Salt-Free Dyeing of Cotton Fabric using Reactive Dyes- a Novel Approach for Green Chemistry

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Abstract— In this paper, initially the introduction to various salt-free dyeing techniques is given. Their application methods has been described in brief. Finally, the usefulness of the paper is given in conclusions.

Keywords: Cotton Fabric, Reactive Dyes, Green Chemistry

I. Introduction

In conventional dyeing techniques, common salt is used as an exhausting agent. This exhausting agent creates problem in effluent treatment. The salt which is dissolved in water becomes unfit for drinking. As the effluent is sent to the river it becomes problematic for the environment. It creates water pollution. For reactive dyeing, very large amount of salt and alkali are used [1]. Due to the hydrolysis of reactive dye, the effluent contains large amount of hydrolysed dye, which may create problem for both aquatic and human life. Hence to overcome this problems, various salt-free dyeing techniques are introduced [1, 2].

II. Different Salt Free Dyeing Techniques

A. Salt-free dyeing of cotton fabric using chitosan (polyacrylamide)

In this method, cationic acrylic copolymer is treated with cotton fabric for increasing the both subtantivity and reactivity of fibre towards reactive dye. The chitosan may form crosslink within the fibre for better dye uptake. When cotton fabric is treated with chitosan (polyacrylamide), amino groups are formed which increases the substantivity of cotton towards reactive dye. The increased dye uptake is attributed to the amide linkage formed due to the introduction of chitosan into the cotton fabric. The improvement in crease recovery has also been detected [1, 2].The dyeing of modified cotton can be carried out at 90-1000C for better fixation and fastness properties. The dyeing can be carried out at neutral pH [1, 3].

B. Using chemically cationized cotton.

Chemically cationized cotton is produced by etherifying reaction of cotton with tertiary amine 2, 3-epoxy-propyl-trimethylammonium chloride. This compound can be formed in situ from the reaction of caustic soda with 3-chloro-2-hydroxy-propyl-trimethyl ammonium chloride (CHPTMAC) [1, 4].

The pre-treatment of cotton can be carried out by using 35 gpl CHPTMAC and 15 gpl caustic soda at 100% wet pickup. The fabric is stored for 24 hrs. First CHPTMAC is reacted with alkali to form EPTMAC. This EPTMAC will react with alcohol to form cationised cotton.

Dyeing of cationized cotton is done as conventional method. This method gives very high exhaustion rates without using any salt. Thanks to the cationic sites for their valueable contribution [1, 2, 3, 4, 5].

C. Through graft polymerization

To modify the fibre, graft polymerization of cationic monomer, methacrylol amino-propyl-trimethyl ammonium chloride (MAPTAC) is done. After that dyeing is done as conventional methods without using salt. The MAPTAC increases the affinity of fibre due to the formation of cationic groups. Cotton fabric is treated with different concentrations of MAPTAC from 0 to 50 gpl using redox initiator using MLR 1:20 for 45 minutes at 750C. Hydrogen peroxide and caustic soda are also added. The temperature is finally raised to 950C [1, 5].

But by using this technique it gives the problem of ring dyeing which means that the grafted compound remain on a yarn surface which gives undesirable effects. Light fastness may get impaired when excess amount of MAPTAC is used [1].

D. Dendrimer polymers.

Cotton samples are treated with dendrimer at 900C at different pH values from 4 to 9 at four different concentrations from 0.25% to 1%. Then, the dyeing is carried out as a conventional method [1]

E. Using organic salts

Sodium edate seems to be a good option as a replacement for sodium chloride (common salt). By using different concentration of sodium edate (SE) good exhaustion and fixation can be achieved. The dyeing is carried out at 80 to 900C without using any salt [1, 2].

F. Using liposomes as a dyeing promoter.

The optimum and level dyeing effects can be achieved at 850C. When liposomes are used as dyeing promoters.

Neutral nano-liposomes (NL) and Cationic nano-liposomes (CL) are used during dyeing. The concentration used for NL and CL may be as high as 84 mmol per litre. Dyeing is done at 800C as conventional method. This gives good color fastness and high exhaustion properties [4].

III. Results and Characterization

For characterization Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray Diffraction Method (XRD), Fourier Transform Infra-red Spectroscopy (FTIR), K/S values, Exhausion (%) can be carried out [1, 2, 3, 4, 5, 6,7].

IV. Conclusions

This paper will make the reader aware about the various salt-free dyeing techniques and their characterization.

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