



Standard Test Method for Accelerated Weathering of Solid Materials Using a Modified Humidity Cell¹

This standard is issued under the fixed designation D 5744; 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 test method covers a procedure that accelerates the natural weathering rate of a solid material sample so that diagnostic weathering products can be produced, collected, and quantified. Soluble weathering products are mobilized by a fixed-volume aqueous leach that is performed, collected, and analyzed weekly. When conducted in accordance with the following protocol, this laboratory test method has accelerated metal-mine waste-rock weathering rates by at least an order of magnitude greater than observed field rates (1).²

1.1.1 This test method is intended for use to meet kinetic testing regulatory requirements for mining waste and ores.

1.2 This test method is a modification of an accelerated weathering test method developed originally for mining wastes (2-4). However, it may have useful application wherever gaseous oxidation coupled with aqueous leaching are important mechanisms for contaminant mobility.

1.3 This test method calls for the weekly leaching of a 1000-g solid material sample, with water of a specified purity, and the collection and chemical characterization of the resulting leachate over a minimum period of 20 weeks.

1.4 As described, this test method may not be suitable for some materials containing plastics, polymers, or refined metals. These materials may be resistant to traditional particle size reduction methods.

1.5 Additionally, this test method has not been tested for applicability to organic substances and volatile matter.

1.6 This test method is not intended to provide leachates that are identical to the actual leachate produced from a solid material in the field or to produce leachates to be used as the sole basis of engineering design.

1.7 This test method is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions.

1.8 This test method is intended to describe the procedure for performing the accelerated weathering of solid materials to generate leachates. It does not describe all types of sampling

and analytical requirements that may be associated with its application.

1.9 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.10 *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:

- D 75 Practices for Sampling Aggregates³
- D 276 Test Methods for Identification of Fibers in Textiles⁴
- D 420 Guide to Site Characterization for Engineering, Design and Construction Purposes⁵
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids⁵
- D 737 Test Method for Air Permeability of Textile Fabrics⁶
- D 1067 Test Methods for Acidity or Alkalinity of Water⁶
- D 1125 Test Methods for Electrical Conductivity and Resistivity of Water⁷
- D 1193 Specification for Reagent Water⁷
- D 1293 Test Methods for pH of Water⁷
- D 1498 Practice for Oxidation-Reduction Potential of Water⁷
- D 2234 Test Methods for Collection of a Gross Sample of Coal⁸
- D 3370 Practices for Sampling Water⁷
- E 276 Test Method for Particle Size or Screen Analysis at No. 4 (4.75-mm) Sieve and Finer for Metal-Bearing Ores and Related Materials⁹
- E 877 Practice for Sampling and Sample Preparation of Iron Ores and Related Materials¹⁰

¹ This test method is under the jurisdiction of ASTM Committee D-34 on Waste Management and is the direct responsibility of Subcommittee D34.02 on Physical and Chemical Characterization.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ *Annual Book of ASTM Standards*, Vol 04.03.

⁴ *Annual Book of ASTM Standards*, Vol 07.01.

⁵ *Annual Book of ASTM Standards*, Vol 04.08.

⁶ *Discontinued*; see 1994 *Annual Book of ASTM Standards*, Vol 07.01.

⁷ *Annual Book of ASTM Standards*, Vol 11.01.

⁸ *Annual Book of ASTM Standards*, Vol 05.05.

⁹ *Annual Book of ASTM Standards*, Vol 03.05.

¹⁰ *Annual Book of ASTM Standards*, Vol 03.06.

3. Terminology

3.1 Definitions:

3.1.1 *acid producing potential (AP), n*—the potential for a solid material sample to produce acidic effluent, based on the percent of sulfide contained in that sample as iron-sulfide mineral (for example, pyrite or pyrrhotite) (3). The AP is commonly converted to the amount of calcium carbonate required to neutralize the resulting amount of acidic effluent produced by the oxidation of contained iron sulfide minerals; it is expressed as the equivalent tons of calcium carbonate per 1000 tons of solid material (4). The AP is therefore calculated by multiplying the percent of sulfide contained in the material by a stoichiometric factor of 31.25 (5).

3.1.2 *interstitial water, n*—the residual water remaining in the sample pore spaces at the completion of the fixed-volume weekly leach.

3.1.3 *leach, n*—a weekly addition of water to solid material that is performed either dropwise or by flooding for a specified time period.

3.1.4 *loading, n*—the product of the weekly concentration for a constituent of interest and the weight of solution collected that may be interpreted for water quality impacts.

3.1.5 *mill tailings, n*—finely ground mine waste (commonly passing a 150- μm (100 mesh screen) resulting from the mill processing of ore.

3.1.6 *neutralizing potential (NP), n*—the potential for a solid material sample to neutralize acidic effluent produced from the oxidation of iron-sulfide minerals, based on the amount of carbonate present in the sample. The NP is also presented in terms of tons of calcium carbonate equivalent per 1000 tons of solid material (4). It is calculated by digesting the solid material with an excess of standardized acid and back-titrating with a standardized base to measure and convert the acid consumption to calcium carbonate equivalents (3, 6).

3.1.6.1 *Discussion*—The AP and NP are specifically applicable to the determination of AP from mining wastes comprised of iron-sulfide and carbonate minerals. These terms may be applicable to any solid material containing iron-sulfide and carbonate minerals.

3.1.7 *run-of-mine, adj*—usage in this test method refers to ore and waste rock produced by excavation (with attendant variable particle sizes) from open pit or underground mining operations.

3.1.8 *waste rock, n*—rock produced by excavation from open pit or underground mining operations whose economic mineral content is less than a specified economic cutoff value.

4. Summary of Test Method

4.1 This accelerated weathering test method is designed to increase the geological-chemical-weathering rate for selected 1000-g solid material samples and produce a weekly effluent that can be characterized for solubilized weathering products. This test method is performed on each sample in a cylindrical cell. Multiple cells can be arranged in parallel; this configuration permits the simultaneous testing of different solid material samples. The test procedure calls for weekly cycles comprised of three days of dry air (less than 10 % relative humidity) and three days of water-saturated air (approximately 95 % relative

humidity) pumped up through the sample, followed by a leach with water on Day 7. A test duration of 20 weeks is recommended (3, 4).

5. Significance and Use

5.1 The purpose of this accelerated weathering procedure is to determine the following: (1) whether a solid material will produce an acidic, alkaline, or neutral effluent, (2) whether that effluent will contain diagnostic cations (including trace metals) and anions that represent solubilized weathering products formed during a specified period of time, and (3) the rate at which these diagnostic cations and anions will be released (from the solids in the effluent) under the closely controlled conditions of the test.

NOTE 1—Examples of products that can be produced from the test include the following: (1) weekly effluent acidity and alkalinity determined by titration and (2) weekly aqueous concentrations of cations and anions converted to their respective release rates (for example, the average release of μg sulfate ion/g of solid material sample/week, over a 20-week period). In acid drainage studies, for example, the average weekly rates of acid production (measured as $\mu\text{g/g/wk}$ of sulfate released) determined from accelerated weathering tests of mine waste samples are compared with the AP present in each sample. The number of years of acidic effluent expected to be produced under laboratory accelerated weathering conditions can then be estimated from this comparison. The years of accelerated weathering required to deplete a mine waste sample's NP are calculated similarly by determining the average weekly calcium and magnesium release rates and dividing the sample's NP by the sum of those rates (7).

5.2 The principle of the accelerated weathering test method is to promote more rapid oxidation of solid material constituents than can be accomplished in nature and maximize the loadings of weathering reaction products contained in the resulting weekly effluent. This is accomplished by controlling the exposure of the solid material sample to such environmental parameters as temperature, volume, and application rate of water and oxygen. Specifically, an excess amount of air pumped up through the sample during the dry- and wet-air portions of the weekly cycle ensures that oxidation reactions are not limited by low oxygen concentrations. Weekly leaches with low ionic strength water ensure the removal of leachable oxidation products produced from the previous week's weathering cycle. The purpose of the three-day dry-air portion of the weekly cycle is to evaporate water that remains in the pores of the sample after the weekly leach. Evaporation increases pore water cation/anion concentrations and may also cause increased acidity (for example, by increasing the concentration of hydrogen ion generated from previously oxidized iron sulfide). Increased acid generation will accelerate the dissolution of additional sample constituents. Precipitation occurs as evaporation continues, and the remaining water becomes over-saturated. Some of these precipitated salts are potential sources of acidity when re-solubilized (for example, melanterite, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$; and jarosite, $\text{K}_2\text{Fe}_6(\text{OH})_{12}(\text{SO}_4)_4$). During the dry-air portion of the cycle, the oxygen diffusion rate through the sample may increase several orders of magnitude as compared to its diffusion rate under more saturated conditions of the leach. This increase in the diffusion rate under near-dryness conditions helps to accelerate the abiotic oxidation of such constituents as iron sulfide. The wet (saturated)-air portion of the weekly cycle enhances the bacteria-catalyzed

oxidation of solid material sample constituents (for example, iron sulfide) by providing a moist micro-environment throughout the available surface area of the 1000-g sample. This micro-environment promotes the diffusion of weathering products (for example, resolubilized precipitation products) and metabolic byproducts (for example, ferric iron) between the microbes and the substrate without saturating the sample and affecting oxygen diffusion adversely.

NOTE 2—Under idealized conditions (that is, infinite dilution in air and water), published oxygen diffusion rates in air are five orders of magnitude greater than in water ($0.178 \text{ cm}^2 \cdot \text{s}^{-1}$ versus $2.5 \times 10^{-5} \text{ cm}^2 \cdot \text{s}^{-1}$ at 0 and 25°C, respectively) (8). However, in the humidity cell setting, corresponding oxygen diffusion rates in porous media are also functions of solid phase porosity and attendant tortuosity. Actual diffusion rates will therefore be somewhat slower than five orders of magnitude.

5.3 This test method has been tested on both coal and metal mine wastes to classify their respective tendencies to produce acidic, alkaline, or neutral effluent, and to subsequently measure the concentrations of selected inorganic components leached from the waste (2-4, 7). The following are examples of parameters for which the weekly effluent may be analyzed:

5.3.1 pH, Eh (oxidation/reduction potential), and conductivity (see Test Methods D 1293, Practice D 1498, and Test Methods D 1125, respectively, for guidance);

5.3.2 Dissolved gaseous oxygen and carbon dioxide;

5.3.3 Alkalinity/acidity values (see Test Methods D 1067 for guidance);

5.3.4 Cation and anion concentrations; and

5.3.5 Metals and trace metals concentrations.

NOTE 3—Sulfate and iron concentrations in the weekly leachates from solid material containing iron-sulfide minerals should be monitored because their release rates are critical measurements of iron-sulfide mineral oxidation rates. Acidic effluent or acid drainage is a consequence of iron-sulfide mineral oxidation and the subsequent aqueous transport of resulting hydrogen ion and oxidation/dissolution products to the receiving environment (for example, surface and ground waters).

5.4 An assumption used in this test method is that the pH of each of the leachates reflects the progressive interaction of the interstitial water with the buffering capacity of the solid material under specified laboratory conditions.

5.5 This test method produces leachates that are amenable to the determination of both major and minor constituents. It is important that precautions be taken in sample preservation, storage, and handling to prevent possible contamination of the samples or alteration of the concentrations of constituents through sorption or precipitation.

5.6 The leaching technique, rate, liquid-to-solid ratio, and apparatus size may not be suitable for all types of solid material.

6. Apparatus

6.1 *Humidity Cell*—A modified column constructed of materials suitable to the nature of the analyses to be performed (see Practices D 3370 for guidance). Multiple humidity cells can be arranged in an array to accommodate the simultaneous accelerated weathering of different solid material types (Fig. 1). Two different sets of humidity cell dimensions are used to accommodate particle size differences present in the solid material:

6.1.1 Cells having suggested dimensions of 10.2-cm (4.0-in.) inside diameter (ID) by 20.3-cm (8.0-in.) height can be used to accommodate coarse solid material samples that have been either screened or crushed to 100 % passing 6.3 mm (¼ in.).

6.1.2 Cells with suggested dimensions of 20.3-cm (8.0-in.) ID by 10.2-cm (4.0-in.) height can be used to accommodate solid material samples that pass a 150- μm (100-mesh) screen (examples would be processed mill tailings or fly ash).

6.1.3 A perforated disk (comprised of materials suitable to the nature of analyses to be performed), approximately 3.15-mm (¼-in.) thick, with an outside diameter (OD) suitable to the suggested vessel ID (6.1.1 and 6.1.2) is elevated approximately 12.5 mm (½ in.) above the cell bottom to support the solid material sample (see Fig. 1).

NOTE 4—The cell and particle size dimensions described above are those used commonly for assessing the potential of waste-rock and mill-tailings samples associated with coal and metal mining operations to produce acidic effluent. A “shoe box”-shaped cell design with similar dimensions is preferred by some researchers (6).

6.2 *Cylindrical Humidifier*, with suggested dimensions of 12.1-cm (4.75-in.) ID by 134.6-cm (53.0-in.) length. The following associated equipment are needed to provide saturated air for the three-day wet-air portion of the weekly cycle:

6.2.1 A thermostatically controlled heating element to maintain the water temperature at 30°C during the wet-air cycle.

6.2.2 An aeration stone (similar to aquarium-aeration equipment) or commercially available gas dispersion fritted cylinders or disks to bubble air into the humidifier water.

6.3 *Flowmeter*, capable of delivering air to each humidity cell at a rate of approximately 1 to 10 L/min/cell.

6.4 *Oil/Water Trap*, 0.01- μm , for inclusion in the feed-air line.

6.5 *BK Bacteria Filter Tube*, for inclusion in the feed-air line, which must be capable of retaining 99.99 % of 0.1- μm particles.

6.6 *Air-Exit Port Bubbler*—A 50-mL Erlenmeyer flask with a rubber stopper containing a vent and air-inlet tube (Fig. 1). The bubbler is connected to the air exit port in the humidity cell lid with flexible tubing. This helps maintain similar positive air pressure throughout all of the humidity cells.

6.7 *Flexible-Tubing Quick Disconnect*—A fitted, two-piece connection placed in the middle of the air-exit port flexible tubing so that the bubbler can be disconnected from the humidity cell to facilitate the measurement of air flow and relative humidity.

6.8 *Separatory-Funnel Rack*, capable of holding 500-mL or 1-L separatory funnels above the humidity cells.

6.9 *Desiccant Column*, 5.1-cm (2-in.) ID by 50.8-cm (20-in.) length, plastic or glass cylinder capped on both ends (one cap should be removable for desiccant replacement), with an air inlet port on the bottom and an air exit port on the top.

6.10 *Dry Air Manifold*—A line of plastic tubing exiting the desiccant column and containing multiple regularly spaced “tee” connectors to supply air to each humidity cell.

6.11 *Filter Media*, such as a 12-oz/yd² polypropylene felt characterized by 22- μm (0.009-in.) diameter filaments. The media should be able to transmit dry air at a rate of 20 to 30

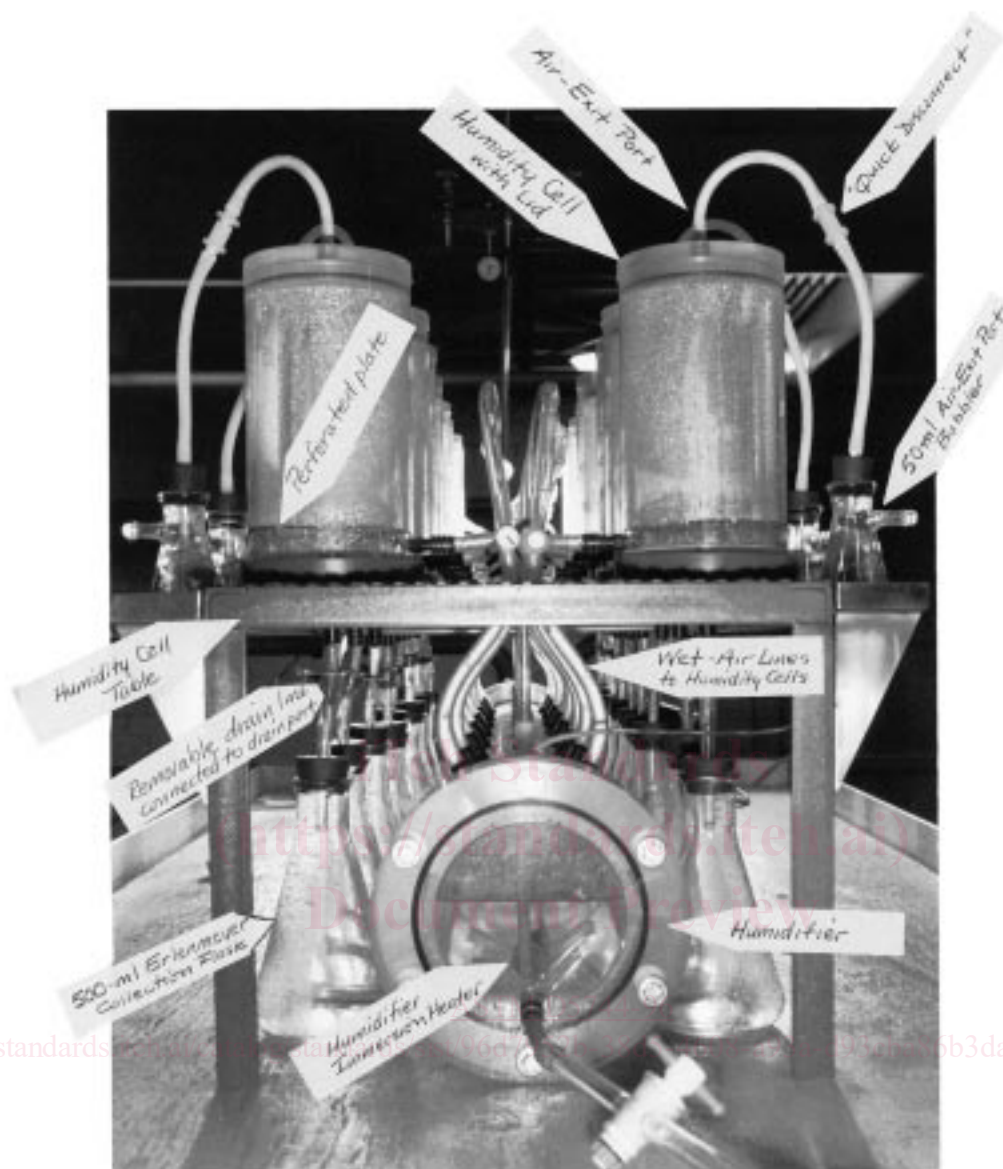


FIG. 1 Side View of 16-Cell Array

cfm (see Test Methods D 276 and D 737 for guidance).

NOTE 5—Caution must be used in the selection of filter media materials since they may affect the effluent pH and chemistry adversely. Both pyrex wool and quartz wool retain as much as 10 to 15 g of water per g of wool (retained water tends to re-humidify the dry-air cycle to as much as 85 % relative humidity). Additionally, pyrex wool causes the neutral effluent pH to be raised by as much as 2 pH units due to leaching of the wool.⁷ In addition, pyrex (borosilicate) can contribute boron if this is a constituent of interest.

6.12 *Two Riffle Splitters*, with 0.63-cm (0.25-in.) and 2.5-cm (1.0-in.) wide riffles, respectively; the riffle splitter is a commonly used device for obtaining representative splits of dry, free-flowing granular materials.

6.13 *Laboratory Balance*, capable of weighing to 0.1 g.

6.14 *Analytical Balance*, capable of weighing to 1.0 mg.

6.15 *Screen*, 6.3 mm (¼ in.).

6.16 *Screen*, 150 µm (100 mesh).

6.17 *Drying Oven*—Any thermostatically controlled drying oven capable of maintaining a steady temperature of $50 \pm 2^\circ\text{C}$.

6.18 *pH Meter*—Any pH meter with a readability of 0.01 units and an accuracy of ± 0.05 units at 25°C ; two-channel operation (that is, pH and Eh) is desirable.

6.19 *Conductivity Meter*, capable of reading in micromohs (microseimens); calibrate at 25°C .

6.20 *Separatory Funnel*, 500 mL or 1 L, one per each humidity cell.

6.21 *Erlenmeyer Flask*, 500 mL or 1 L, one per each humidity cell.

6.22 *Volumetric Flask*, 500 mL or 1 L.

6.23 *Digital Hygrometer/Thermometer*, with a relative humidity range of 5 to 95 %, and temperature range of -40 to

104°C (−40 to 220°F).

7. Reagents

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.¹¹

7.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type III at 18 to 27°C conforming to Specification D 1193. The method by which the water is prepared, that is, distillation, ion exchange, reverse osmosis, electro dialysis, or a combination thereof, should remain constant throughout testing.

7.3 *Purity of Air*—The feed air line shall contain a 0.01- μ m oil/water trap and a grade BK bacteria filter tube in advance of the flowmeter.

8. Sampling

8.1 Collect the samples using available sample methods developed for the specific industry (see Practices D 75 and E 877, Guide D 420, Terminology D 653, and Test Methods D 2234).

8.2 The sampling methodology for materials of similar physical form shall be used where no specific methods are available.

8.3 The amount of material to be sent to the laboratory should be sufficient to provide 8 to 10 kg of bulk sample for splitting and testing (see 9.3).

NOTE 6—Additional information on theory and methods for obtaining representative samples is contained in Pitard (9).

8.4 To prevent sample contamination or constituent loss prior to testing, store the samples in closed containers that are appropriate to the sample type and desired analyses (see Guide D 420 for guidance).

8.5 The time elapsed between sample collection and subsequent humidity cell testing should be minimized to reduce the amount of sample pre-oxidation (see Practices D 3370 for guidance). Report the length of time between sample collection and testing.

9. Sample Preparation

9.1 Air dry as-received bulk samples of solid material to prevent the additional oxidation of reactive minerals or compounds. If air drying is not practicable, oven dry the solid material at a maximum temperature of $50 \pm 2^\circ\text{C}$ for 24 h, or until a constant weight is reached.

9.1.1 If exploration-generated or run-of-mine solid material samples are not readily available, archived dried and crushed samples from geological exploratory or development drilling programs may be used for preliminary evaluations of ore and

waste rock from new operations; this is provided that the available solid material samples are not significantly finer than 95 % passing a No. 12 (1.7-mm) sieve. Document the sample drying and preparation procedures used during the drill sampling program in order to interpret the results properly. Evaluate the effects of drying temperature on metals volatilization (for example, mercury in cinnabar vaporizes at temperatures exceeding 80 to 90°C) and mineral morphology and chemistry modifications (for example, on heating at temperatures exceeding 100°C, chalcocite changes crystal form and is oxidized subsequently from Cu_2S to CuO , CuSO_4 , and SO_2). Especially ensure that the effects of particle size distribution changes resulting from the more finely crushed sample are considered in the interpretation (that is, the potential for increased liberation of acid-producing and acid-consuming minerals with an attendant increase in mineral surface area).

9.1.2 In mining waste evaluations, the particle size for mill tailings will be significantly finer (commonly less than 150 μm /100 mesh) than the particle size distributions from ore and waste rock. Pilot plant tailings should be used if mill tailings are not available.

9.2 Screen the air-dried bulk samples through a 6.3-mm (1/4-in.) screen in accordance with Test Method E 276. Crush any oversize material so that 100 % passes the screen.

NOTE 7—**Caution:** Recent accelerated weathering studies of run-of-mine waste rock from metal mines demonstrate that crushing a bulk sample so it passes a 6.3-mm (1/4-in.) screen may change the character of the sample by artificially increasing liberation and consequent surface areas of acid-producing and acid-consuming minerals contained in the + 6.3-mm (1/4-in.) material. A suggestion for avoiding this problem is to segregate the − 6.3-mm (1/4-in.) fraction by screening rather than crushing, and to test that fraction according to the protocol and equipment described in this test method. The + 6.3-mm (1/4-in.) material can be tested separately (for example, Brodie, et al (10) describe a large-scale humidity cell test that would accommodate − 75-mm material). Samples from the drill core and cuttings also present material sizing problems, which must be considered when interpreting drill core and cuttings accelerated weathering data. The drill core must be crushed to − 6.3-mm (1/4-in.) to fit the cell described in this test method. The resulting size distribution from crushing will differ from that of run-of-mine due to differences in fracture patterns inherent to blasting practices that produce run-of-mine material. By contrast, drill cuttings size fractions are commonly less than 6.3-mm (1/4-in.) due to the rotary-percussive nature of obtaining the sample.

9.3 Mix and divide the bulk sample to obtain a representative test unit with a weight in the range of 8 to 10 kg, using a riffle splitter with 1-in. (2.54-cm) chutes. Divide the test unit into eight nominal 1-kg test specimens. Seal each test specimen in a moisture-barrier bag.

NOTE 8—The dried sample should be mixed through the riffle splitter at least once before making any splits; recombine the splits resulting from the sample mixing exercise by pouring individual splits either over each other or through the splitter again. Once the actual split is made, it is wise to re-mix it (according to the above procedure) prior to making the next split.

9.4 Select one test specimen at random, and determine the moisture content by weighing and drying to constant weight at $80 \pm 5^\circ\text{C}$.

9.4.1 Crush the dried test specimen so that at least 95 % passes a 1.7-mm (10-mesh) screen, in accordance with Test Method E 276.

¹¹ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.

9.4.2 Divide the crushed test specimen in half twice, using a riffle splitter with 6.35-mm (1/4-in.) chutes, and select a 1/4 subsample at random.

9.4.3 Transfer the selected subsample to a ring and puck grinding mill and grind to a nominal 95 % passing a 150- μ m (100-mesh) screen, in accordance with Test Method E 276. Use the subsample for chemical and mineralogical characterization of the test unit.

9.5 Select one test specimen at random, and determine the particle size distribution in accordance with Test Method E 276.

9.6 Select one test specimen at random for use in the accelerated weathering test method. Divide the test specimen into four nominal 250-g subsamples using the riffle splitter with 25.4-mm (1-in.) chutes, and label and store in vapor-barrier bags until it is time to load the humidity cells.

9.7 Reserve the remaining test specimens for replicated testing or to resolve disputed results.

10. Apparatus Assembly

10.1 The humidity cells are table-mounted at a height sufficient to accommodate the placement of both the humidifier and one Erlenmeyer flask for effluent collection from the bottom of each cell (Fig. 1). During the water-saturated and dry-air portions of each weekly cycle, feed air is metered to the bottom of each cell at the selected rate (1 to 10 L/min). Feed air

for the three-day dry-air portion is routed first through a desiccant column and then to each of the cells through a dry-air manifold (Fig. 2 and Fig. 3). Feed air for the water-saturated air portion is routed through a water-filled humidifier by means of aeration stones or gas dispersion fritted cylinders/disks, and then to each humidity cell (Fig. 2). Attach a water-bubbling vessel to each humidity cell lid air exit port to prevent the short circuiting of air through cells containing more permeable solid material samples (Fig. 1). A separatory funnel rack is mounted on the table that holds the cells if the weekly water leach is applied dropwise (drip trickle). Multiple separatory funnels (one for each cell) are held in the rack during the drip trickle leach that is performed on the seventh day of each weekly cycle (Fig. 2). The separatory funnel can be used to meter the required water volume slowly down the sides of the cell wall until the sample is flooded if the weekly leach is to be a flooded leach.

11. Procedure

11.1 Cell Loading:

11.1.1 If more than one humidity cell is used at one time, label each with a sequential number, and use the same number for the matching collection vessel (Erlenmeyer flask).

11.1.2 Weigh each humidity cell (without its lid) and each collection vessel; record the tare weights of each to the nearest 0.1 g.



FIG. 2 Front View of 16-Cell Array with Separatory Funnel Rack