GAS FADING CHARACTERISTICS OF DYED CLOTHES ON EXPOSURE OF OXIDES OF NITROGEN

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Introduction

Air pollution can cause fading of dyed fabrics. Specifically, the fading effects of oxides of nitrogen have received attention, because they are emitted from many sources such as motor vehicles, factories in urban areas, cooking, and heating facilities in the domestic environment. Oxides of nitrogen in cigarette smoke also have the potential to induce fading in some closed environments. Blue ribbon dyed with Disperse Blue 3 (ISO 105-G01 and G04) has been supplied by the American Association of Textile Chemists and Colorists (AATCC) as a standard for evaluating fading caused by exposure to different concentrations of oxides of nitrogen. On the other hand, in Japan, blue ribbon is dyed with Disperse Blue 56 (JIS L 0855) instead of Disperse Blue 3, because the chemical nature of Disperse Blue 3 is associated with some human health risks. Recently, the AATCC reported their examination of Disperse Violet 1 as a candidate dye for a new revised ribbon.

In this report, the characteristics of blue ribbon fading were investigated on exposure to oxides of nitrogen to elucidate the fading nature of these dyestuffs, including the time dependency of fading.

Materials and methods

1. Specimens

Blue ribbons of Japan Industrial Standard (JIS), Disperse Blue 56 and AATCC, Lot 20, Disperse Blue 3 were used in the experiments. In addition, blue ribbon dyed with Disperse Violet 1 was obtained by two methods, in the firstit was prepared as a trial specimen dyed in our laboratory, and in the other it was distributed as a round robin specimen by AATCC. Commonly, the substrate used in this experiment is cellulose acetate.

2. Exposure

Specimens were exposed simultaneously to oxides of nitrogen produced by the chemical reaction of sodium nitrite and sulfuric acid solutions according to the procedure described in ISO 105-G01 and G04. Two sets of specimens were selected for the experiments. The first set consisted of JIS, Disperse Blue 56; AATCC, Lot 20, Disperse Blue 3; and a trial specimen dyed with Disperse Violet 1 in our laboratory. The second set consisted of JIS, Disperse Blue 56; AATCC, Lot 20, Disperse Blue 3; and an AATCC round robin Disperse Violet 1 specimen.

3. Grading of color change

The gray scale (JIS L 0804, ISO 105-A02) was used to assess changes in specimen color. Grading at every 1/2 of an integer scale on the gray scale is given in ordinary judgments, and this method used for the second set of specimens. But for the first set of specimens, grading at every 1/4 of an integer scale on the gray scale was applied.

Results and discussion

Figure 1 shows the gray scale evaluation results with increasing exposure time to oxides of nitrogen for the first set of specimens (ribbons dyed with JIS, Disperse Blue 56; AATCC, Disperse Blue 3; and a trial specimen of Disperse Violet 1). The AATCC Disperse Blue 3 specimen showed moderate fading. On the other hand, the JIS, Disperse Blue 56 specimen showed better fastness to fading, but the Disperse Violet 1 trial specimen showed the less fastness on exposure to oxides of nitrogen. For all the specimens, the fading characteristics against time seem to exhibit a curved, and not a linear relationship.

Figure 2 shows the fading results for the AATCC round robin Disperse Violet 1 specimen compared with the JIS, Disperse Blue 56 specimen on the basis of standard fading of the currently used AATCC, Disperse Blue 3 specimen. The exposure was stopped when fading of the AATCC, Disperse Blue 3 specimen reached the AATCC designated standard for fading. From the results in both figures it seems that Disperse Blue 3 is the most suitable dye for a standard ribbon among those tested in this study. Notably, Disperse Blue 3 was used in a former standard ribbon as the Japan Industrial Standard. The currently used JIS ribbon was shown to have more stable fastness. The AATCC-proposed Disperse Violet 1 dye was shown to have very low fastness. Thus judging the standard fading in real time during an experiment would be difficult.

Conclusion

As alternatives to Disperse Blue 3, the former JIS and the current AATCC standard, Disperse Blue 56 and Disperse Violet 1 were examined on exposure to oxides of nitrogen. The results indicate that Disperse Blue 56 may be more appropriate than Disperse Violet 1, because Disperse Blue 56 fading was moderate whereas Disperse Violet 1 faded too rapidly.

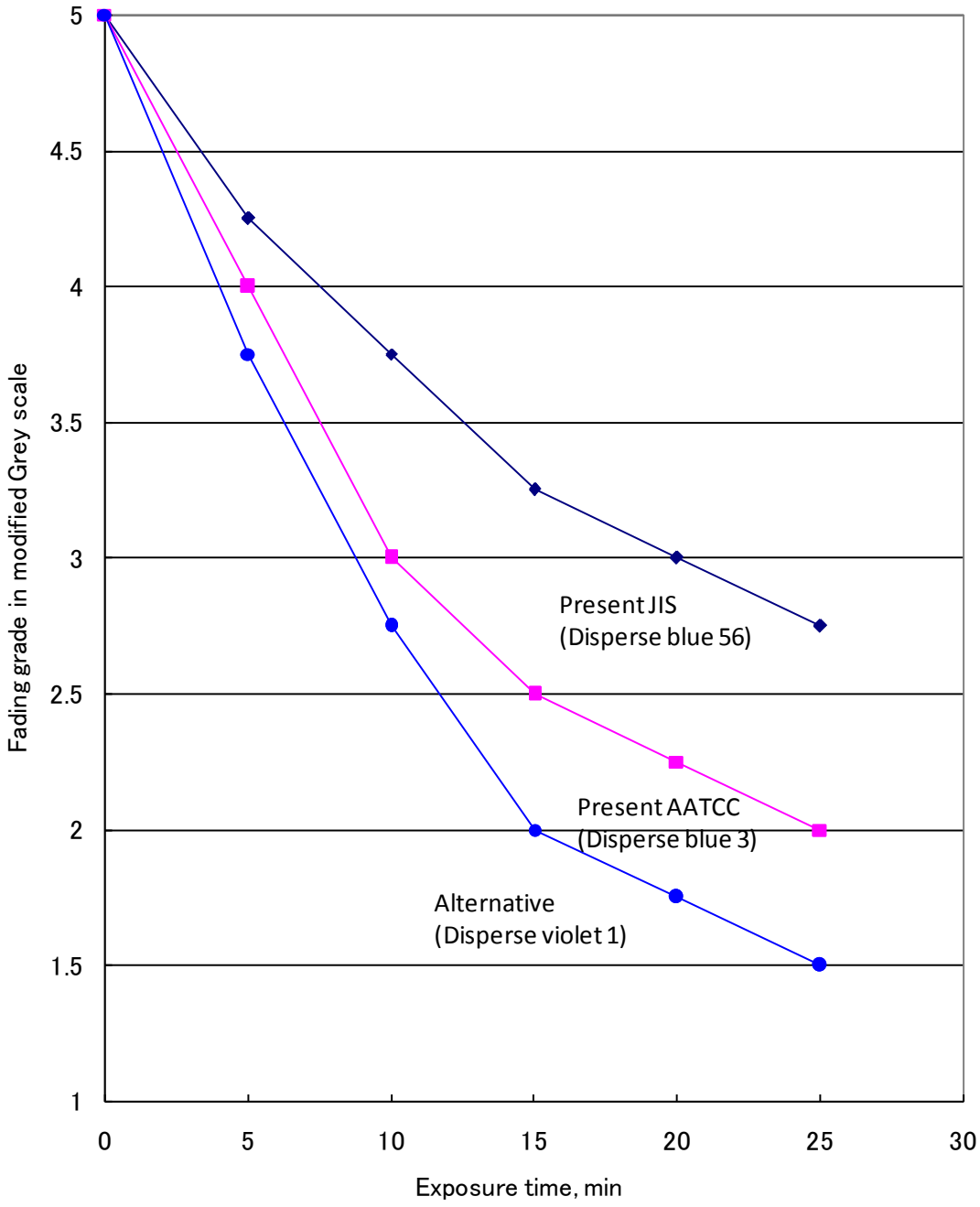

Figure 1 Characteristics of Fading of Standard Ribbons, Present JIS (Disperse blue 56), Present AATCC (Disperse blue 3) and Alternative (Disperse violet 1), under the Exposure to Oxides of Nitrogen

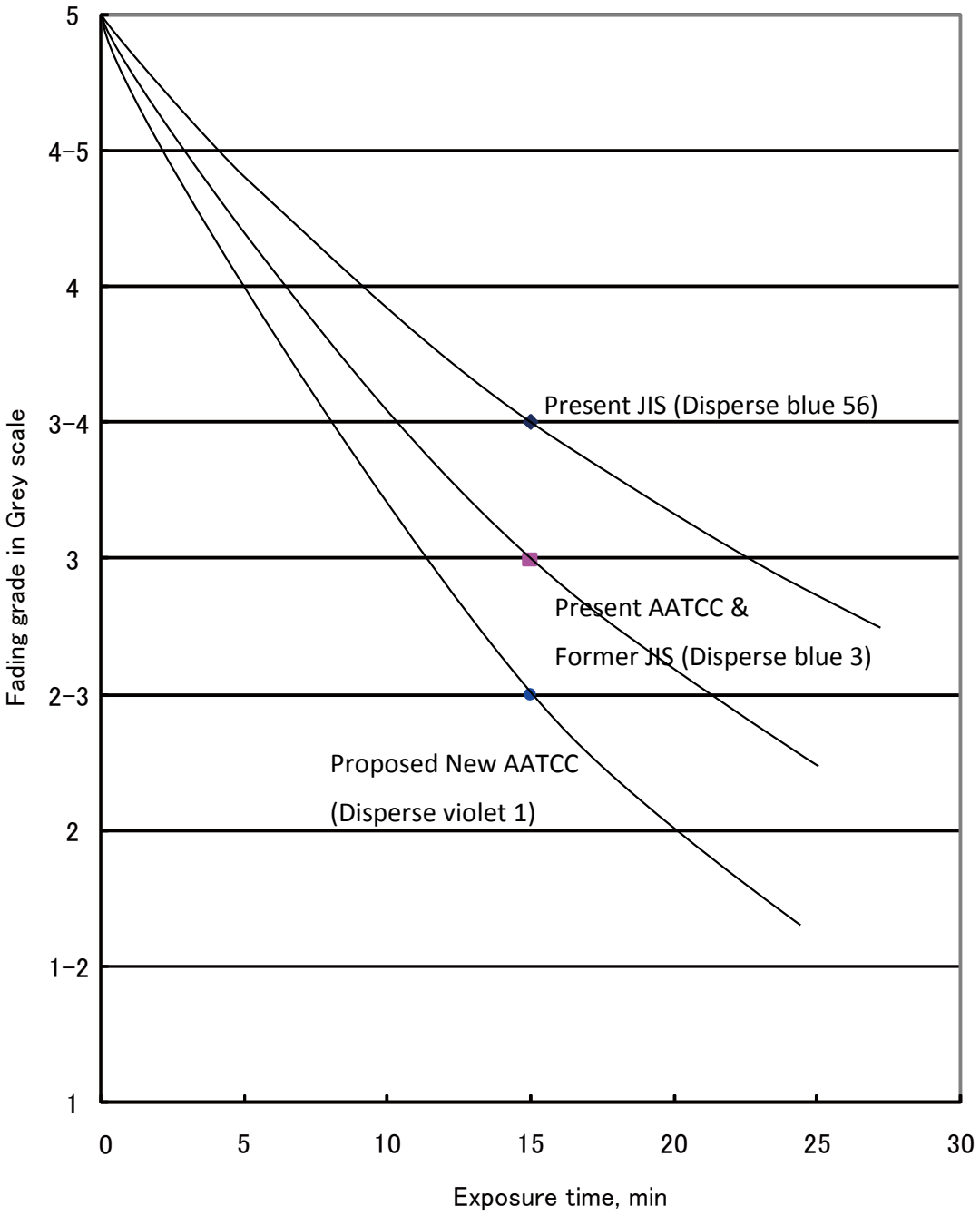

Figure 2 Schematic Diagram of Fading of Standard Ribbons, Present JIS (Disperse blue 56), Present AATCC (Disperse blue 3) and Proposed New AATCC (Disperse violet 1), under the Exposure to Oxides of Nitrogen