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An American National Standard

Standard Test Method for Wax Binder Removal from Equestrian Synthetic Track Surfaces[1]

This standard is issued under the fixed designation F3401; 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 Equine surfaces containing wax-oil based coatings/binders must be treated and cleaned prior to the subsequent material tests described for sand and fiber surfaces. Note: skip this test for surfaces that are not wax coated.

1.2 The procedures described for wax separation employ Soxhlet extraction to remove wax content from the surface and to calculate crude wax percentage in the surface. Procedures are based upon the Soxhlet extraction method, which has been modified for use on equestrian surfaces by Lab/Cor Materials, Seattle, Washington, USA.[2]

1.3 If synthetic fibers are present, then fiber solubility will need to be considered prior to Soxhlet extraction to ensure that the Soxhlet procedure will not damage fiber integrity.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D938 Test Method for Congealing Point of Petroleum Waxes, Including Petrolatum

D1321 Test Method for Needle Penetration of Petroleum Waxes

D6045 Test Method for Color of Petroleum Products by the Automatic Tristimulus Method

3. Terminology

3.1 *Definitions:*

3.1.1 *binder, n*—The binder contributes to improving both the mechanical and hydraulic properties of sand filler. The binder is either melted or emulsified in order to coat sand particles with a thin layer as thick as a few micrometers. After having been applied, the binder coating enhances adherence between sand particles, which leads to a better control of the packing density, and affects elasticity and cohesion. The binder coating also repels water from sand grains, making those hydrophobic, and therefore influences compaction, porosity and permeability of the sand filler. Surfaces manufacturers use three major types of binder, that is, wax, polymers, and polymer enhanced petroleum products. The differences between these binder types can be detected by the difference in the color of these tracks.

3.1.2 *fibers and rubber chips, n*—The other constituents of synthetic soils, besides sand filler and binder, are fibers and rubber chips. Synthetic soils use different types of fibers depending on the manufacturers. Fibers are usually made of synthetic materials, have a length of 1.5 to 2.5 cm and a diameter of 0.01 to 0.4 mm. Fibers originate from recycled carpets, shredded tires, or fibers used in fiber-reinforced concrete. Experimental results collected over the last 20 years indicate that short fibers mixed into soils have a noticeable reinforcement effect (for example, Gray and Ohashi;[4] Michalowski[5]). The fibers increase the cohesion and shear strength of sand fillers, and have also been shown to influence the optimum water content in compaction tests. Rubber chips usually originate from shredded tires. In most synthetic soils,

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[2] Suits, L. D. et al., "Soxhlet Extraction Determination of Composition of Synthetic Soils," *Geotechnical Testing Journal*, Vol. 34, No. 3, 2011, p. 102751.

[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.

[4] Gray, D.H. and Ohashi, H, "Mechanics of Fiber Reinforcement in Sand," *Journal of Geotechnical Engineering*, Vol. 109, No. 3, 1983.

[5] Michalowski, R., "Triaxial Compression of Sand Reinforced with Fibers," *Journal of Geotechnical and Geoenvironmental Engineering*, Vol. 129, No. 2, 2003.

the chips have sizes ranging from approximately 1.3 cm down to the size of sand grains.

3.1.3 *polymers and polymer-enhanced asphaltic products, n*—Polymers and polymer-enhanced petroleum products are the newest types of binder used by manufacturers. At this time, there are only two manufacturers that have explored their application. The track record of these binders is, however, too recent to conclude on their superiority over other types of binders. In the absence of detailed chemical analysis of these products, the manufacture process of which is proprietary, it is reasonable to assume that these products present some similarities with dust suppressants. These dust suppressants include polymer-enhanced resins, which belong to the class of petroleum products.

3.1.4 *sand filler, n*—Sand, which constitutes the largest fraction of synthetic soils, is referred to as filler. Fillers are usually made of silica sand. By nature, silica sand is hydrophilic, that is, tends to retain water on its grain surfaces. Water drops are immediately absorbed by compacted sand surfaces, leaving only the imprints where water drops penetrated the surfaces. The hydrophilicity of sand particles depends on sand mineralogy. When it rains, layers of hydrophilic sand may retain a large amount of water. The grain size distribution of sand filler found in most synthetic soils corresponds to medium fine sands with negligible silt contents. Silts are avoided because they have often unknown and uncontrollable characteristics strongly dependent on geographic locations.

3.1.5 *wax binders, n*—Wax traditionally refers to a substance that bees secrete (beeswax) to construct their honeycombs. Wax may be natural or artificial substance with properties similar to beeswax, namely it is plastic (malleable) at normal ambient temperatures, has a melting point above approximately 45°C (113°F), has a relatively low viscosity when melted, is insoluble in water, and is hydrophobic. Microcrystalline waxes are a type of wax produced by refining petroleum. They are generally darker, more viscous, denser, tackier and more elastic than paraffin waxes, and have a higher molecular weight and melting point. Microcrystalline waxes are typically produced to meet a number of ASTM test methods. These include congeal point [Test Method D938-05 (2005)], needle penetration [Test Method D1321-10 (2010)], color [Test Method D6045-09(2009)], and viscosity [Test Method D445-10 (2010)]. The congealing point is the temperature at which a wax begins to harden into a solid form. The congealing point is a few degrees below the melting point. Harder waxes have a higher melting and congealing point than soft waxes, which makes them more appropriate for the hot temperatures of racing surfaces in California. Harder waxes tend to be more expensive, more hydrophobic, less adhesive, and more difficult to process than soft waxes. Wax blends are mixture of a soft main wax and a hard secondary wax. They enhance the desired qualities of both constituent waxes. Wax blends may exhibit different qualities such as appearance, strength, opacity, hydrophobicity, adhesiveness, cohesiveness, and chemical resistance.

4. Summary of Test Method

4.1 The procedures described for wax separation employ Soxhlet extraction to remove wax content from the surface and to calculate crude wax percentage in the surface.

5. Significance and Use

5.1 Wax binders are critical for synthetic equestrian surfaces to stay together at consistencies desired. Surfaces are designed to prevent injuries and the wax binders are critical to ensure that this happens. Soxhlet extraction of wax binder is an efficient method to determine the amount of wax binder present in a synthetic equestrian surface.

6. Interferences

6.1 The procedure must be carried out twice (2 × 100 g) to ensure that results are within 0.5 to 1 % of one another. A third sample must undergo wax extraction if differences between sample 1 and 2 are greater than this range.

6.2 If using a filter paper bag, care must be taken to ensure that the bag is folded so that none of the surface sample can escape when it is immersed in hot solvent.

6.3 The Soxhlet apparatus works automatically and should be left to run for 6 to 8 h or when the solvent runs clear. Excessive reflux cycles may result in fiber degradation and should be avoided. The apparatus should be checked every hour. The heating mantle may be turned off when the solvent in the Soxhlet chamber is clear, indicating that it has dissolved all wax from the sample.

7. Apparatus

7.1 Fig. 1 below figure shows a diagram of a typical Soxhlet Apparatus.

8. Reagents and Materials

8.1 *Dry Surface Sample*—Approximately 330 g. Sample must have undergone moisture removal procedure.

8.2 *Heating Mantle*—Greater than 200 W needed.

8.3 *Convective Oven*—Any type.

8.4 *Isooctane Solvent* 99+ 2,2,4-Trimethylpentane (isooctane) CAS# 540-84-1.[6]

8.5 *Balance/Scale*—Any style; must be accurate to 0.1 g.

8.6 *Glassware/Soxhlet Apparatus*—Includes the following below:

1000 mL Round Bottom Flask (24/40)
Soxhlet Extractor (55/50 size on Condenser side)
Soxhlet Condenser (55/50)
30 cm Condenser Arm (24/40)
3-way Distillation Adapter (24/40)

[6] The sole source of supply of the solvent (ACS 99+% 4L SKU:31787) known to the committee at this time is Alfa Aesar, 2 Radcliff Rd., Tewksbury, MA 01876, https://www.alfa.com/en/. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

99.5+ Environmental Grade can often be obtained for a similar price.