Test Method for Wetting Agents, Evaluation of

Developed in 1932 by AATCC Committee RR8; jurisdiction transferred in 2003 to AATCC Committee RA63; reaffirmed 1943, 1971, 1977, 1980, 1989, 2005, 2010, 2014, 2018; revised 1952, 1999; editorially revised and reaffirmed 1974, 1985, 1994; editorially revised 1988, 1991, 2004, 2008, 2019.

1. Purpose and Scope

1.1 This test method determines the efficiency of ordinary commercial wetting agents.

2. Principle

2.1 A weighted cotton test skein is dropped into a tall cylinder containing a water solution of a wetting agent. The time required for a string stirrup connecting the weight and the skein to relax is recorded as the sinking time.

3. Terminology

3.1 **wetting agent,** n.—a chemical compound which when added to water lowers both the surface tension of the liquid and its interfacial tension against the solid material.

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

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

4.2 Wear chemical goggles, rubber gloves and apron in preparing wetting agent stock solution.

5. Apparatus and Materials (see 10.1)

5.1 Hooks of standard weight and attached anchors (see 10.2 and 10.3).

5.2 Volumetric flasks, 1000 mL.

5.3 Beaker, 1500 mL.

5.4 Graduated cylinders, 500 mL.

5.5 Bulb pipette (or aspirator), 100 mL.

5.6 Bulb transfer pipettes, assorted sizes.

5.7 Cotton yarn, greige unboiled, 2-ply, in 5-g skeins (see 10.4).

5.8 Water, distilled (see 10.5).

5.9 Graph paper, log-log.

6. Test Solutions

6.1 Stock solutions of the agents to be tested are normally prepared to contain 50.0 g of agent per liter unless the solubility is so poor that less must be employed. The wetting agent is first thoroughly dissolved in about a quarter of the necessary distilled water at a temperature above 80°C and is then diluted to the final volume with cold distilled water. Aliquot portions of 5, 7, 10, 15, 25, 35, 50, 75 and 100 mL of the 5% stock solution taken with delivery bulb pipettes and diluted with suitable water (see 10.4) to 1000 mL correspond, respectively, to concentrations of 0.25, 0.35, 0.50, 0.75, 1.25, 1.75, 2.50, 3.75 and 5.00 g of wetting agent per liter. This range of concentrations is sufficient for the study of any commercial product.

7. Procedure

7.1 The diluted solution for test is poured from the liter volumetric flask into a 1500 mL beaker to ensure mixing. The solution in the beaker is then divided equally between two 500 mL graduated cylinders. If the more dilute solutions are tested first, the mixing beaker and cylinders need not be rinsed out and dried each time. The operator must wait after the cylinders have been filled until all bubbles *below* the surface of the solution have risen to the top before the sinking tests are made. The operator may advantageously prepare solutions for 6 more cylinders while waiting for the bubbles to rise. Foam on the surface of the solution is removed either with a 100 mL bulb pipette or with an aspirator. Where there is little tendency for exhaustion of the wetting agent on the test skeins—practically always true for cotton—it is permissible to use the same diluted solution over again several times rather than to make a new diluted solution for each new skein. In this case only one 500 mL cylinder can be filled repeatedly from one liter of solution of a certain concentration.

7.2 Since temperature often markedly affects wetting, standard temperatures of 25°C, 50°C, 70°C and 90°C have been chosen for testing so as to include the complete commercially useful range. It is most convenient to attain a temperature of 25°C merely by using water which has been brought to the correct temperature in a large pail. For tests at higher temperatures, heat the diluted solution for test in the mixing beaker to a temperature somewhat above that required, pour the solution into the cylinder and then allow it to cool back to the testing temperature.

7.3 For a determination, a 5.00 g skein of yarn is folded enough times to form a loop 45.7 cm around. A 91.4 cm skein is most convenient and can be formed into a 45.7 cm loop with only 2 folds; a 137.2 cm skein requires 3 folds; a 182.9 cm skein, 4 folds and a 228.6 cm skein requires 5 folds. The hook with its anchor is fastened at one end of the folded skein and the skein is cut through with shears at the opposite end. The cut skein is drawn through the fingers when testing wetting agents in order to make it more compact. Any threads which have been tied around the skein to correct its weight are folded into the skein near the hook. The skein is held in one hand with the anchor dangling into the wetting solution contained in the 500 mL graduated cylinder. A stopwatch held in the other hand is started just as the skein is released into the solution and it is stopped when the buoyant skein definitely starts to sink to the bottom of the cylinder. The skein before sinking must be entirely covered with solution and yet it must possess enough buoyancy from the air within the yarn to keep the linen thread taut between the anchor and the hook (see Fig. 1). The average of at least four determinations of sinking time should be obtained for each concentration of wetting agent. An average deviation of 10-12% in sinking time may be expected (see 10.6).

8. Evaluation

8.1 The method of handling the data obtained by the technique described above is very important. The most useful

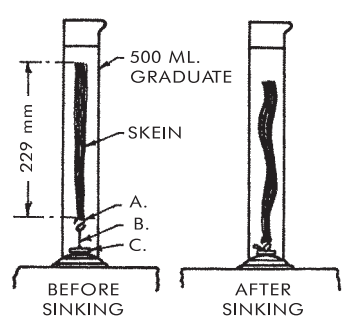

Fig. 1—Position of skein before and after sinking.

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plot where a complete curve is desired is one made on log-log graph paper with logarithmic coordinates along both axes but reading directly in antilogarithms. Values of concentrations of wetting agent are shown on the horizontal scale, or X-axis, the value on the left being 0.1 g and the value on the right 10 g/L. In like manner, sinking times in seconds are shown on the vertical scale, or Y-axis, the value on the bottom being 1 or 10 s and the value at the top being 100 s. A smooth curve is drawn through the points. For most products this curve will be a straight line (see Fig. 2).

8.2 When sinking curves for two products have the same slopes for a 3.0 g hook, it has been found that they have the same slopes for any weight of hook by the method of testing described here, and they even have quite closely the same slopes for any other method of testing in which cotton is employed. Under such conditions it is then logical to assume that solutions that cause wetting in equal times for the same lot of cotton under similar conditions are equivalent. Comparisons of relative costs of wetting can then be made as illustrated in Table I, where the cost for 378.5 L of wetting agent is calculated from the following formula:

8.3 Cost for 378.5 L of solution at wetting conc. = 0.835 × (wetting conc. in g/L × (cost per g).

8.4 When two products have markedly different slopes for plots representing the relationship between sinking times and concentrations on log-log graph paper, great care must be exercised in interpreting the wetting data.

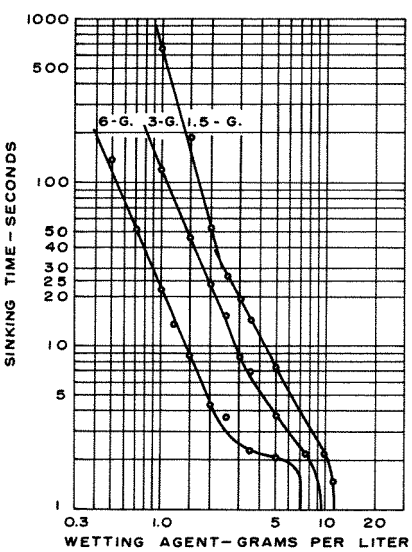

Fig. 2—Plot of results. (See text under Evaluation.)

Table I—Comparison of Two Original Wetting Agents*

Standard		New Product
3.000 g	Wt. of hook	3.000 g
25°C	Temperature	25°C
20¢	Cost per lb	18¢
1.95	25 s wetting conc., g/L	2.44
100	Equivalent parts	125
32.5¢	Cost for 378.5 L of soln. at wetting conc.	36.7¢

*Medium: distilled water, neutral.

9. Precision and Bias

9.1 *Precision*. A *within-laboratory* test was conducted to establish the precision of the test method. Three testers, on three different days, performed four checks per level of surfactant. An average of the four checks was computed for each level of surfactant. Table II indicates the average, and the standard deviation, from the data of the three testers.

9.1.1 The coefficient of variation is being used to determine the bias of this method. The data used was generated from the *within-laboratory* results of three testers. Table III indicates the percentage per level of surfactant.

9.2 *Bias*. Wetting agents 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.

Table II—Sinking Time Average and Standard Deviation

Surfactant Level	Sinking Time: Avg. of 3 Testers	Sinking Time: S.D. of 3 Testers
0.25 g/L	120.00 s	0 s
0.35 g/L	120.00 s	0 s
0.50 g/L	77.00 s	13.18 s
0.75 g/L	32.75 s	3.70 s
1.25 g/L	14.42 s	1.70 s
1.75 g/L	8.58 s	0.80 s
2.50 g/L	4.75 s	0.50 s
3.75 g/L	3.10 s	0.14 s
5.00 g/L	2.00 s	0 s

Table III—Coefficient of Variation at Different Surfactant Levels

Surfactant Level	CV %
0.25 g/L	0
0.35 g/L	0
0.50 g/L	17
0.75 g/L	11
1.25 g/L	12
1.75 g/L	9
2.50 g/L	11
3.75 g/L	5
5.00 g/L	0

10. Notes

10.1 For potential equipment information pertaining to this test method, please visit the online *AATCC Buyer's Guide* at www.aatcc.org/bg. AATCC provides the possibility of listing equipment and materials sold by its Corporate members, but AATCC does not qualify, or in any way approve, endorse or certify that any of the listed equipment or materials meets the requirements in its test methods.

10.2 The hook of a standard weight and the attached anchor are prepared as follows: A piece of No. 10 B&S gauge copper wire about 6.51 cm long is bent into the form of a hook as illustrated by "A" in Fig. 3 and then the weight of the bent hook is adjusted to exactly 3.000 g. Nickel, silver and stainless steel wire are even more suitable than copper for this purpose because they are more corrosion resisting. The anchor, "C," is a flat, cylindrical, lead slug weighing over 40 g and having a diameter of 25 mm and a thickness of about 4.7 mm. In the center of the anchor is soldered a loop of wire to serve as a small ring, or eye, for attaching the anchor to the hook with a fine linen thread, "B," at a distance apart of 19 mm. If many products are to be tested, prepare at least two hooks and anchors.

10.3 In the comparison of wetting agents it has been found that a 3.0 g hook gives a concentration for 25 s wetting which is most often fairly close to the concentration employed in practice for original wetting in various mill processes. If now, however, the concentration of wetting agent found satisfactory for the particular work in the mill is much higher or much lower than the concentration obtained with the 3.0 g hook, then a hook of a different weight should be employed for making comparisons between products which are valid for the particular situation.

For comparisons at low concentrations a 6.0 g, or even a 9.0 g hook, is employed for a sinking time of 25 s. Only products with sinking curves of similar slopes show the same equivalent values for 0.5 g, 1.5 g, 3.0 g, 6.0 g, and 9.0 g hooks at any standard sinking time.

For comparisons at higher concentrations than those corresponding to a sinking time of

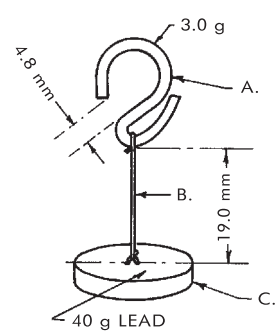

Fig. 3—Hook for use in test of wetting agents.

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