Designation: D1109 – 21

Standard Test Method for 1 % Sodium Hydroxide Solubility of Wood [1,2]

This standard is issued under the fixed designation D1109; 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 the determination of the solubility of wood in a hot dilute alkali solution. A1 % solution of sodium hydroxide (NaOH) is used. One application is in determining the degree of fungus decay that has taken place in a given wood sample. As the wood decays, the percentage of alkali-soluble material increases in proportion to the decrease in pulp yield caused by the decay.

1.2 *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.*

1.3 *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. Significance and Use

2.1 Hot alkali extracts low molecular weight carbohydrates consisting mainly of hemicellulose and degraded cellulose in wood. This solubility of wood is an indication of the degree of fungal decay, or degradation by heat, light, oxidation, and so forth. The more decay or degradation, the higher the solubility.

3. Apparatus

3.1 *Water Bath*—The water bath shall be designed so that the temperature of the material during treatment is uniformly maintained at 97 to 100 °C. When a new bath is used the temperature shall be checked to ensure the use of proper conditions (see Note 1).

NOTE 1—The type of bath recommended is one that is covered and that has holes in the top of such size that beakers may be set down in the bath until they are supported by the flared rim of the beakers. The top of the beaker is recommended to be nearly level with the cover of the bath. By using this type of bath the sides of the beakers are entirely surrounded by boiling water or steam. The water level in the bath is recommended to be maintained above the level of the liquid in the beakers.

3.2 *Beakers*—The beakers shall be tall-form, 200-mL, alkali-resistant glass[3] beakers.

3.3 *Filtering Crucibles*—Alundum or fritted-glass crucibles of medium porosity are recommended for filtering the treated sawdust.

4. Reagents

4.1 *Sodium Hydroxide Solution (1.0 %)*—Allow a chemically pure NaOH solution (50 %) to stand about 1 week in a stoppered vessel to permit settling of Na_2CO_3 and other insoluble impurities. Dilute the supernatant clear solution with distilled water free of CO_2 (see Note 2) and adjust to between 0.9 and 1.1 % NaOH.

NOTE 2—It is difficult to make water totally free of CO_2 and deareated water is recommended since a high CO_2 content will convert NaOH to Na_2CO_3 which will alter the titration value. A titration against a standard HCl solution can check the NaOH content, Water with very low CO_2 high content can be made by boiling the water and keeping it in a stoppered vessel.

4.2 *Acetic Acid (10 %)*.

5. Test Specimen

5.1 The test specimen shall consist of air-dried sawdust or milled wood that has been ground to pass a 425-µm (approx. 40 mesh) sieve and be retained on a 250-µm (approx. 60 mesh) sieve. The weight of the test specimen shall be such that it will be equivalent to 2 ± 0.1 g of moisture-free wood.

6. Procedure

6.1 Place two test specimens in 200-mL, tall-form beakers and add to each 100 mL of NaOH solution (1 %) measured carefully with a graduated cylinder. After stirring well, place the covered beakers in the water bath, which shall be boiling steadily. Leave the beakers in the bath for exactly 1 h, stirring the contents three times, at periods of 10, 15, and 25 min after the beakers are placed in the bath.

6.2 At the end of 1 h, filter the contents of each beaker by suction using a tared crucible. Wash the wood with 100 mL of

[1] This test method is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.01 on Fundamental Test Methods and Properties.

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[2] Based upon Technical Association of the Pulp and Paper Industry Standard Method T 212 om-18. One percent sodium hydroxide solubility of wood and pulp.

[3] Borosilicate glass has been found satisfactory for this purpose.

hot water, then with 50 mL of acetic acid (10 %), and then thoroughly with hot water. Dry the crucible and contents to constant weight at 100 to 105 °C, cool in a desiccator, and weigh in a stoppered weighing bottle.

7. Calculation and Report

7.1 Report the results as weight percentage of matter soluble in 1 % sodium hydroxide solution, on the moisture-free basis, calculated as follows:

$$\text{Matter soluble in caustic soda, } \% = [(W_1 - W_2)/W_1] \times 100 \quad (1)$$

where:

W_1 = weight of moisture-free wood in specimen prior to test (Section 5), and

W_2 = weight of dried specimen after treatment with the NaOH solution (6.2).

7.2 Base the results on the average of at least two determinations.

8. Precision and Bias[4]

8.1 Results obtained from an interlaboratory study by nine laboratories on four wood samples indicate a repeatability of 0.45 and reproducibility of 1.96. The solubility of the wood samples ranged from 11.2 to 17.0 %.

8.2 Bias is unknown.

9. Keywords

9.1 sodium hydroxide; solubility

[4] Data in this section obtained by the Technical Association of the Pulp and Paper Industry, P.O. Box 105113, Atlanta, GA 30348.