



Designation: D 5247 – 92

Standard Test Method for Determining the Aerobic Biodegradability of Degradable Plastics by Specific Microorganisms¹

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1. Scope

1.1 This test method describes the procedures required to carry out a pure-culture study for evaluating the biodegradation of degradable plastics in submerged culture under aerobic conditions. Degradation will be evaluated by weight loss, tensile strength loss, percent-elongation loss and changes in molecular-weight distribution.

1.2 *This standard does not purport to address all of the safety problems, 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 638 Test Method for Tensile Properties of Plastics²

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting²

D 3536 Test Method for Molecular Weight Averages and Molecular Weight Distribution of Polystyrene by Liquid Exclusion Chromatography (Gel Permeation Chromatography—GPC)³

G 22 Practice for Determining Resistance of Plastics to Bacteria⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *degradable plastic*—a plastic designed to undergo a significant change in its chemical structure under specific environmental conditions resulting in a loss of some properties that may vary as measured by standard test methods appropriate to the plastic and the application in a period of time that determines its classification.

3.1.2 *residual plastic*—the remaining plastic material in the culture medium after incubation with shaking.

3.1.3 *uninoculated control*—a plastic that is chemically disinfected and incubated with shaking in the same manner as test samples but without exposure to microorganisms.

3.1.4 *zero control*—a plastic without disinfection or cultural incubation; the starting material.

4. Summary of Test Method

4.1 The test method described herein follows the method developed by Lee et al.⁵ and consists of the following steps:

4.1.1 Cut degradable plastic samples into appropriate lengths suitable for tensile strength determinations as specified in Test Methods D 882 and a suitable size for a 250-mL Erlenmeyer shake-flask.

4.1.2 Plastic strips are chemically disinfected, aseptically dried, and initial weights determined.

4.1.3 Disinfected plastic strips are aseptically added to the appropriate growth medium, incubated with shaking for 24 h (125 r/min; orbital shaker) at the appropriate temperature for the specific microorganism being used. If not contaminated (contaminated medium becomes cloudy) the medium is then inoculated with a pure culture.

4.1.4 Inoculated and uninoculated-control flasks are incubated with shaking for specified period of time. Each film is evaluated with a minimum of four replicates with and without each microorganism.

4.1.5 Residual plastic strips are washed in 70 % ethanol for 30 min and dried.

4.1.6 Biodegradation is determined by weight loss, tensile-strength loss, percent-elongation loss, and average-molecular-weight distribution changes.

4.1.7 Significant differences between the inoculated flask and its corresponding uninoculated-control film are determined by performing an analysis of variance ($p < 0.05$).

5. Significance and Use

5.1 Several states in the United States and many European countries have required the use of degradable plastics in disposable products. As a result, several regulatory agencies

¹ This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.96 on Environmentally Degradable Plastics.

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² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 08.02.

⁴ Annual Book of ASTM Standards, Vol 08.03.

⁵ Lee, B., Pometto III, A. L., Fratzke, A., and Bailey Jr., T. B., "Biodegradation of Degradable Plastic Polyethylene by *Phanerochaete* and *Streptomyces*," *Applied Environmental Microbiology* 57, 1991, pp. 678–685.