

Dyeing of Polyvinyl Alcohol Fibers in Filament Yarn Form with Reactive and Vat Dyes

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1. Introduction

As polyvinyl alcohol(PVA) filament yarn is commercially used in many fields due to its high strength and modulus properties. This research was carried out to study the dyeing behavior of PVA. The dyeabilities of Remazol reactive dyes and Indanthren vat dyes on PVA fiber were investigated.

2. Experimental

PVA filament yarn was supplied by Hyosung company, it was wet spun and heat treated, unformalized filament yarn. Degree of polymerization is 2099, and count is 1000 denier.

Three reactive (Remazol Brill. Blue R special, Remazol Brill. Red F3B gran, Remazol Brill. Yellow 4GL gran) and three vat dyes (Indanthren Yellow C-GC plus, Indanthren Blue BC, Indanthren Red FBB) supplied by Dystar Co. were used. Recommended dyeing procedure was adopted.

After dyeing the K/S value of all the samples were measured by colorimeter CCM(X-rite 8200). Fixation of dye on fibers after washing with detergent, i.e., percentage fixation(% F) was calculated by measuring the K/S values for the dyed samples before washing and after washing.

AATCC 61-1A washing method without steel balls was used to check the fixation of dye on the fiber, and colorfastness to laundering was evaluated using the AATCC 61-1A test to check the color change and staining of adjacent multifibers.

3. Results and Discussions

The PVA fibers dyed with vat dyes have high K/S value, i.e., high color strength, as compared with the samples dyed with reactive dyes. Indanthren vat dye dyes PVA fiber better than Remazol reactive dye. K/S value increases with the concentration of dye for both of reactive and vat dye, but the magnitude of the K/S value of the PVA fiber dyed with reactive dyes is much lower than that with vat dyes.

From the percentage fixation, it is clear that the fixation percentage of Indanthren vat dyes is far better than that of Remazol reactive dyes. Remazol reactive dyes are adsorbed on PVA fiber to some extent, but most of them are flushed away in detergent washing steps. From this it might be thought that Remazol reactive dyes have some affinity with the PVA fiber, but the reaction with the PVA hydroxyl group is not sufficient to make a meaning.

The colorfastness to laundering of the vat-dyed PVA was satisfactory, 4-5 grades of color change and also 4-5 grades of staining. Unexpectedly, the colorfastness of reactive-dyed PVA fiber was also shown to be very high, 4-5 grades of color change and 5 grades of staining. This means that reactive dyes have some degree of affinity with PVA fiber and adsorb on PVA, but they can not react with PVA hydroxyl groups efficiently. But the dyes that reacted with PVA hydroxyl, although being very small portion, form very stable covalent links, and do not leach out even at the severe conditions of laundering.

4. Conclusions

The dyeabilities of Remazol reactive dyes and Indanthren vat dyes on PVA fiber were investigated. Vat dyes were more suitable than reactive dyes for exhaust dyeing of PVA fiber, giving much better color strength, and fixation properties than reactive dyes. Reactive dyes were also exhausted on PVA fiber, but fixation yields were very low. They flushed away by simple detergent-washing.

The colorfastness to laundering of PVA fiber dyed with vat dyes were good enough to show 4-5 grade of color change and staining as is usual with vat dyes. That of PVA fiber dyed with reactive dyes were also shown sufficient with 4-5 grades of color change and 5 grade of staining.

From these results it was concluded that, for PVA fiber, vat dyes are more suitable than reactive dyes, and that reactive dye form very stable linkage with PVA fiber although fixation yield is much lower.