

Acid Cellulase Enzymes, Effect of: Top Loading Washer

Developed in 2002 by AATCC Committee RA41; reaffirmed 2003; editorially revised and reaffirmed 2004; editorially revised 2005.

1. Purpose and Scope

1.1 This test method provides a simple testing procedure to evaluate the effect of acid cellulase enzymes on cellulose by laundering.

1.2 The evaluations are carried out as listed in Section 8.

1.3 Other cellulase enzymes, i.e., modified acid and neutral types, may be evaluated by this test procedure. However, the concentration, pH, and time should be followed as recommended by the enzyme supplier.

1.4 A specific concentration of enzyme, buffer, and detergent are required in the bath to achieve the desired improvements. Since this test method utilizes an automatic washing machine to simulate the action of rotary drum machines, paddle machines, or jets used in production type operations (that usually operate at low liquor ratios), the concentrations required in this test method are based on grams/liter (g/L), to compensate for the difference in liquor ratios.

2. Principle

2.1 This test method determines the reaction of cellulosic fabrics to treatment with acid cellulase enzymes. Such treatments usually result in improvements in the hand, drape, fuzz and pill appearance of cellulosic fabrics together with the removal of linters and immature/dead cotton fibers. The agitation in the washer simulates the action in rotary drum machines, paddle machines and jets.

3. Terminology

3.1 **cellulase enzyme**, n.—an enzyme that attacks cellulose.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all-inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations.

tions. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. All chemicals should be handled with care. Wear safety glasses and rubber gloves when working with chemicals. Material Safety Data Sheets should be obtained for all the chemicals used in the method.

4.2 An eyewash/safety shower should be located nearby, and readily accessible in case of an emergency.

5. Apparatus

5.1 Automatic washing machine, (the term *top loading washer* used in this method is synonymous with an automatic washing machine) (see 10.1).

5.2 Automatic tumble dryer (see 10.1).

5.3 Ballast of 920 × 920 ± 30 mm (36 × 36 ± 1 in.) hemmed pieces of bleached cotton sheeting (Wash load ballast type 1), or 50/50 polyester/cotton plain weave (Wash load ballast type 3) (see 10.2 and 10.3).

5.4 Reagents

5.4.1 Nonionic detergent; linear alcohol with 9 moles of ethylene oxide.

5.4.2 Buffer AC, sodium acetate (see 10.3).

6. Test Specimens

6.1 Take four to eight garments, or four to eight full width fabric specimens, 0.9 m (1 yd) in length. It is recommended that the cut edges of fabric specimens be sealed by sewing or some other means.

6.2 Two to four garment/fabric specimens are to be used to run the test cycle with enzyme.

6.3 The other two to four garment/fabric specimens are to be used to run through the test cycle without enzyme, for comparison.

7. Procedure

7.1 Use very hot water setting at 60°C (140°F) as listed in the AATCC mono-

graph of standardized home laundry test conditions.

7.2 Set the home laundry machine on low, small load (12 gal water), approximately 41 kg (90 lbs.) water and hot wash/cold rinse temperature setting.

7.3 Fill the washer using the regular cycle (12 mins wash cycle).

7.4 Add a nonionic detergent (1 g/L); volume 40 mL and weight 40 gm.

7.5 Add sodium acetate buffer (6 g/L), volume 195 mL and weight 240 gm.

7.5.1 Stir well; pH 4.5-5.0 (if too high, add acetic acid. pH should not be below 4.5; if so, add caustic, 50%).

7.6 Add acid cellulase enzyme as shown in Table I.

7.6.1 For 100% cotton garments or fabrics, normally 1-2 g/L acid cellulase enzyme is recommended.

7.6.2 For 50/50 cotton/polyester blends, normally 1-2 g/L acid cellulase enzyme is still used since a certain enzyme concentration in the bath must be maintained to achieve the desired effect on the cotton portion of the fabric.

7.6.3 For linen garments or fabrics, and its blends, normally 0.25-0.50 g/L acid cellulase enzyme is recommended.

7.6.4 For rayon and lyocell garments or fabrics, normally 4 g/L acid cellulase enzyme is recommended. The acid cellulase enzyme attacks these fibers much slower; therefore, four wash cycles (48 min) is required.

7.7 Place the garments or fabrics together with ballast, if needed for good agitation, in the water. Two to four garments or two to four fabrics 0.9 m (1 yd length) is sufficient.

7.8 Start the washer and complete only the wash portion.

7.9 Repeat the complete wash cycle and let it continue through its rinse and spin cycles to the termination of the wash cycle. Note: It is necessary to expose the samples to 24 mins in the enzyme bath.

7.10 Remove test specimens and ballast immediately. Place in a tumble dryer on Normal or cotton-sturdy setting. Operate the dryer until the total load is dry.

Table I—Acid Cellulase Enzyme Portions

Volume		Weight	Fiber Content of Test Specimens	Number of Wash Cycles
(g/L)	mL	Gm		
(0.5)	20	21.3	100% linen and its blends	2
(2.0)	80	85.0	100% cotton and its blends	2
(4.0)	160	170.0	rayon or lyocell	4

Note drying time. Remove the load immediately after the dryer stops. Avoid over drying.

8. Evaluation

8.1 Evaluate and compare the hand of tested specimens exposed to acid cellulase enzyme with that of tested specimens not exposed to acid cellulase enzyme using AATCC Evaluation Procedure 5, Fabric Hand: Guideline for the Subjective Evaluation of.

8.2 Visually compare the appearance of tested specimens exposed to acid cellulase enzyme with tested specimens not exposed to acid cellulase enzyme to determine the degree of improvement in fabric fuzz, pill appearance, and degree of removal of linters and immature/dead cotton fibers. Visual ratings should be identified as none, slight, distinct, or considerable differences or improvement.

8.3 If desired, determine the strength of tested specimens exposed to acid cellulase enzyme and compare with that of tested specimens not exposed to acid cel-

lulase using ASTM D 3786-87, Hydraulic Bursting Strength of Knitted Goods for Knits, and the current version of ASTM D 5035, Breaking Force and Elongation of Textile Fabrics-Strip Method for Woven Fabrics.

9. Precision and Bias

9.1 *Precision.* Precision for this test method has not been established. Until a precision statement is generated for this method, use standard statistical techniques in making any comparisons of test results for either *within-laboratory* or *between-laboratory* averages. Analysis of variance or *t*-tests may be used to compare averages. See any standard statistical text for more information.

9.2 *Bias.* The evaluation of acid cellulase enzymes in an automatic washing machine can be defined only in terms of a test method. There is no independent method for determining the true value. As a means of estimating this property, the method has no known bias.

10. Notes

10.1 Contact AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org, for model number(s) and source(s) of current approved washer(s) and dryer(s).

10.2 Ballast are available from Testfabrics Inc., P.O. Box 26, 415 Delaware St., W. Pittston PA 18643; tel: 570/603-0432; fax: 570/603-0433; e-mail: testfabric@aol.com; and Textile Innovators Corp., div. of SDL Atlas L.L.C., P.O. Box 8, 101 Forest St., Windsor NC; tel: 252/794-9703; fax: 252/794-9704; e-mail: tic@sdlatlas.com.

10.3 In addition to acting on the cellulose of the test specimens, the cellulase enzyme used in this test will also act on the cellulose content of the ballast fabric. Hence, ballast fabrics used in this method may not be reusable to the same extent as in other methods. It is, therefore, recommended that if ballast are reused, they be weighed prior to each use, to ensure that they have not incurred weight loss greater than 75% from their original weight. If they have, they should be replaced with new ballast.

10.4 Contact AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org.