Milestones—Testing Textiles for Colorfastness to Light

An American’s Perspective
For the DEK 100th anniversary

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Subcommittee on Lightfastness,
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“To develop and revise, in view of the best current practice, test methods for measuring color changes in textiles under the influence of light, such as carbon-arc, sunlight and daylight; to establish criteria to tell whether influences other than light have caused significant changes in color.”
The New Type FDA FADE-OMETER
Colorfastness to Light

- Light
- Heat
- Humidity
- Speed
- Reliability
- Repeatability
“In the earlier tests the material was simply exposed to the sun for known lengths of time. It was apparent at an early date that this method was unsatisfactory, since the fading power of the sun was variable. However, many light fastness tests are still reported in hours or days exposure to bright sunlight without any attempt at measuring the intensity of the light. There are three possible methods of overcoming this difficulty, namely: (1) measuring the intensity of sunlight; (2) substitution of some constant light for sunlight; (3) substitution of a chemical reaction for actual light tests.”
“the DEK recommended that a series of standard dyes of graded fastness be exposed with the sample.”
“For those who prefer lamp fading to sun fading and particularly for testing in the fall and winter, it is suggested that one six hour period of standard sun exposure can be approximated by 4-2/3 hours of exposure in the Fade-Ometer. Where speed and convenience are the chief requirements in a light test, the Fade-Ometer is satisfactory as a rule, but the standard sun test is considered to be more reliable.”
“The change in reflectance of some dyeings on exposure to light is not proportional to the intensity of the incident radiation, other conditions being unchanged.

The time of exposure required to produce a given amount of fading at intensity 0.1 may be anywhere from 10 times to only 2 times that requires at intensity 1. This finding is based upon exposures of the glass-enclosed carbon arc, with unit intensity defined as that used in the Fade-Ometer. (An exposure of 1 hour in the Fade-Ometer produces the same fading of dyeings on average, as an exposure of 1.3 hours in the standard sun test of the Association.)

The rate of fading of some dyeings is not affected by a change in the relative humidity of the surrounding atmosphere of from 75 percent to 31 percent, but the rate of fading of others may be retarded by a factor of two.”
“... considerable progress was made during the year in the development of an entirely new series of standard dyeings for defining the minimum requirements of the several classes of fastness to light. All the new standards have very nearly the same blue color and all undergo a similar color change when they fade. They are evenly spaced in fastness and should be readily duplicable. Thus they promise to be a distinct improvement over the present standards. The new standards are produced by carding together two lots of slubbing, one dyed with a relatively fast dye and the other with a relatively fugitive dye in the proportions requires to produce the desired fastness.”
“J. Bolton and J.C. Guthrie reported in the JSDC, that at the same air temperature surface temperatures of samples varied depending on both the colour of the fabric and the dye used. Humidity control was once again stressed along with a provision for performing wet fading.”

“. . . work continues on the development of a new lightfastness standard to replace the Blue Wools.”
Where do we place our milestones?
Blue Wool Standards

- Improve Communication
- Provide a framework for reporting relative performance of one material vs. another
- Demonstrate factors in fading tests
• Fade-Ometer Hours
• Standard Fading Hour
• AATCC Standard Lamp Hour
• Exposure Clock Hours
• AATCC Fading Unit (AFU)

1. “As a temporary working basis 20 Standard Arc Hours has been defined as corresponding to ‘appreciable fading’ of AATCC No. 4 Blue Wool Standard.” (NBS directions for use of light-sensitive paper, July 1, 1947)

2. “The setting adopted was based on the ‘Fade-Ometer Hour’ used for some years in industry for rating colorfastness of Textiles and dyes.” NBS Letter Circular LC 906, May 21, 1948)

3. “The Standard Fading Hour Scale now under trial was selected with the advice and cooperation of the committees on colorfastness of the American Association of Textile Chemists and Colorists and of the American Society for Testing and Materials. Samples of the paper were exposed simultaneously with samples of the AATCC dyed wool light fastness standards. When the latter had failed to an extent the committee considered representative of 20 Fade-Ometer hours of exposure the paper was considered to have faded to 20 Standard Fading Hours of exposure.” (NBS Circular LC 934, January 13, 1949)
4. “Twenty standard fading hours of exposure in the master lamp is equivalent to 20 clock hours of exposure in the well-known Atlas Electric Devices Company’s FDA-R Fade-Ometer, based on the average results of tests in 130 of these lamps.” (NBS Letter Circular LC1004, August 30, 1951)

1. “As a temporary working basis 20 Standard Arc Hours. . .  WRONG

2. “The setting adopted was based on the ‘Fade-Ometer Hour. . . . MAYBE

3. “The Standard Fading Hour Scale now under trial was selected with the advice and cooperation of the committees on colorfastness . . . SUBJECTIVE

4. “Twenty standard fading hours of exposure in the master lamp is equivalent to 20 clock hours of exposure . . . MAYBE
Significant factors in Light fastness testing

- Temperature
- Humidity
- Airflow
Actinic measurements . . .

- Standard Sun Test
- Langley
- Ultraviolet Sun Hours
- Pyroheliometer
- TUVR
Effects of humidity on light fastness...
Xenotest---1954
The correlation is...
7.0 Comparison Standards

7.1 AATCC Blue Wool Lightfastness Standards, as defined in Method 16, are preferred for all options. However, the rate of fade of any AATCC Blue Wool Lightfastness Standard by one test option may not agree with that of other test options.

TM 16-2004
Thank you.