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Standard Test Method for Determination of Attrition ~~and Abrasion~~ of ~~Powdered~~FCC Catalysts by Air Jets[1]

This standard is issued under the fixed designation D5757; 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

~~1.1This test method covers the determination of the relative attrition characteristics of powdered catalysts by means of air jet attrition. It is applicable to spherically or irregularly shaped particles which range in size between 10 and 180 µm, have skeletal densities between 2.4 and 3.0 g/cm~~

1.1 This test method covers the determination of the relative attrition characteristics of FCC catalysts by means of air jet attrition. Other fine powder catalysts can be analyzed by this test method but the precision of this test method has been determined only for FCC catalysts. It is applicable to spherically or irregularly shaped particles which range in size between 10 and 180 µm, have skeletal densities between 2.4 and 3.0 g/cm^3 (2400 and 3000 kg/m^3) (see IEEE/ASTM SI-10) and are insoluble in water. Particles less than 20 µm are considered fines.

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1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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:*[2]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *Air Jet Index (AJI)*—a unitless value numerically equal to the percent attrition loss at 5 h.

4. Summary of Test Method

4.1 A sample of dried powder is humidified and attrited by means of three high velocity jets of humidified air. The fines are continuously removed from the attrition zone by elutriation into a fines collection assembly.

4.2 The AJI is calculated from the elutriated fines to give a relative estimate of the attrition resistance of the powdered catalyst as may be observed in commercial use.

5. Significance and Use

5.1 This test method is intended to provide information concerning the ability of a powdered catalyst to resist particle size reduction during use in a fluidized environment.

5.2 This test method is suitable for specification acceptance, manufacturing control, and research and development purposes.

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[1] This test method is under the jurisdiction of ASTM Committee D32 on Catalysts and is the direct responsibility of Subcommittee D32.02 on Physical-Mechanical Properties.

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[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.

6. Apparatus

6.1 The air jet attrition system consists of the following:

6.1.1 *Attrition Tube*, a stainless steel tube 710-mm long with a 35-mm inside diameter.

NOTE 1—NPS 1¼-in. pipe, Schedule 40 has the appropriate inside diameter.

6.1.2 *Three 2-mm Long Drilled Sapphire Square Edged Nozzles*, precision drilled 0.381 ± 0.005 mm in diameter. They are mounted equidistant from each other, 10 mm from center and flush with the top surface in a circular orifice plate 6.4-mm thick. The plate is designed to be attached to the bottom of the vertical attrition tube within an air delivery manifold.

6.1.3 *Settling Chamber*, a 300-mm long cylinder with a 110-mm inside diameter and with conical ends reducing to 30-mm inside diameter. The upper cone is approximately 100-mm long and the lower cone is approximately 230-mm long. The chamber is mounted to the top of the attrition tube.

6.1.4 *Fines Collection Assembly*, made up of a 250-mL filtering flask, an extraction thimble connected to the side arms of the flask, and a 200 by 13-mm diameter metal tubing bent to an angle of 125° connecting the top of the flask to the top of the settling chamber.

NOTE 2—The flask may be eliminated and the thimble connected directly to the tubing if the attrition is expected to be low enough to avoid clogging the thimble and creating a backpressure in the settling chamber.

6.1.5 *Rubber Couplers and Seals*, appropriately sized to ensure tight and leak free connections of the system.

6.2 *Air Supply Source*, controlled and capable of maintaining an air flow rate of 10.00 L/min stable to 0.05 L/min at a pressure up to 200 kPa. The air must be at a relative humidity of 30 to 40 % to minimize electrostatic effects.

NOTE 3—The air may be bubbled through a 0.25-m column of deionized water at ambient temperature to obtain the required humidity.

6.3 *Diaphragm-Type Test Meter (dry test meter) or Liquid-Sealed Rotating Drum Meter (wet test meter)*~~, minimum capacity of 30 L/min and maximum scale subdivision of 0.1 L.~~ , minimum capacity of 30 L/min and maximum scale subdivision of 0.1 L. Alternately, an electric mass flow controller may be used.

6.4 *Balance*, 400-g capacity open pan with 0.01-g sensitivity.

6.5 *Desiccator*, with a desiccant grade molecular sieve such as 4A.

6.6 *Muffle Furnace*.

6.7 *Relative Humidity Gage*.

7. Sampling

7.1 Obtain a representative sample of approximately 65 g of material from larger composites by riffling or splitting with the aim of obtaining a sample that represents the size distribution of the larger composite.

7.2 Gently screen the sample through a No. 80 (180 μm) ASTM sieve to remove any particles larger than 180 μm.

7.3 The step in 7.3.1 is followed for all samples except fresh FCC catalysts for proper equilibration at 35 % humidity to avoid absorption of water during the test.

7.3.1 Transfer the presieved sample to a shallow wide dish and place in a humidifier over a saturated calcium chloride solution for 16 h.

7.4 The steps in 7.4.1-7.4.4 are followed for fresh FCC catalysts to ensure a proper moisture level that will not change during the test.

7.4.1 Transfer the presieved sample to a shallow dish and dry it for 1 h in a muffle furnace preheated to 565°C.

7.4.2 Cool the sample to room temperature in a desiccator.

7.4.3 Mix 45 g of the dried and cooled material thoroughly with 5 g of demineralized water ensuring that the water is well dispersed and that there are no lumps of material present.

7.4.4 Allow the sample to stand over a saturated calcium chloride solution in a humidifier for 1 h.

8. Preparation of Apparatus

8.1 Thoroughly clean any residual material from the apparatus by tapping it loose and blowing or vacuuming the dust. Reassemble the system except for the fines collection assembly.

8.2 Turn on the air supply and adjust the relative humidity of the air exiting the settling chamber to a range of 30 to 40 %.

8.3 Connect the inlet of the wet test gas meter to the top of the settling chamber and adjust the humidified air flow to 10.00 ± 0.05 L/min at standard temperature and pressure (STP) (273.15 K and 101.325 kPa). The back pressure should be in the range of 130 to 180 kPa; if it is not, check that the air jet nozzles are clean and within specifications and that there are no leaks in the apparatus connections.

8.4 Prepare two fines collection assemblies and condition the thimbles by installing them on the apparatus in succession and passing the humidified air through the apparatus for 30 min each.

9. Procedure

9.1 Weigh the first conditioned fines collection assembly to the nearest 0.01 g and record its mass.