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## Standard Practice for Exposing Plastics to a Simulated Active Landfill Environment<sup>1</sup>

This standard is issued under the fixed designation D 5525; 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 practice covers the exposure of plastics to a specific test environment. The test environment is a laboratory-scale reactor that simulates a landfill with enhanced biological activity. Biological activity is enhanced by adding moisture, recirculating leachate, and heating to 35°C. Plastic exposure occurs in the presence of a media undergoing anaerobic degradation. The standard media used in the practice simulates a municipal solid-waste stream. The practice allows for the use of other media to represent particular waste streams. This practice provides exposed specimens for further testing and for comparison with controls. This test environment does not necessarily reproduce conditions that could occur in a particular landfill.

1.2 Changes in the material properties of the plastic and controls should be determined using appropriate ASTM test procedures. Changes could encompass physical and chemical changes such as disintegration and degradation.

1.3 This practice may be used for different purposes. The interested parties therefore must select the following: exposure conditions from those allowed by this practice; criteria for a valid exposure, that is, minimum or maximum change requirements for the simulated landfill environment and controls; and magnitudes of material properties changes required for the plastic specimens.

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

1.5 *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. Specific hazards statements are given in Section 8.*

NOTE 1—There is no similar or equivalent ISO standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>2</sup>
- D 638 Test Method for Tensile Properties of Plastics<sup>2</sup>
- D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting<sup>2</sup>
- D 883 Terminology Relating to Plastics<sup>2</sup>

D 1898 Practice for Sampling of Plastics<sup>2</sup>

D 1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method<sup>2</sup>

D 3593 Test Method for Molecular Weight Averages and Molecular Weight Distribution of Certain Polymers by Liquid Size-Exclusion Chromatography (Gel Permeation Chromatography—(GPC) Using Universal Calibration<sup>3</sup>

D 3826 Practice for Determining Degradation End Point in Degradable Polyolefins Using a Tensile Test<sup>3</sup>

E 1196 Test Method for Determining the Anaerobic Biodegradation Potential of Organic Chemicals<sup>4</sup>

2.2 *American Public Health Association Standard:*  
5210 B. 5-Day BOD Test<sup>5</sup>

### 3. Terminology

3.1 *Definitions*—Definitions of terms applying to this practice appear in Terminology D 883. Definitions in Terminology D 883 supersede those presented in this section.

#### 3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *anaerobic*—a life process that occurs in the absence of oxygen (based on Ref (1)).<sup>6</sup>

3.2.2 *anaerobic digester sludge*—the semi-solid residue from an anaerobic biological reactor at a municipal wastewater treatment system.

3.2.3 *biological reactor*—a vessel in which living organisms, usually microorganisms, catalyze a reaction.

3.2.4 *degradation*—the process by which a chemical is reduced to a less complex form (1).

3.2.5 *disintegration*—physical breakup of a solid material.

3.2.6 *enhanced biological activity*—an increased metabolic rate resulting from favorable environmental conditions.

3.2.7 *inoculum*—microorganisms placed in a simulated-landfill environment to start or accelerate biological action (1).

3.2.8 *landfill*—a disposal site in which solid waste is spread in layers, compacted to the smallest practical volume, and covered at the end of each operating day (based on Ref (1)).

3.2.9 *leachate*—a liquid that results from water collecting contaminants as it trickles through a waste (based on Ref (1)).

3.2.10 *moisture-holding capacity (MHC)*—the maximum fraction of moisture that the matrix will retain against

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 11.04.

<sup>5</sup> *Standard Methods, For the Examination of Water and Wastewater 18th ed.*, 1992, published by American Public Health Association, 1015 Fifteenth St., NW, Washington, DC 20005.

<sup>6</sup> The boldface numbers in parentheses refer to the list of references at the end of this standard.

gravity. At MHC, any liquid applied at the top causes a discharge of liquid at the bottom.

3.2.11 *simulated landfill environment*—a biological reactor containing a solid-waste matrix, devoid of oxygen, and in which anaerobic degradation occurs due to the action of microorganisms and other mechanisms.

3.2.12 *simulated solid waste*—a media representing a typical waste stream. Although every item found in an actual stream is not included, it includes representative items that establish a consistent and easily reproducible waste matrix.

#### 4. Summary of Practice

4.1 This practice consists of the following: (1) preparing a representative simulated solid-waste mixture; (2) loading the biological reactor with controls, test specimens, and simulated solid waste; (3) inoculating, operating, and monitoring the biological reactor to ensure active biological degradation; and (4) removing the specimens for cleaning (if desired), conditioning, testing, and reporting.

#### 5. Significance and Use

5.1 Changes to the material properties of a plastic within a landfill by various mechanisms, such as biodegradation or hydrolysis, are important. Such changes can affect the degradation of other materials enclosed by the plastic and the resulting volume reduction. This practice allows screening of the stability of plastics exposed to a biologically active anaerobic environment simulating landfill conditions. ASTM test methods conducted on plastic products or specimens before and after exposure in accordance with this practice can determine the degree to which material properties of the plastic have changed.

5.2 This practice does not preclude the pre-exposure of the test specimens to other environments.

##### 5.3 Limitations:

5.3.1 Due to the wide variation in the construction, operation, and content of landfills, and due to variations in regulatory requirements for landfills, this procedure does not simulate the environment of all landfills. However, it is expected to simulate the environment of a biologically active landfill operated under near optimum conditions.

5.3.2 Appropriate post-exposure testing is not included in this practice, but it is addressed by other ASTM test methods.

5.3.3 Predicting the long-term fate or effects of a plastic from the results of short-term exposure in accordance with this practice could be difficult. Caution should be exercised when considering such extrapolations.

5.3.4 A specimen that becomes indistinguishable from other materials within the system could be not fully mineralized. Determination of degradation products and their toxicity requires further testing. Tests that could be valuable for evaluating such materials include Test Method E 1196.

#### 6. Apparatus

6.1 *Biological Reactor*, for containing the simulated solid waste and plastic specimens in a suitable environment. This may consist of a 30-cm (1-ft) diameter  $\times$  60-cm (2-ft) long column. Reactor sizes may be increased or decreased to a size appropriate for the specimen being exposed. The reactor size should not be so small that it prevents an even

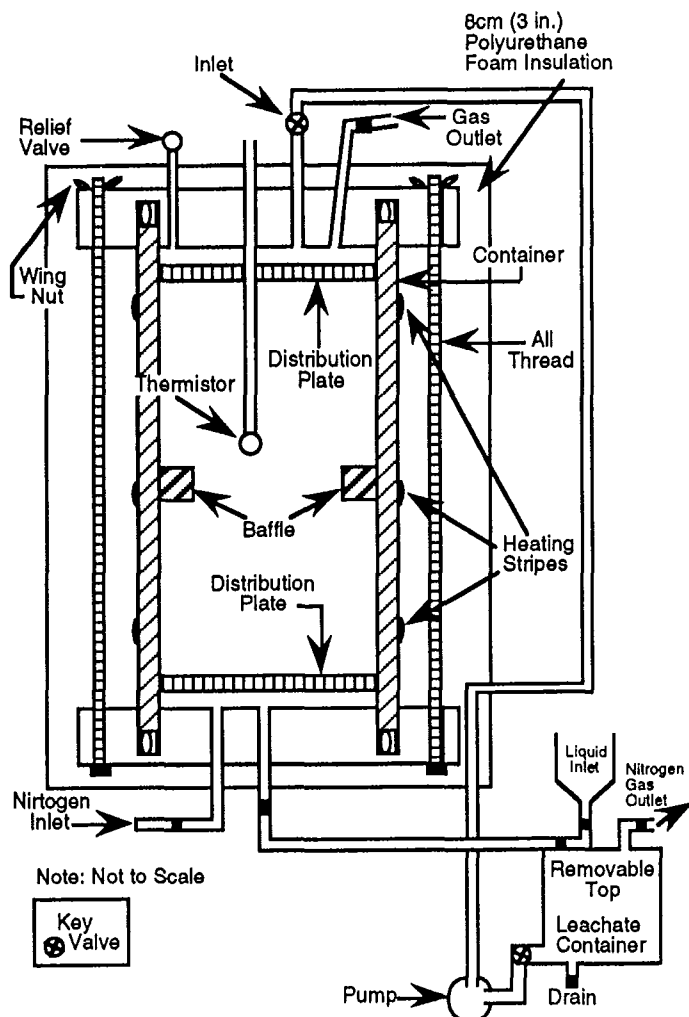


FIG. 1 Typical Apparatus

distribution of waste components throughout the column. The diameter-to-length ratio should be in the range of 1:1 to 1:3. Columns should be fitted with removable end caps that provide a hermetic seal when attached. Construct the reactor and appurtenances of a non-corrosive, chemically inert material. Fit the bottom bulkhead with a valved nitrogen-gas inlet and a valved leachate drain. Fit the upper bulkhead with a valved inlet for adding leachate or water, a valved outlet for venting generated gases, a pressure-relief device, and a temperature-measuring device for reactor-core-temperature measurement. Mount a distribution plate on the column 1.3 cm (1/2 in.) above the bottom bulkhead, and perforate it with 50 uniformly distributed 1.6-mm (1/16-in.) holes. Midway between the top and bottom of the column, extend a baffle 2.5 cm (1 in.) into the simulated solid waste to reduce any wall effects. The top of the column shall have a distribution plate identical to that in the column bottom.

6.2 *Insulation*, to cover the entire vessel.

6.3 *Optional Center Tube*—A sturdy hollow metal or plastic tube for use during packing of the reactor. This tube should extend from above the top to approximately half-way down the middle axis of the reactor. It should be long and narrow enough to extend through the hole for the temperature-measuring device in the center of the top distribution