Standard Test Method for
Determination of Wood Fiber in Asbestos Cement[1]

This standard is issued under the fixed designation C 1096; 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 cellulose content of asbestos-cement products. Refer to Note 1 and Note 2.

1.2 Before this test method can be used for the determination of other organic substances in asbestos-cement, it must be ascertained that accurate results can be obtained by correlation trials with known concentrations of the organic substances in question present in samples of asbestos-cement.

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

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.* See 7.1 for specific safety hazard.

2. Referenced Documents

2.1 *ASTM Standards:*
C 114 Test Methods for Chemical Analysis of Hydraulic Cement[2]
D 1193 Specification for Reagent Water[3]
E 11 Specification for Wire Cloth Sieves for Testing Purposes[4]
E 50 Practices for Apparatus, Reagents, and Safety Precautions for Chemical Analysis of Metals[5]

2.2 *ACS Standard:*
Reagent Chemicals, American Chemical Society Specifications[6]

3. Significance and Use

3.1 The determination of wood fiber in asbestos-cement products is necessary because such fibers may be added when multi-wall paper bags containing the asbestos are included in the batch formulations, or cellulose may be added as a processing aid during the manufacture of the products.

3.2 Although moderate concentrations of wood fiber usually have a negligible effect on product durability and performance, higher concentrations can have deleterious effects on products exposed to moisture and thermal shocks.

4. Interferences

4.1 The presence of organic compounds such as surface-active processing aids and water-repellent substances that would produce CO_2 during the digestion steps of the procedure would probably affect results. Refer to Note 1.

4.2 The presence of organic pigments and organic polymeric fibers other than cellulose could also interfere and impair accuracy (Note 2).

5. Apparatus

5.1 *Sieve, a 149 μm (No. 100)*, sieve conforming to Specification E 11.

5.2 *Drying oven*, ventilated, capable of maintaining 100 to 105°C (212 to 220°F).

5.3 Apparatus for determination of total carbon by direct combustion. Apparatus No. 1 of Practices E 50.

6. Reagents

6.1 Type III Reagent water conforming to Specification D 1193.

6.2 *Hydrochloric Acid*—Dilute one part of concentrated hydrochloric acid (HCl, sp gr 1.19 conforming to the ACS specifications) with 17 parts of reagent water.

6.3 *Chromic Acid*— For each digestion dissolve 30 g of chromium trioxide crystals conforming to the ACS specifications (see 2.2) with 60 cm^3 of reagent water.

7. Hazards

7.1 **Warning**—When grinding asbestos-cement products minimize the dust that results. Prolonged breathing of significant airborne concentrations of silica or asbestos dust is hazardous. When such dust is created, effective measures should be taken to prevent inhalation.

8. Sampling, Test Specimens, and Test Units

8.1 For each replicate analysis desired take sufficient sample to yield two specimens each with a mass of 0.15 g per unit

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percentage of wood fiber expected in the product under analysis. If no estimate of the wood fiber concentration is available take a 3-g sample. If the inorganic carbonate content is known to yield 1 % CO_2 or more when digested, a 1-g sample will suffice.

8.2 Grind the sample to entirely pass the 149 μm (No. 100) sieve (see 7.1).

8.3 Dry the sample to constant weight in the oven at 100 to 105°C (212 to 220°F) and cool to room temperature in a desiccator.

8.4 Weigh out two specimens to the nearest 0.001 g.

9. Procedure

9.1 Transfer one specimen to the digestion flask of the apparatus and connect this to the carbon dioxide absorption system.

9.2 Determine the mass of the carbon dioxide absorption tube.

9.3 Pour the chromic acid into the addition funnel.

9.4 Apply vacuum to the absorption system and introduce the chromic acid slowly.

9.5 When the acid is completely added, rinse the chromic acid from the funnel with small amounts of reagent water.

9.6 Slowly heat the digestion flask to boiling and maintain boiling for 30 min.

9.7 Obtain the total mass of carbon dioxide evolved by reweighing the carbon dioxide absorption tube and subtracting the initial mass determined in 9.2.

9.8 Determine the evolved carbon dioxide of inorganic origin (present as carbonates) by repeating steps 9.1-9.7 using the hydrochloric acid with the second specimen.

NOTE 1—Asbestos-cement products may include surface-active processing aids and water-repellent substances that would produce carbon dioxide during the chromic acid digestion step of this test method. Such substances are usually soluble in chloroform. In case of dispute, the chloroform-soluble organic substance shall be determined as described in Sections 69 to 72 of Test Methods C 114. A 40.0-g sample of the pulverized, oven-dried material shall be used for this correction procedure. Water-repellent substances contain a higher percentage of carbon than cellulose. To correct for this, 1.8 times the percentage of chloroform-soluble organic substance, so determined, shall be subtracted from the calculated percentage of wood fiber.

NOTE 2—This test method does not provide a correction for organic pigments or polymeric fibers that decompose during chromic acid digestion and which could produce carbon dioxide and thereby interfere with the results obtained by this test method.

10. Calculation

10.1 Calculate the carbon dioxide evolved from wood as the difference between the total carbon dioxide evolved as obtained in 9.7, and the carbon dioxide evolved from inorganic carbonates as obtained in 9.8.

10.2 Calculate the carbon that corresponds to the carbon dioxide evolved from wood as obtained in 10.1 by multiplying by the ratio of carbon to carbon dioxide = 12/44.

10.3 Calculate the concentration of wood on the as-received basis by dividing the percentage carbon evolved as obtained in 10.2 by the percent carbon in the wood. If that value is not known, assume the nominal value of 45.1 % carbon.

10.4 Calculate the concentration of wood present in the dry furnish (solid ingredients of the asbestos-cement) by dividing

the concentration of the wood on the as-received basis as obtained in 10.3 by

$$(100 - A - B) \% \tag{1}$$

where:
A = Percent CO_2 originating from the hydration reaction (carbonation) of the cement and calculated from the results obtained with a blank sample prepared similarly and containing no wood. Alternatively, use the arbitrary value of 5.6 %.
B = Percent CO_2 of inorganic origin obtained in 9.8.

10.5 *Sample Calculation*:

10.5.1 For the case where the following analytical results were obtained:

10.5.1.1 W_a = 2.0602 g mass of specimen digested in the chromic acid.

10.5.1.2 W_1 = 249.0113 g mass of absorption tube before chromic acid digestion.

10.5.1.3 W_2 = 249.3499 g mass of absorption tube after chromic acid digestion.

10.5.1.4 W_b = 1.9398 g mass of specimen digested in the hydrochloric acid.

10.5.1.5 W_3 = 249.0236 g mass of absorption tube before hydrochloric acid digestion.

10.5.1.6 W_4 = 249.0643 g mass of absorption tube after hydrochloric acid digestion.

10.5.1.7 Carbon content of wood assumed to be 45.1 %.

10.5.1.8 Carbon dioxide originating from hydration of cement; 5.6 % assumed. Total carbon dioxide evolved $W_2 - W_1$ = 249.3499 g – 249.0113 g = 0.3386 g $(W_2 - W_1)$/W_a = 0.3386/2.0602 = 0.165 = 16.5 % CO_2.

10.5.2 The carbon dioxide evolved from wood is:

10.5.2.1 Carbon dioxide evolved from inorganic carbonates = $W_a - W_3$ = 249.0643g – 249.0236g = 0.0407g $(W_4 - W_3)$/W_b = 0.0407/1.9398 = 0.021 = 2.1 % CO_2.

10.5.2.2 Net value of carbon dioxide evolved from wood = 16.5 – 2.1 = 14.4 % CO_2.

10.5.2.3 Carbon dioxide evolved from the inorganic carbonates (from 10.5.1.5 and 10.5.1.6)
= 249.0643 – 249.0236 = 0.0407 g.

10.5.2.4 Percentage carbon dioxide evolved from inorganic carbonates (from 10.5.1.4) = 0.0407 × 100/1.9398 = 2.1 %.

10.5.2.5 Carbon dioxide evolved from wood
= 16.5 – 2.1 = 14.4 %.

10.5.3 The carbon that corresponds to the carbon dioxide evolved from wood (from 10.5.2.5)
= 14.4 % × 12/44 = 3.9 %.

10.5.4 The concentration of wood on the as-received basis (from 10.5.1.7 and 10.5.3) = 3.9 % × 100/45.1 = 8.7 % (where 45.1 denotes C_{std} nominal).

10.5.5 The concentration of wood present in the dry furnish (from 10.5.4) = 8.7/(100 – A – B) %,

where:
A = 5.6 % (from 10.5.1.8), and
B = 2.1 % (from 10.5.2.4).

Therefore, the nominal concentration of wood present in the dry furnish = 8.7 × 100 (100 – 5.6 – 2.1) % = 9.5 %.

11. Precision and Bias

11.1 *Precision*—The intra-laboratory single apparatus, operator and specimen repeatability of the percent of wood fiber in the dry furnish determined is as follows:

Mean, % = 9.6 %,
Standard Deviation, % = 0.082 %,
Relative standard deviation, % = 0.85 %.

11.2 *Bias*—Results obtained average 4.2 % lower than the true value of the wood fiber concentration in the dry furnish.

12. Keywords

12.1 asbestos; asbestos-cement; cellulose; cellulose fiber content; determination; wood; wood fiber content