immediately after removal from water and again after wringing out all excess water (typical hand wringer for laundry or equivalent). Test specimens for ~~oil~~ test fluid and water sorbency following both weighings.

10.4 *Flammability*— This test should indicate either contribution to an existing fire, that is, a UL rating of 94, if desired, or a simple rating of combustible or noncombustible and flashpoint by Cleveland open-cup. (**Warning**—All sorbent materials, even those considered nonhazardous, take on the characteristics of the material they pick up. If the material is flammable, the used absorbent material is flammable. If the fluid picked up is toxic, then the used absorbent should be handled as a toxic substance. Basic active absorbent and simple fabricated units are adequate for this test.)

11. Determination of Expected Performance

11.1 *General*:

11.1.1 Initial testing for performance can be accomplished with absorbent in the as-received condition. Conditioning as described in Section 9 may be necessary for special use or for special fluids to be absorbed. Good practice requires triplicate testing with results reported as the average.

11.1.2 For all tests, without exception, the fabricated materials or units must remain handleable (without tearing) at the maximum pickup rate reported while being held by a corner of the unit.

11.2 ~~*Oily Material Absorption*~~ Oily Material Absorption (Typically Type II Absorbent)—This test provides a simple method of