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Standard Test Method for Synthetic Anionic Ingredient by Cationic Titration¹

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^{ε1} NOTE—Keywords were added editorially in February 1996.

1. Scope

1.1 This test method covers the determination of the amount of synthetic anionic ingredient in a surfactant by direct titration with a standardized cationic reagent. The test method is a simple and convenient means for the quantitative estimation of the anionic material. The end point is detected by the transfer of a colored complex from an organic solvent phase to an aqueous phase. The colored complex is formed by the addition of a solution of dye to a solution of the anionic surfactant. This complex is soluble in the organic-solvent phase and insoluble in the aqueous phase. When this solution is titrated with a standardized solution of a cationic reagent, the dye is displaced from the colored complex and, being water-soluble, migrates to the aqueous phase. Therefore, a cationic titrating solution that has been standardized against a characterized anionic agent can be used to analyze for other anionics of known molecular mass.

1.2 This test method is applicable to alkylaryl sulfonates, alkyl sulfonates, alkyl sulfates and hydroxy-sulfates, alkylphenol- and fatty alcohol ethoxy-sulfates and dialkylsulfosuccinates. It applies to active materials containing one hydrophilic group per molecule.

1.3 The analytical procedures appear in the following order:

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1.4 *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.* A precautionary statement appears in Section 7. Material Safety Data Sheets are available for reagents and materials. Review them for hazards prior to usage.

¹ This test method is under the jurisdiction of ASTM Committee D-12 on Soaps and Other Detergents and is the direct responsibility of Subcommittee D12.12 on Analysis of Soaps and Synthetic Detergents.

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2. Referenced Documents

2.1 *ASTM Standards:*

D 1193 Specification for Reagent Water²

3. Summary of Test Method

3.1 An aqueous solution of an anionic-type detergent, to which is added a small amount of mixed indicator (dimidium bromide and disulphine blue), is shaken with aqueous Hyamine solution and chloroform. The pink complex which is formed by the reaction between the anionic detergent and the cationic dye, dimidium bromide, is extracted into the chloroform. Increments of additional Hyamine solution are added with a thorough mixing after each addition. At first the reaction takes place between the Hyamine and the excess anionic-type detergent, during which there is no noticeable change in the color (pink) of the chloroform phase. As the equivalence point between the anionic and cationic materials is approached, the dimidium bromide portion of the anionic detergent active-dimidium bromide complex (pink) is gradually released and transferred to the aqueous layer. As excess Hyamine is added it reacts with the anionic dye, disulphine blue, to form a chloroform-soluble blue complex. During the transition at the end point the chloroform layer, therefore, changes from pink to gray, to blue. The gray color is taken as the end point.

4. Significance and Use

4.1 This test method offers a means of determining anionic detergents commonly found in laundry, dishwashing, and other cleaning materials. Accurate determination of the anionic active substance is highly important in assessing the cost and effectiveness of such cleaning substances.

4.2 This test method is not affected by low molecular weight sulfonates, such as those of toluene and xylene commonly found in detergent formulations, when these substances are present up to 15 weight % of active material.

5. Interferences

5.1 Normal inorganic components of detergent formulations, such as chloride, sulfate, borate, phosphates, perborate, and silicates do not interfere. Soaps, urea, and ethylenediaminetetraacetic acid salts do not interfere. Bleaching agents

² *Annual Book of ASTM Standards*, Vol 11.01.

other than perborate should be destroyed prior to performing this analysis. Low molecular weight sulfonates, such as those of toluene and xylene, do not interfere when present up to 15 % (w) of active material. Since the titration is performed under acidic conditions (about pH 2.0), care should be exercised when using this procedure on products containing significant amounts of alkaline materials, such as carbonates and silicates, to ensure that the final solution is being titrated in the proper pH range.

6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.³ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Specification D 1193.

6.3 *Chloroform*.

6.4 *Ethanol*.

6.5 *Petroleum Ether*, boiling range 30 to 50°C.

6.6 *Phenolphthalein Indicator Solution (1 %)*—Dissolve 1 g of phenolphthalein in 95 % ethanol and dilute to 100 mL.

6.7 *Sodium Hydroxide, Standard Solution (0.1 N)*—Prepare a 0.1 N solution of sodium hydroxide (NaOH).

6.8 *Sodium Hydroxide, Standard Solution (1 N)*—Prepare a 1 N solution of NaOH.

6.9 *Sodium Hydroxide, Standard Solution (50 %)*—Prepare a 50 % solution of NaOH.

6.10 *Sodium Lauryl Sulfate, Standard Solution, (0.004 M)*.

6.10.1 Weigh accurately between 1.14 and 1.16 g of sodium lauryl sulfate and dissolve in 200 mL of water.

6.10.2 Transfer to a stoppered graduated 1-L flask and dilute to volume with water.

6.10.3 Calculate the molarity of the solution as follows:

$$\text{Molarity} = (W_2 \times P)/(288.4 \times 100) \quad (1)$$

where:

W_2 = sodium lauryl sulfate, g, and

P = purity of the sodium lauryl sulfate, %.

6.11 *Sodium Sulfate* (Na_2SO_4), anhydrous.

6.12 *Sulfuric Acid, Standard (0.1 N)*—Prepare a 0.1 N solution of sulfuric acid (H_2SO_4).

6.13 *Sulfuric Acid, Standard (0.5 N)*—Prepare a 0.5 N solution of H_2SO_4 .

6.14 *Sulfuric Acid, Standard (1 N)*—Prepare a 1 N solution of H_2SO_4 .

³ *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.

7. Safety Precaution

7.1 This test method includes the use of small amounts of chloroform. Appropriate safety practices, such as those included in the Material Safety Data Sheets for chloroform, should be employed. Good ventilation is especially important.

8. Primary Standard

8.1 The primary standard used in this procedure is sodium lauryl sulfate.⁴ Three tests are made on this primary standard as follows:

8.2 *Purity*:

8.2.1 This test should be run in duplicate.

8.2.2 Weigh, to the nearest 0.1 mg, 10 ± 0.2 g of the primary standard into a 250-mL round-bottom flask.

8.2.3 Add exactly 25 mL of 0.5 N H_2SO_4 . It is not necessary to standardize this acid.

8.2.4 Reflux under a water condenser for 2 h. Heat moderately in the beginning until the solution clarifies and the foaming ceases; then increase the heat input until a vigorous reflux is attained.

8.2.5 Remove the heat source, cool the flask, and then wash down the condenser with approximately 30 mL of ethanol followed by 50 mL of water. Add the washings to the reaction flask.

8.2.6 Disconnect the condenser and wash the point and the neck with water. Add these washings to the reaction flask.

8.2.7 Add a few drops of 1 % phenolphthalein indicator solution and titrate the H_2SO_4 with standardized 1 N NaOH solution.

8.2.8 Determine a blank value by titrating 25 mL of the 0.5 N H_2SO_4 with the standardized 1 N NaOH solution. This should be done in duplicate and the average used.

8.2.9 Calculate the percent purity of the primary standard as follows:

$$\text{Purity, \%} = [28.84 \times (A - B) \times N]/W \quad (2)$$

where:

A = NaOH solution used in sample titration, mL,

B = NaOH solution used in blank titration, mL,

N = normality of the NaOH solution, and

W = primary standard used, g.

8.2.10 For best precision and accuracy, temperature and buret corrections should be made when titrating the hydrolytate of the sodium lauryl sulfate with 1 N NaOH solution.

8.3 *Alcohols*:

8.3.1 The primary standard, sodium lauryl sulfate, is sold as having not more than 1 weight % (Note 1) of a sum of decyl and tetradecyl alcohol sulfates. The following test should be run in duplicate.

NOTE 1—The term “weight” is temporarily used in this standard because of established trade usage. The word is used to mean both “force” and “mass,” and care must be taken to determine which is meant in each case (SI unit for force = newton and for mass = kilogram).

8.3.2 Mix approximately 5 g of sodium lauryl sulfate with 25 mL of 1 N H_2SO_4 in a 250-mL round-bottom flask.

⁴ Manufactured by British Drug House, Ltd. as Product No. 30176. It is sold as being more than 99 % pure. It is available in the United States from Gallard-Schlesinger Chemical Manufacturing Corp., Carle Place, Long Island, NY 11514.