

Effect of isothermal and migration process on knit fabric dyeing with reactive dye especially on light colour

by Md. Mahfuzur Rahman, Department of Textile Engineering,
Faculty of Science & Information Technology, Daffodil International University.

Abstract: This paper presents the effects on cotton fabric dyeing process (isothermal and migration) with reactive dyes. Cotton fabric was dyed with reactive dyes with an analysis optimizing procedure by varying dyeing process (isothermal and migration) and parameters. Dyes and chemicals are used for dyeing to achieve the appropriate effect. It was observed that dyeing process and parameters are wide-ranging for using different types of reactive dyes and auxiliaries. It helps to find out the differentiation between the two processes and provide a better result.

Key words: chemicals and dyes, process parameters, after treatments, method analysis.

Introduction

Fabric dyeing usually requires three basic dyes in a mixture to achieve the desired hue and shade. Dyes with similar reactive groups and same exhaustion properties will be said to be compatible with each other and are ideal for use in such mixtures. Selecting compatible dyes is a part of ensuring an optimum dyeing recipe which will most efficiently utilize the dye, produce optimal dyeing results and will reduce the number of chemicals that enter the wastewater.^[1] This research has been taken to describe the parameters like M:L, temperature, time, costing, scouring, bleaching, enzyme treatment, recipe, dyes, auxiliaries and two types of process etc. Reactive dye has high affinity for knit fabric because of its very good fastness properties.

General structure of reactive dye: D-B-Y-X

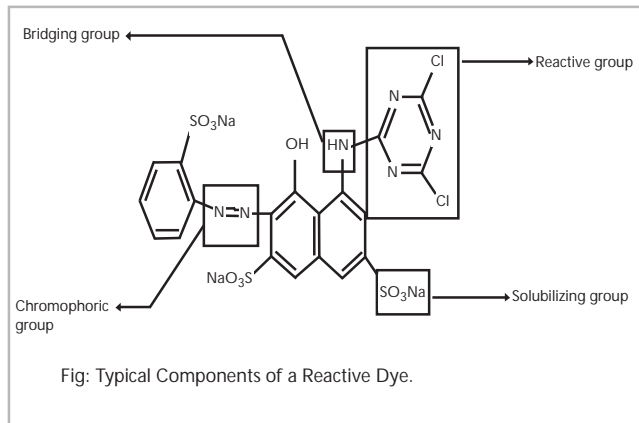
Where,

D= Chromophore of dye part

B= Bridge (such as, -NH-, -NR- group)

Y= Reactive group bearing parts

X= Reactive atom or group



The reactions are as follows:

(i) Substitution reaction

(a) In case of cellulose fibers:



(b) In case of protein fibers:



(ii) Addition reaction

(a) In case of cellulose fibers:



(b) In case of protein fibers:



Chemical and dyes

The author some of the following chemicals.

1. Sandoclean PCLF- Detergent.
2. Ck- wetting agent.
3. Sirrix 2UD- Sequestering agent.
4. Centafoam SC- Anti-foaming agent.
5. H₂O₂- Hydrogen Per-oxide.
6. Na₂CO₃/NaOH.
7. Caustic soda flax.
8. Imacol C2G- Anti-creasing agent.
9. SOF- Stabilizer.
10. Centalizer ASB - Per-oxide Killer.
11. Strong acid.
12. Bio-Polish 80L- Enzyme.
13. Drimazin E2R - Leveling agent.
14. Salt & Soda.
15. Sandoper Sp- Soaping agent.
16. Sandofix EC- Fixing agent.
17. Softener- Alkamine CWS.

Dyes: Color: Pink

- ❖ Dri. Yellow K2R=0.0012%
- ❖ Dri. Red K8B=0.0097%
- ❖ 20/5 60°C.
- ❖ Salt: Soda: 20:5;
- ❖ Temperature: 60°C.
- ❖ Shade %: 0.0109%.

Process parameters

The required knit fabric was dyed in Winch dyeing machine from Fongs National Engineering. Dyeing parameters plays a vital role during dyeing. Temperature, Liquor ratio, Salt and Soda concentration, fabric weight, etc is very important stipulations during dyeing process.

1. Machine weight:750 kg (250kg/nozzle)
2. Fabric weight: 600 kg (80%)
3. Fabric type: 1*1 Rib
4. M:L: 1:8; 1:7;
5. Dyeing process: Migration; Isothermal.

6. Color: Pink.
7. Scouring temperature: 98°C
8. Bleaching temperature: 80°C
9. Scouring acid temperature: 60°C
10. Enzyme temperature: 55°C to 70°C
11. Leveling temperature: 60°C
12. Dyeing temperature: Varying due to process
13. Salt : Soda : 20:5
14. Softener.

Process study

Exhaustion & Fixation study

The dye-bath exhaustion and fixation was studied by known methods by collecting the samples of exhausted liquor at various intervals and studying the absorbancy by diluting the exhausted liquor up to various folds. [2]

Solubility

Due to the presence of the OH and NH functional group in the dye molecule, a dissociation resulted in a higher solubility during the dyeing process at low liquor ratio. Also, the presence of the sulfonic chromophores (two to three) and the novel sulphatoethyl sulphone groups promoted the solubility of the new bifunctional (MCT/SES) dyes. [2]

pH value of dye bath

The pH of dye bath during exhaust dyeing method was widely taken into consideration, where, we first used the neutral pH and gradually increased the alkalis by dosing the $\text{Na}_2\text{CO}_3/\text{NaOH}$ to a pH of 11.5 to differentiate the probable exhaustion in both cases. Both SES and MCT groups functioned as the reactive sites. However, we recommend a dyeing process for this type of dye exhaust dyeing method set at 60°C with a control dye bath pH. [2]

Color measurements

The (%R) percent reflectance of the dyed material was measured at different wavelengths in the visible region (400-700 nm) using a ACS-600 color control system. [2]

Shade evaluation

The hue over the knitted cotton fabric as checked by matching it with standard shade cards. The shade appeared at a somewhat higher wavelength of the dye. [2]

Substantivity

The dyes showed medium-to-good substantivity which can be detected by the exhaustion and fixation study. This can be due also to the presence of the two pioneer groups as the reactive sites involved in the dye substrate. The substantivity of the hydrolyzed byproduct can be readily detected from the amount of unfixated dye and can easily be removed after three or four washes at different temperatures. [2]

Experimental Procedure

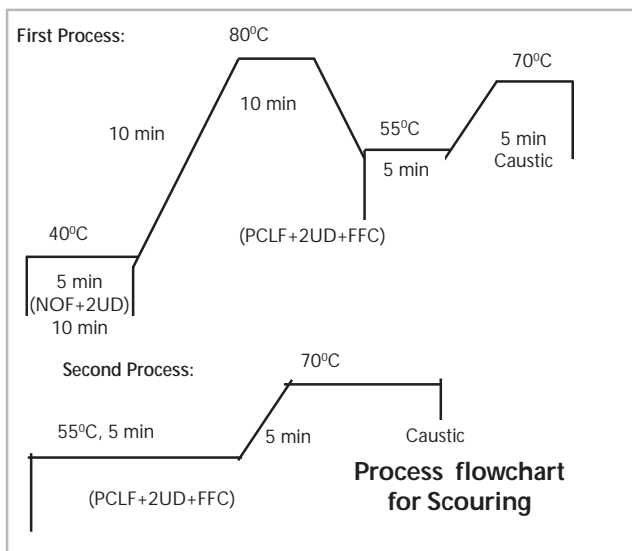
Knit fabric dyeing procedure consists of five steps; scouring, bleaching, enzyme treatment, dyeing and softener treatment. These five steps are necessary for completing the whole dyeing process. Fongs dyeing machine is used for this experiment and subsequent steps are given as under.

Scouring

In this experiment, 1*1 rib fabric of weight 600 kg (Grey fabric) is used, with NOF, 2UD, PCLF, FFC and Caustic chemical used for scouring process. The required amount of chemical used for this process are as follows:

- (i) NOF: 0.5 g/l
- (ii) 2UD: 0.5 g/l
- (iii) PCLF : 0.6 g/l
- (iv) 2UD: 0.3 g/l
- (v) FFC: .05 g/l
- (vi) Caustic: 2.5 g/l
- (vii) Process temperature: 70°C.

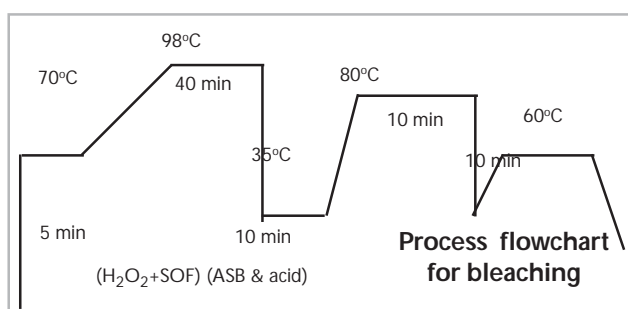
Both the processes given as above are satisfactory, but first process is preferable because in this process, fabrics are better cleaned and absorbency power will be increased. The first process also removes the natural impurities, dirt or grease from cloth more efficiently.



Bleaching

Normally scouring and bleaching is done simultaneously in the dyeing machine. Bleaching creates a permanent whiteness in the fabric which is helpful for dyeing knit fabrics. Acid and peroxide killer are added in the bath for this light color dyeing. Strong acid is more beneficial than Acetic acid because strong acid controls the PH values more strictly. The chemicals used for this process:

- i) H_2O_2 : 4.0 g/l
- ii) Centalizer ASB (Per-oxide destroyer): 0.6 g/l
- iii) Stabilizer SOF: 0.25 g/l
- iv) Strong acid: 0.6 g/l



Enzyme treatment

Enzyme removes the hairiness from the fabric surface which is helpful for fabric dyeing. Normally enzyme percentage varies from 0.9-1.0 and following two processes are applied. The using chemicals for this process are as follows:

- i. Bio-Polish 80L : 0.9 % (on the weight of the fabric)
- ii. Acetic acid: 0.6 g/l.
- iii. PH: 4.5 – 5.5

First process consists of two steps. At temperature 55°C, 0.6% enzyme concentration is used in the machine, with a runtime of 30 minutes. The fabric sample is then take for hairiness checking, and then 0.3% enzyme is added with a running time of 20 minutes, with another fabric sample to check the hairiness. In order to ensure better fabric performance the temperature is increased upto 70°C, with further 10 minutes runtime in the bath.

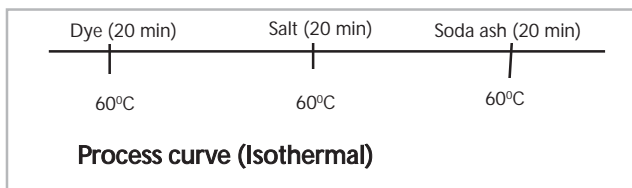
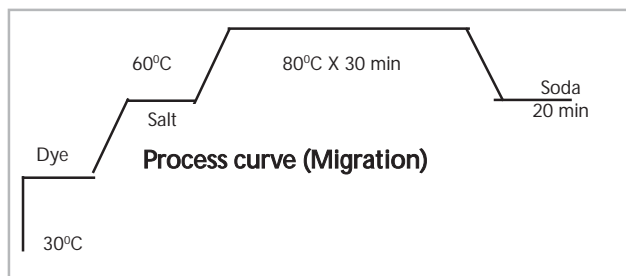
The second process entails a single step, at bath temperature of 55°C, with 0.9% enzyme ratio, with running time of one hour. The first process is comparatively better, because in this process hairiness of fibers is smoothly removed which is helpful for the next dyeing process.

Method analysis

For this experiment, two methods are being used, one is migration process and another is isothermal process.

Process curve (Migration)

In migration process, color (30°C), salt (60°C), then runtime 30 minutes at 80°C, soda (60°C), then again temperature rises up to 80°C, to be completed in the dye bath.



Process curve (Isothermal)

At first the dye bath is prepared by adding chemicals and auxiliaries, with temperature raised to 60°C. The dyestuff are added slowly into a bath over a period of 20 mins. After the addition of dyestuff, the required amount of salt is added in two portions or in some case slowly over the duration of 20 mins. Afterwards the soda ash is added to the bath in two portions or over a period of 20 mins.

Softener

After matching the shade, the CWS softener is added and for pink color dyeing.

Results and discussion

In isothermal process dyeing process has been completed at 60°C (for light color dyeing). In migration process, dyeing is being completed at 60°C-80°C-60°C process. In migration process, the value added time remains 90 mins, whereas at isothermal process this time remains 60 mins that's why total time saving of 30 mins is observed for one batch. Fixation and exhaustion has been completed at same temperature during isothermal process for light color dyeing. In migration process, Fixation and exhaustion has been completed at various temperatures, so that chemical and dyes consumption and energy expenditure also increases the cost of production. Therefore, it can be concluded from this experiment that for light color dyeing, isothermal process is much better alternative to migration dyeing process.

References

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Vietnam reports rising demand for branded clothes

With growing brand awareness, fashion consciousness and rising demand for quality clothes, sales of clothes in Vietnam are projected to grow at a CAGR of around 15% by the end of 2012, according to a new research report by Vietnam Retail Analysis (2008-2012).

The report further says that while Vietnam's domestic garment market is largely export-oriented, local demand for better quality clothing is also keeping pace with rising brand awareness and consumer-oriented society.

As Vietnam has recently acquired the WTO membership, growth prospects for its textiles and garments industry have shown more promise as it has a potential to increase exports to the US and Europe (the biggest export markets for Vietnam) without any quota limitations. Besides, rise in textile exports will also enable Vietnam to generate more jobs and increase foreign exchange. In the backdrop of these factors, the Vietnamese apparel industry is expected to grow at a CAGR of 9.95% from 2007 to 2011. ♦

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