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Test Method for Chlorine, Retained, Tensile Loss: Single Sample

1. Purpose and Scope

1.1 This is an accelerated test method to determine the potential damage caused by retained chlorine.

1.2 It has been designed for use on cotton and rayon fabrics, but may be used on any fabric or finish that is not damaged by heat alone (see 13.1). Fabrics must be appropriate for tensile strength testing (typically woven fabrics).

2. Principle

2.1 The fabrics are treated in sodium hypochlorite solution, rinsed, dried, and pressed between hot metal plates. The damaging action of the retained chlorine is calculated from the difference in tensile strength before and after pressing.

3. Referenced Documents

NOTE: Use current versions of all publications unless otherwise specified.

3.1 ASTM D5035, Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method) (see 13.3).

4. Terminology

4.1 **retained chlorine**, *n.*—in textiles bleached with chlorine-type bleaches, available chlorine that remains in the material after washing and drying.

5. Safety Precautions

5.1 The safety precautions specified in the method/procedure are ancillary to the testing procedures and are not intended to be all inclusive.

5.2 It is the user's responsibility to reference applicable safety data sheets, use safe and proper techniques, and wear appropriate personal protective equipment in handling materials in this standard.

5.3 Users MUST consult manufacturers for specific details such as equipment operating instructions and other recommendations.

6. Apparatus and Reagents (see 13.2)

6.1 Beakers, 800 mL.

6.2 pH meter (see 13.4).

6.3 Constant temperature bath (or suitable alternative means of controlling temperatures).

6.4 Wringer, laboratory, or household type.

6.5 Heating device, providing even heat transfer to the specimen from the top by close contact at a controlled tempera-

ture and giving a pressure on the specimen of 8.8 g/cm² (see Fig. 1 and 13.5).

6.6 Tensile-strength tester.

6.7 Sodium hypochlorite stock solution having an available chlorine content of approximately 5.0%.

6.8 Water, distilled.

7. Preparation of Specimens

7.1 Normally, only warp specimens are tested. Cut a swatch approximately 35.6 cm (14 in.) in the warp direction and 20.3 cm (8 in.) in the filling direction (if testing filling specimens, reverse these dimensions). Specimens will be cut from this swatch after chlorination.

8. Preparation of Reagents

8.1 Prewetting and Rinse Solutions. Determine the pH of the distilled water; if outside the range of 6-7, report the actual pH (see 13.6).

8.2 Chlorination Solution. Prepare a chlorination solution containing 0.25% available chlorine at a pH of 9.5 ± 0.1 as follows:

8.2.1 If unable to purchase 5% available chlorine solution, determine the percent available chlorine (Cl) of the sodium hypochlorite stock solution. Pipette a 1.00-mL portion of approx. 5% sodium hypochlorite solution into an Erlenmeyer flask and dilute to 100 mL with distilled water. Add 6 mL of 12% KI followed by 20 mL of 6N H₂SO₄. Titrate with 0.1N sodium thiosulfate solution and calculate as follows:

Percent available chlorine:

$$\frac{\text{mL Na thiosulfate} \times 0.1N \times 0.0355 \times 100}{1 \text{ mL} \times \text{sp. grav. Na hypochlorite}}$$



Fig. 1—Heating device.

8.2.2 Calculate the number of grams (g) of stock solution required to make one liter of a 0.25% available chlorine solution as follows:

$$g = \frac{1000 \times 0.25}{Cl}$$

where:

g = grams of stock solution required.
Cl = % available chlorine determined.

8.2.3 To 900 mL of distilled water add the calculated grams (g) of stock solution required. Adjust the pH to 9.5 ± 0.1 by the addition of either sodium bicarbonate to lower the pH or sodium carbonate to raise it. Finally, add distilled water to make 1 L and recheck the pH.

9. Procedure

9.1 Because many factors, such as pH, concentration, and time, significantly influence the amount of damage caused by retained chlorine, it is *important* to follow closely the conditions of the test. Should any deviations be necessary, include details in the test. As a means of checking the test procedure, it is good practice to run, at the same time, a cotton fabric whose chlorine-retentive properties have been determined previously.

9.2 Chlorination Step.

9.2.1 Prewetting Bath. Measure into an 800-mL beaker a volume of distilled water equal to 50 times the dry weight of the fabric sample. Immerse the sample for 3 min at 71 ± 3°C (160 ± 5°F), stirring frequently. Remove sample from bath, allow to drain and cool at room temperature.

9.2.2 Chlorination Bath. Place the swatch in an 800-mL beaker containing the chlorination solution (equal to 50 times the dry weight of the fabric) that is maintained at a temperature of 25 ± 1°C (77 ± 2°F). Agitate the swatch frequently and gently with a glass stirring rod during the 15-min chlorination period. At the end of 15 min, remove swatch, allow to drain momentarily, and pass through a wringer to remove as much solution as possible using care to keep the swatch flat and free from wrinkles. Rinse equipment free of chlorination solution with distilled water to avoid contamination of specimens during the subsequent rinsing procedure.

9.2.3 Rinsing. Immerse the swatch in an 800-mL beaker containing distilled water (equal to 50 times the weight of the swatch) at a temperature of 21-32°C (70-90°F) for 2 min, agitating the swatch gently and continually. Remove the swatch from the bath, allow to drain momen-