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Standard Test Method for Rubber Chemicals—Solubility[1]

This standard is issued under the fixed designation D1766; 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 practical test for the solubility of commercial chemicals used in rubber products.

1.2 It is not a true measure of solubility, since equilibrium is not approached from both sides, that is, higher temperature and lower temperature.

1.3 The test method indicates the total solubility, under the conditions of the test, of all components in the presence of each other and in the proportions present in the sample.

1.4 This test method does not measure the solubility of a rubber chemical in rubber.

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

1.6 *This standard does not purport to address 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]

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Summary of Test Method

3.1 The test specimen is shaken in a specified volume of a desired solvent at a specified time and temperature. Solids are allowed to settle and a specified aliquot of the clear supernatant solvent is quantitatively removed, the solvent evaporated, and the mass of the residue obtained. From the masses of the residue and original specimen, the solubility of the specimen is obtained by calculation.

4. Significance and Use

4.1 This test method may be used as a raw material quality-control tool.

5. Apparatus

5.1 *Containers,* capacity approximately 100 cm^3 (4-oz), glass, screw caps with metal foil liners.

5.2 *Weighing Bottles,* 50-cm^3, ground-glass, low-form, with covers.

5.3 *Mechanical Shaker.*

5.4 *Steam Bath.*

5.5 *Oven,* constant-temperature, controllable, 110°C max in accordance with Type B of Specification E145.

6. Procedure

6.1 Place 50 cm^3 of the desired solvent in each of two suitable containers described in 5.1. Add, with shaking, a sufficient test specimen of the organic chemical in the "as-received" condition to each of the bottles to give apparent saturation, and then add about 25 % more. Close both bottles tightly and place in a mechanical shaker, at room temperature, for a minimum of 4 h.

6.2 Hold at 23 ± 0.5°C with occasional shaking for a minimum of an additional 4 h. If a significant quantity of solids is not in evidence at this point in both bottles, add 25 % more of the organic chemical to each bottle and repeat both shaking cycles.

6.3 Allow the solids to settle and while maintaining the temperature of the solution at 23 ± 0.5°C, remove this solution by pipetting 25-cm^3 aliquots from each of the bottles through a suitable filter stick (Note 1). Transfer the contents of the pipets into each of two tared, ground-glass, low-form, 50-cm^3, covered weighing bottles. Call the tare masses *A*. Cover the weighing bottles immediately. Weigh the bottles and solution. Call these masses *B*.

NOTE 1—A filter stick may be made by wiring a small piece of medium grade filter paper over the end of a pipet with fine wire. The filter paper should be removed before emptying the pipet. A pressure-type apparatus may also be used to fill the pipet.

6.4 Remove the covers and evaporate the solvent on a steam bath. Then place the bottles in an oven maintained at a

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.11 on Chemical Analysis.

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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.

temperature at least 10°C below the melting point of the product (but in no case higher than 110°C), and dry to constant mass. Place the bottles in a covered desiccator until cool, and then weigh. Call these masses *C*.

7. Calculation

7.1 The solubility may be calculated as follows:

$$\text{Mass g of 25 cm}^3\text{ of solution at 23°C} = B - A \quad (1)$$

$$\text{Mass g of solute in 25 cm}^3\text{ solution at 23°C} = C - A \quad (2)$$

$$\text{Solubility in grams of solute per 100 cm}^3\text{ of solution at 23°C} = (C - A) \times 4 \quad (3)$$

Solubility may also be expressed as follows:

$$\text{Mass g of solvent in 25 cm}^3\text{ of solution at 23°C} = B - C \quad (4)$$

Let D = density of solvent at 23/4°C. Then:

$$\text{Solubility in grams solute per 100 g of solution at 23°C} = [(C - A)/(B - A)] \times 100 \quad (5)$$

$$\text{Solubility in grams solute per 100 cm}^3\text{ of solvent at 23°C} = [(C - A)/(B - C)] \times D \times 100 \quad (6)$$

$$\text{Solubility in grams solute per 100 g of solvent at 23°C} = [(C - A)/(B - C)] \times 100 \quad (7)$$

TABLE 1 Code for Reporting Solubility Test Results

Descriptive Code	Description	Range of Solubility, kg/m³
P Ins	practically insoluble	<0.1
SS	slightly soluble	0.1 to <1.0
MS	moderately soluble	1.0 to <5.0
S	soluble	5.0 to <10.0
VS	very soluble	10.0 and over

8. Report

8.1 Solubility shall be reported as indicated in Table 1.

8.2 The solvent used shall be specified.

9. Precision and Bias

9.1 *Precision*—The two net masses of solute should agree within 10 % of each other. If not, the test should be repeated. If agreement within 10 % is obtained, the average mass of solute should be used.

9.2 *Bias*—No statement about bias is being made at this time.

10. Keywords

10.1 rubber chemicals; solubility