Dyeing of Polyester/Cotton Fibers with Vinyl Sulphone Disperse/ Reactive Dyes

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Abstract

A reactive disperse dye containing a temporarily anionic sulphatoethylsulphone and nonionic disulphide bis (ethylsulphone) groups was applied to cotton/polyester fiber by the exhaust dyeing at a verity of pH and temperature conditions. A mono functional reactive disperse containing only nonionic disulphide bis (ethylsulphone) groups was also its dyeing behaviour was compared with the bifunctional dye. The bifunctional reactive disperse dye exhibited high exhaustion and fixation values at pH 6 and 120^0C.

The result also indicate that the combination of temporarily anionic and nonionic reactive groups of the bifunctional dye provided great enhancement in dyeing performance compared to that of monofunctional dye. The dye also showed very good leveling and fastness properties.

Introduction

For dyeing cotton/polyester fiber is well reported dye. Its use of reactive disperse the advantages of these dyes stem from their excellent wet fastness and good coverage of the fiber, which overcome the leveling problems on cotton/polyester fiber with conventional reactive disperse dyes. Attempts have also been made to produce other types of reactive disperse dye carrying monocholorotriazine and vinyl Sulphone reactive disperse groups. The last year research in applied reactive disperse dye containing sulphatoethylsulphone reactive groups on nylon, silk and polyester fiber and dyeing properties of reactive disperse dye having sulphatoethylsulphone reactive groups and found that these dyes, when applied at 95^0C and pH8, exhibited excellent build-up profiled and wash fastness on cotton/polyester.

This dye was adequate for the dyeing of cotton/polyester and exhibited good build-up and fastness properties at high temperature (130^0C). However, it was found that this dye showed modest exhaustion and fixation at conventional dyeing temperature, probably resulting from the presence of a nonionic disulphide bis (ethylsulphone) groups, which could temporarily enlarge the dye molecular size as the temperature increased. The formation of low molecular weight vinyl Sulphone derivative through disulphide B-elimination leads to good fixation of the dye fiber. An additional temporarily anionic sulphatoethylsulphone reactive group to the structure of nonionic disulphide bis (ethylsulphone) groups could gradually convert in to the reactive vinyl Sulphone forms. Different factor affecting the dye ability and fastness properties of such a bifunctional reactive disperse dye.

Experimental

Material

Fabrics: Cotton/Polyester fabric its 35/65 blends, enzymatic method with 2 g/l by Baylase AT (Bayer co.) at 70^{0}C 40 minute and then washing hot water all 0.5 g/l nonionic soap, Scoured and bleaching H202 35%, 4 g/l and NaOH 30% 2 g/l and stabilizer 2 g/l and wetting agents 1 g/l in 90^{0}C at 45 minute and then washing hot water and cold water and air dried at room temperature when finishing in pre treatment dyeing with reactive disperse vinyl Sulphone dyes.

Dye: sulphatoethylsulphone disulphide bis (ethylsulphone) Reactive disperse dye

One batch Dyeing of P/C Blend

Polyester cotton fabrics blend were dyed in Atlas dyeing machine without any dispersing agent using one-batch dyeing profile as shown in Figure 1.

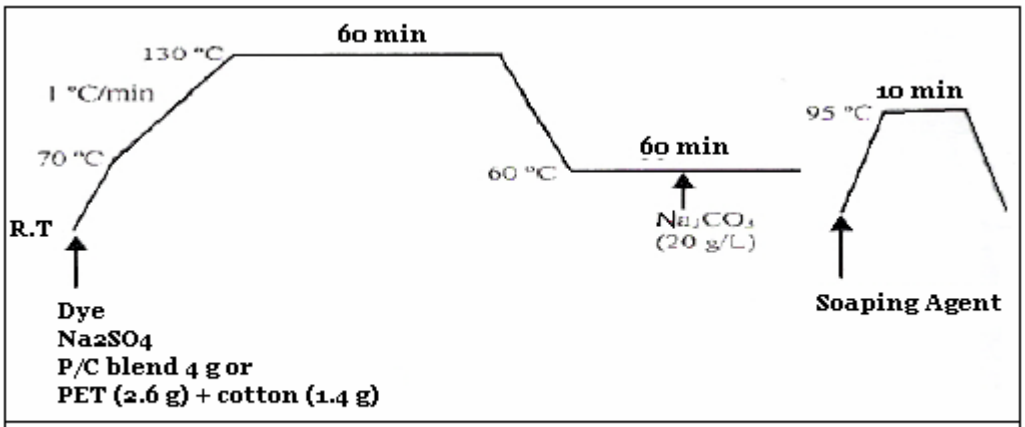

Figure 1 - One batch dyeing proile of P/C blend with temporarily solubilized reactive disperse dyes

Dyeing of Cotton/Polyester fabric

For satisfactory dispersion in the dye batch, the dyes were initially finished by mortar milling in the presence of a specially selected dispersing agent. Cotton/Polyester fabrics were dyed in Atlas dyeing machine at a liquor ratio of 40:1 using distilled water. The dye batch was prepared with the dye at range of dye concentrations (0.5 %, 1%, 1.5%, 2% and 3% owf) and with 1.5 g/l anionic dispersing agent (Avolan IS Bayer Co.). The pH was then adjusted to 4, 6, 7, 8, 9 and 10 using 10% acetic acid and 0.2 mol sodium carbonate solution. Dyeing was started at 45^{0}C for 15 minutes, then the dye batch temperature was raised at a rate of 1.5-2 C/min to 90, 100, 110, 120 and 130 ^{0}C and the dyeing continued at the desired temperature for a further 60 minutes unless otherwise specified. Dyeing was commenced at 70^{0}C. The dye batch temperature was raised by 1 C/min to 130^{0}C, maintained at this temperature for 60 minutes and cooled to 60^{0}C. After 30 minutes at 60^{0}C, 20g/l of alkali (Na_2Co_3) was added to effect fixation of the dye on cotton and maintained at 60^{0}C for further 30 minutes. The dyeing were rinsed and soaped at 95^{0}C for 15 minutes with 1.5 g/l soaping agent.

Effect of pH dyeing temperature

The effect of pH and temperature on the exhaustion and fixation of the disperse reactive dyes using 2% owf dye concentration. For dyeing were carried out and different temperature (90-130^{0}C) at pH from 4 to 10, the exhaustion and total fixation of dye in Figure 2 respectively. The results show that dye is characteristically insensitive to temperature at 110-130^{0}C and maximum fixation at 120^{0}C and pH 6. The higher dyeing temperature at 110-130^{0}C can bis (ethylsulphone) B-elimination reaction, which could dye fiber fixation through the high reactive and low molecular bifunctional bis (ethylsulphone).

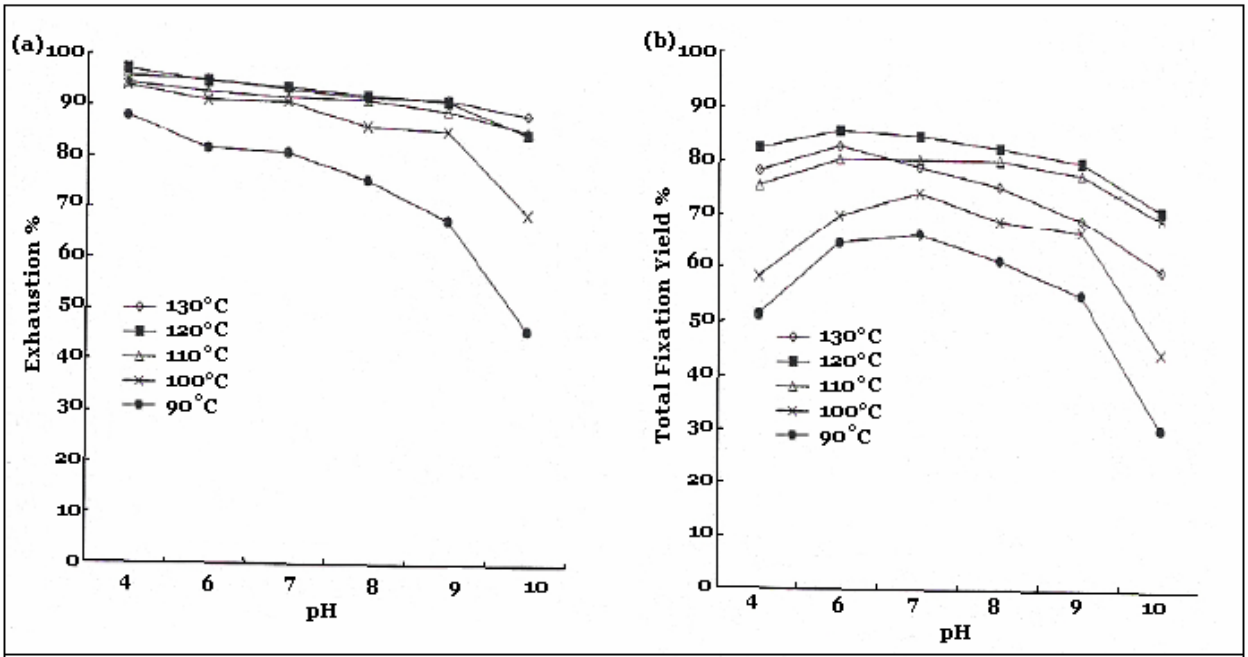

Figure 2: Effect of pH and Temperature condition on the exhaustion and total fixation yield of dye on cotton polyester fiber

Effect of Dyeing Time

The effect of dyeing time on the extent of exhaustion and total fixation yield of dye assessed. Figure 3 show the build up of both dyes on cotton polyester fiber examined with 2% owf dye concentration at pH6 and at optimum dyeing temperature of 130^{0}C. The result indicates that the dyeing rates of the groups. At the early stage of dyeing using dye the percentage of dye exhaustion increases signification until 50 min, probably due to its high substantively, then equilibrates as the dyeing proceeds. This means that the vinyl Sulphone derivatives obtained from the sulphatoethylsulphone and disulphide bis(ethylsulphone) groups increase and the reaction with cotton polyester increases, so that the dye equilibrates is achieved at a shorter dyeing time.

Effect of Dyeing Concentration

The extent of the dye exhaustion and total fixation yield of dyeing cotton polyester fiber with different concentration of the reactive disperse dye (0.5-3% omf) was investigated.

All the dyeing was carried out at the optimum dye (pH 6,120c and 100 minute). The result is shown in Figure 4.

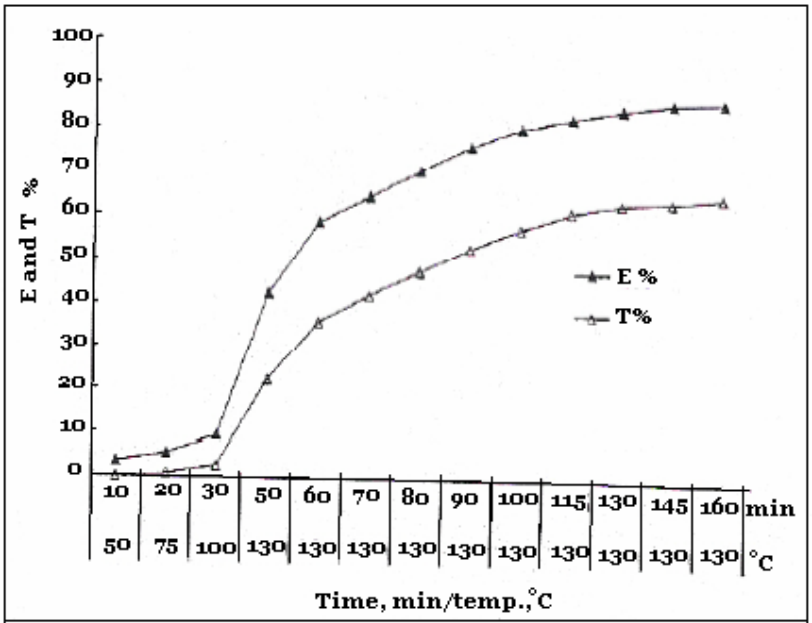

Figure 3- Effect of dyeing time on the exhaustion and total fixation yield of dye (2%owf) at pH 6 and at 130 C on cotton polyester fiber

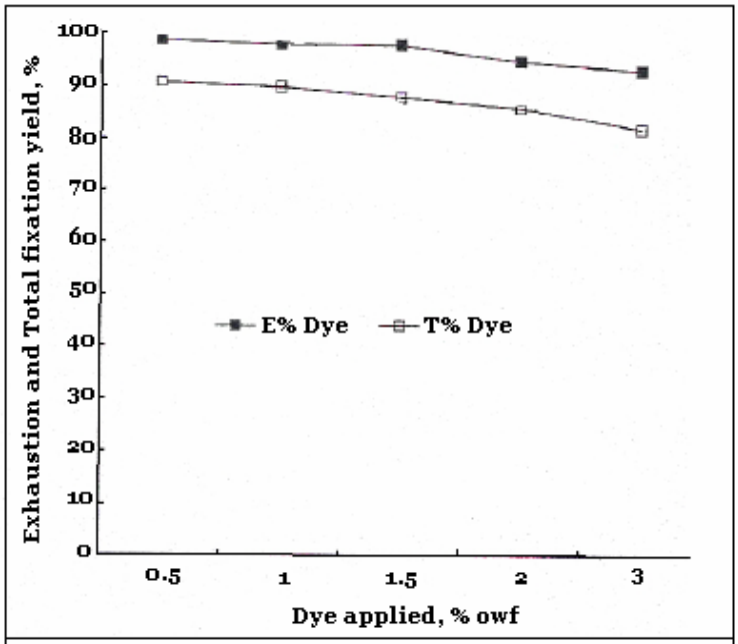

Figure 4: Exhaustion and total fixation at different dye concentration, pH 6 and 130c on cotton polyester fiber

Leveling properties

The leveling properties of dyed cotton polyester fiber at different concentration (0.5%, 1%, 1.5%, 2.0% and 3% owf) of the dye, from which its clear that the average colour different L*a*b* of the dyed fiber indicate very good leveling properties. This can be attributed to the fact that the disulphide B-elimination reaction of both dyes allows good dispersion because of the consequent reduction in dye molecular size.

Conclusions

Disperse reactive dye containing both temporarily anionic sulphatoethylsulphone and nonionic) disulphide bis (ethylsulphone) reactive groups has been applied to cotton polyester fabric by exhaust dyeing. The optimum exhaustion and fixation were achieved at pH 6 and at the dyeing temperature of 130^0C. This dye exhibited a good build-up even at the conventional dyeing temperature of 90-100 because of its high substantively resulted from the temporarily anionic sulphatoethylsulphone groups. The *B*-elimination of both, temporarily anionic sulphatoethylsulphone and nonionic Disulphide bis (ethylsulphone) group, result in the formation of bis (ethylsulphone) derivatives which increase the dye-fiber fixation.

The dyeing performance of such a sulphatoethylsulphone disulphide bis (ethylsulphone) reactive disperse dye on cotton polyester fiber should lead to the design of novel reactive disperse dye with good application properties.

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