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Standard Guide for Assessing Biodegradability of Hydraulic Fluids[1]

This standard is issued under the fixed designation D6006; 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 guide covers and provides information to assist in planning a laboratory test or series of tests from which may be inferred information about the biodegradability of an unused fully formulated hydraulic fluid in its original form. Biodegradability is one of three characteristics which are assessed when judging the environmental impact of a hydraulic fluid. The other two characteristics are ecotoxicity and bioaccumulation.

1.2 Biodegradability may be considered by type of environmental compartment: aerobic fresh water, aerobic marine, aerobic soil, and anaerobic media. Test methods for aerobic fresh water, aerobic soil and anaerobic media have been developed that are appropriate for the concerns and needs of testing in each compartment.

1.3 This guide addresses releases to the environment that are incidental to the use of a hydraulic fluid but is not intended to cover situations of major, accidental release. The tests discussed in this guide take a minimum of three to four weeks. Therefore, issues relating to the biodegradability of hydraulic fluid are more effectively addressed before the fluid is used, and thus before incidental release may occur. Nothing in this guide should be taken to relieve the user of the responsibility to properly use and dispose of hydraulic fluids.

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

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

1.6 *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:*[2]

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D5210 Test Method for Determining the Anaerobic Biodegradation of Plastic Materials in the Presence of Municipal Sewage Sludge (Withdrawn 2016)[3]

D5291 Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants

D5480 Test Method for Engine Oil Volatility by Gas Chromatography (Withdrawn 2003)[3]

D5864 Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components

E1196 Test Method for Determining the Anaerobic Biodegradation Potential of Organic Chemicals (Withdrawn 1998)[3]

2.2 *ISO Standards:*[4]

ISO 9439:1990 Technical Corrigendum I, Water Quality–Evaluation in an Aqueous Medium of the Ultimate Biodegradability of Organic Compounds

ISO 4259:1992(E) Petroleum Products–Determination and Application of Precision Data in Relation to Methods of Test

2.3 *OECD Standards:*

OECD 301B (the Modified Sturm Test) Guidelines for Testing Chemicals[5]

OECD 301F (the Manometric Respirometry Test) Guidelines for Testing of Chemicals[5]

[1] This guide is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.12 on Environmental Standards for Lubricants.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.

[5] Available from Organisation for Economic Co-Operation and Development (OECD), 2, rue André Pascal, F-75775 Paris Cedex 16, France.

***A Summary of Changes section appears at the end of this standard**

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this guide, refer to Terminology D4175.

3.1.2 *aerobic, adj*—1. taking place in the presence of oxygen; 2. living or active in the presence of oxygen.

3.1.3 *anaerobic, adj*—1. taking place in the absence of oxygen; 2. living or active in the absence of oxygen.

3.1.4 *biodegradation, n*—the process of chemical breakdown or transformation of a material caused by organisms or their enzymes.

3.1.4.1 *Discussion*—Biodegradation is only one mechanism by which materials are transformed in the environment.

3.1.5 *biomass, n*—biological material including any material other than fossil fuels which is or was a living organism or component or product of a living organism.

3.1.5.1 *Discussion*—In biology and environmental science, biomass is typically expressed as density of biological material per unit sample volume, area, or mass (g biomass / g (or / mL or / cm^2) sample); when used for products derived from organisms biomass is typically expressed in terms of mass (kg, MT, etc.) or volume (L, m^3, bbl, etc.).

3.1.5.2 *Discussion*—Products of living organisms include those materials produced directly by living organisms as metabolites (for example, ethanol, various carbohydrates and fatty acids), materials manufactured by processing living organisms (for example: pellets manufactured by shredding and pelletizing plant material) and materials produced by processing living organisms, their components or metabolites (for example, transesterified oil; also called biodiesel).

3.1.6 *blank, n—in biodegradability testing*, a test system containing all system components with the exception of the test material.

3.1.7 *environmental compartment, n*—a subdivision of the environment based on physical or chemical properties, or both.

3.1.7.1 *Discussion*—Examples of environmental compartments are aerobic fresh water, aerobic marine, and aerobic soil. The results of test procedures may be applied to environmental compartments but the test systems do not constitute an environmental compartment.

3.1.8 *inoculum, n*—spores, bacteria, single celled organisms, or other live materials that are introduced into a test medium.

3.1.9 *pre-adaptation, n*—the pre-incubation of an inoculum in the presence of the test material under conditions similar to the test conditions.

3.1.9.1 *Discussion*—The aim of pre-adaptation is to improve the precision of the test method by decreasing variability in the rate of biodegradation produced by the inoculum. Pre-adaptation may mimic the natural processes which cause changes in the microbial population of the inoculum leading to more rapid biodegradation of the test material, but not to a change in the final degree of biodegradation.

3.1.10 *primary biodegradation, n*—degradation of the test substance resulting in a change in its physical or chemical properties, or both.

3.1.11 *primary biodegradation test, n*—a test which follows the disappearance of a test substance by measuring some attribute of the substance.

3.1.11.1 *Discussion*—The extent to which the results of a primary biodegradation test correspond to the biological conversion of the test substance will depend on the attribute which is being measured.

3.1.12 *sonication, n*—the act of subjecting a material to the shearing forces of high-frequency sound waves.

3.1.12.1 *Discussion*—Sonication of a two phase liquid system may result in the dispersal of one phase as fine droplets in the other phase.

3.1.13 *ultimate biodegradation, n*—degradation achieved when a material is totally utilized by microorganisms resulting in the production of carbon dioxide (and possibly methane in the case of anaerobic biodegradation), water, inorganic compounds, and new microbial cellular constituents (biomass or secretions, or both).

3.1.14 *ultimate biodegradation test, n*—a protocol which estimates the extent to which the carbon in a material is converted to CO_2 or methane, either directly, by measuring the production of CO_2 or methane, or, in the case of aerobic biodegradation, indirectly by measuring the consumption of O_2.

3.1.14.1 *Discussion*—The measurement of new biomass usually is not attempted.

4. Summary of Guide

4.1 This guide gives two kinds of information which relate to testing of hydraulic fluids for biodegradability. First, it gives information of a general nature relating to biodegradability. For example, it includes definitions of terms not traditionally used by users or producers of hydraulic fluids (Section 3) and a brief discussion of some of the technical issues which are common to most biodegradability tests when they are applied to hydraulic fluids (Section 7). Second, the guide gives more specific information on the methods, advantages, and disadvantages of several of the biodegradation tests frequently used for hydraulic fluids (Section 6).

5. Significance and Use

5.1 This guide discusses ways to assess the likelihood that a hydraulic fluid will undergo biodegradation if it enters an environment that is known to support biodegradation of some substances, for example the material used as the positive control in the test. The information can be used in making or assessing claims of biodegradability of a fluid formula.

5.2 Biodegradation occurs when a fluid interacts with the environment, and so the extent of biodegradation is a function of both the chemical composition of the hydraulic fluid and the physical, chemical, and biological status of the environment at the time the fluid enters it. This guide cannot assist in judging the status of a particular environment, so it is not meant to provide standards for judging the persistence of a hydraulic fluid in any specific environment either natural or man-made.

5.3 If any of the tests discussed in this guide gives a high result, it implies that the hydraulic fluid will biodegrade and