

Foaming Propensity of Disperse Dyes

Developed in 1986 by AATCC Committee RA87; reaffirmed 1987, 1988, 1993, 1998, 2003; editorially revised 1989, 1991, 1997.

1. Purpose and Scope

1.1 Foam generation must be controlled in dyeing equipment such as jet machines which operate with high circulation and high agitation of the dye liquor at low bath ratios.

1.2 This test method provides a standard for measuring the foaming properties of disperse dye under controlled conditions and determines the relative contribution of a single disperse dye to generate dyebath foam.

2. Principle

2.1 A quantity of disperse dye is prediluted, preheated and placed in a regular kitchen blender (see 12.4). Using a predetermined blender speed, the dye dispersion is blended for a specific time, transferred to a glass graduated cylinder and the foam and liquid levels are measured.

3. Terminology

3.1 **foam**, n.—a dispersion of a gas in a liquid or solid (see 12.2).

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The safety 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 data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Handle all chemicals carefully. Use chemical goggles or face shield, impervious gloves and an impervious apron when handling the chemicals used in this procedure. An eyewash/safety shower should be located nearby for emergency use.

4.2 Wear safety glasses and a dust mask when handling powdered dyestuff.

4.3 If concentrated acetic acid is diluted to prepare the acetic acid for pH adjustment (7.1.4), use chemical goggles or face shield, impervious gloves and an im-

pervious apron during preparation. Handle concentrated acids only in an adequately ventilated laboratory hood. An eyewash/safety shower should be located nearby for emergency use. CAUTION: Always add acid to water.

4.4 Exposure to chemicals used in this procedure must be controlled at or below levels set by governmental authorities [e.g., Occupational Safety and Health Administration's (OSHA) permissible exposure limits (PEL) as found in 29 CFR 1910.1000 of January 1, 1989]. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of Time Weighted Averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should be met (see 12.3).

5. Uses and Limitations

5.1 The test method provides a means of comparing lot-to-lot variation of foam generation in dye shipments versus a control or standard reference sample of the same dye.

5.2 The test procedure is not complex, uses readily available equipment and provides results that correlate with results from other more elaborate lab dye testing equipment (see 12.1).

5.3 The test method offers a specific procedure and set of conditions that are useful for comparative studies by an individual laboratory. Variability between laboratories using different equipment and operators can produce slightly different measurements but will distinguish among low, moderate and high foaming disperse dyes.

5.4 Variables which affect accuracy and reproducibility of the test are specified in the notes (see 12.5, 12.6 and 12.7).

6. Apparatus and Materials

6.1 Equipment:

6.1.1 500 mL glass graduated cylinder.

6.1.2 Kitchen blender (see 12.4).

6.1.3 Glass blender container.

6.1.4 Stopwatch.

6.1.5 pH meter

6.2 Materials:

6.2.1 Distilled water.

6.2.2 Acetic acid, 10% solution.

6.2.3 1993 AATCC Standard Reference Detergent WOB.

7. Preparation

7.1 Prepare dye dispersion.

7.1.1 Weigh out 5 g of 100% strength dye. (For other dye strengths adjust accordingly. Example: 200% strength dye—weigh 2.5 g.)

7.1.2 Paste dye in 25 mL distilled water in a 400 mL beaker.

7.1.3 Further dilute the dispersion with 175 mL of distilled water and heat to 50°C (122°F) while stirring.

7.1.4 Dilute dye dispersion to 1 L with distilled water. Using a pH meter, adjust to pH 5.5 ± 0.2 with acetic acid (see 12.5). Final temperature of dispersion should be 30°C (86°F) for the test.

7.2 Prepare detergent solution.

7.2.1 Prepare a 0.5 g/L solution of 1993 AATCC Standard Reference Detergent WOB in tap water at 30°C (86°F) to check for any blender contamination that would prevent foaming.

7.3 Check the blender for contamination.

7.3.1 Pour 200 mL of detergent solution in clean 1.4 L (1.5 qt) capacity container of the blender.

7.3.2 Operate the blender at its highest speed for 30 s and then stop it. Allow the dispersion to stand for 30 s. A minimum of 2.5 cm of foam should be present on top of the solution. If less foam is present, clean the container and repeat the procedure until enough foam is generated (see 12.6).

7.3.3 Thoroughly rinse the blender container and add 200 mL of distilled water.

7.3.4 Operate the blender for 30 s at highest speed and then stop it. No foam should be present after 30 s. If foam is present, rinse the blender container thoroughly and repeat the procedure until no foam is present.

8. Foam Test

8.1 Pour 200 mL of dye dispersion into the blender container. Place a lid on the container.

8.2 Select blender speed which corresponds to the blade speed 14,000-15,000 rpm, usually highest speed of blender (see 12.4).

8.3 Start the stopwatch simultaneously with starting the blender. Hold the container, but not the lid, to prevent any spills.

8.4 After 30 s, stop the blender but allow the stopwatch to continue running.

8.5 Immediately pour the contents of the blender into a dry 500 mL graduated

cylinder. When pouring, tilt the container only once, and allow the dye dispersion and foam to freely flow into the cylinder. Keep the container tilted over the cylinder until 60 s have elapsed on the stopwatch. Then remove the container.

8.6 After 150 s, read the bottom of the meniscus of both the foam and liquid levels in the cylinder. The reading will be erroneous if the top of the foam which clings to the sides of the cylinder is read as the foam level (see 12.8).

8.7 Record the volume of foam and liquid volume and subtract the liquid volume to determine the mL of foam produced.

9. Evaluation

9.1 Rate dyes according to following classifications:

Class A: 0-30 mL—Very Low Foam
Class B: 31-60 mL—Low Foam
Class C: 61-90 mL—Moderate Foam
Class D: 91-120 mL—High Foam
Class E: Greater than 120 mL—Very High Foam

10. Report

10.1 Report the class (see 9.1) for each dye tested.

10.2 A standard, control or reference sample of the same product should be tested and reported under the same conditions if the test is used for lot-to-lot comparisons of the dye.

11. Precision and Bias

11.1 *Precision Between-Laboratories.* Interlaboratory testing of 14 dyes by five laboratories in 1982 was conducted with a single operator in each laboratory making two tests with each dye. A standard deviation of 7.8 was calculated for the study, but some laboratories had data that were significantly different from others. Blender speed was the major contributor to variation in test results. Blender speeds

can vary with both model of blender and line voltage; there is even 10-15% variation in speed between blenders from the same manufacturer. Therefore, the test is not suggested for comparison between laboratories because variations were larger than expected.

11.2 *Precision Within-Laboratory.* The standard deviation of low, moderate and high foam dyes as evaluated by a single operator was determined by conducting five tests with each of five dispersions of each dye. Using a Duncan's multiple range test for variable value, less than 0.1% of the total variation is due to dispersion preparation. About 1.2% of the total variation is due to the test. Of the total variation, 98.7% is due to foam level. The test will distinguish with 95% confidence level or higher between low, moderate and high foam generating disperse dyes. Multiple dispersions of the same dye are not necessary. Unless test results are significantly different from those expected, multiple tests of the same dye dispersion are not necessary. Listed below are the standard deviations of low, moderate and high foam generating disperse dyes:

Dye Type	Standard Deviation (mL foam)
Low Foam	2.04
Moderate Foam	4.85
High Foam	9.16

11.3 *Bias.* No statement on bias can be made since the true value cannot be established by an independent method.

12. Notes

12.1 The Gaston County Lab Dye Tester gives very good correlation with the blender test using 30°C (86°F) and ambient pressure. The apparatus should first be checked to be sure that contaminants that could affect foam levels are not present. A suggested procedure to measure foam is listed below.

12.1.1 Prepare a dye dispersion as described in the blender test except use 2 L of

distilled water and 10 g of disperse dye.

12.1.2 Adjust the dye dispersion to pH 5.5 with acetic acid and raise the temperature to 30°C (86°F).

12.1.3 Circulate the dye dispersion for 30 s.

12.1.4 Move machine function switch to STAND BY which stops dye dispersion circulation.

12.1.5 After an additional 30 s, measure the foam volume.

12.1.6 For information regarding the Gaston County Lab Dye Tester, contact Gaston County Dyeing Machine Co., P.O. Box 308, Stanley NC 28164; tel: 704/822-5000; fax: 704/827-0476.

12.2 The mass of bubbles formed by agitation of a dye dispersion in a regular kitchen blender is very similar to that which dyers commonly observe on the surface of highly agitated dyebaths.

12.3 Available from Publications Office, ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Cincinnati OH 45240; tel: 513/742-2020.

12.4 A standard kitchen blender such as Waring, Osterizer, Hamilton Beach or other readily available kitchen blenders having an agitator blade speed selection of 14,000-15,000 rpm can be used. Blade speed selection can be determined by consulting the manufacturer, but is usually near the highest speed selection.

12.5 Measure pH with a pH meter rather than pH paper or liquid indicators. Excess acetic acid producing pH values in the range of 3.5-4.5 can significantly increase the foam generated by some disperse dyes.

12.6 Excess silicone lubricants in the bearing of the agitator blade of the blender in new propeller assemblies can cause defoaming action. In such cases, rinse the assembly in an appropriate solvent to remove the lubricants.

12.7 Reproducible readings for foam generation are best taken at a 120-180 s interval after blending rather than the 60 s or less. A 60-s reading is too variable because some dyes require longer foam-liquid separation time than others.

12.8 A detailed description of the development of this procedure can be found in the 1982 AATCC Intersectional Technical Paper Competition from the Piedmont Section entitled, A Method for Measuring the Foam Propensity of Disperse Dyes, *Textile Chemist and Colorist*, Vol. 15, No. 1, January 1983, p21.