

ABSTRACT

Cotton is one of the widely used textile fiber substrates in the world, particularly in India, due to its comfort, aesthetic value, strength, affinity towards various chemicals and dyestuffs, and customer - friendly end-use products.

Cotton is dyed by various dyestuffs including natural dyes, the prominent among which are direct dye, reactive dye, sulphur dye, pigment dye and vat dye. From these dyes, vat dyes give exceptional properties on cotton material and hence they are welcome by textile industries. However, vat dye has some applicational problems. Vat dye is insoluble in water; hence, powerful reducing agent like sodium hydrosulphite (hydrose) in the presence of strong alkali is required for its solubilisation (vatting). This process creates effluent and environmental problems that reduce the utility of vat dyes in the textile market.

Therefore, the aim of this research work is to reduce the problem of vat dyeing due to the commercial reducing agent (hydrose) and to revive the use of vat dyes for cotton dyeing within the effluent parameters set for industries. With respect to solving this problem, the methodology was fixed after many literature surveys and dyeing trials in the laboratory and in an industry using various techniques and reducing agents.

Eventhough many research have been carried out on vat dyeing of cotton materials, they are not being practiced in industries anywhere. After adapting these techniques and methods in the industrial trial, it was decided to implement a simple technique commercially for industries.

Against this background, a vat dye (Jade green XBN) was selected in this research work, for dyeing on cotton fabric. For the reduction of vat dye, reducing agents such as hydrose, zinc and ferrous sulphate and their combinations in different proportions were selected. The sequence of study is as follows: Different reducing agents for vat dyeing on cotton fabric were applied. Then effect of reducing agents on vat dyeing of cotton fabric was studied. Using different reducing agents Vat dyed cotton fabric was analysed for fabric strength, fastness properties, colour strength, SEM study and FTIR study. Vat dye bath during and after dyeing was analysed for reduction potential and effluent parameters respectively. Optimum combination of reducing agents for vat dyeing on cotton fabric was then selected. Reducing agents of vat dyeing for industries with respect to cotton fabric properties and effluent parameters can be preferred.

The selected reducing agents were Hydrose 2.0% owm, Zinc 2.0% owm, FeSO_4 2.0% owm and their combination as Zinc 0.5% owm + Hydrose 1.5% owm, Zinc 1.0% owm + Hydrose 1.0% owm, Zinc 1.5% owm + Hydrose 0.5% owm, FeSO_4 0.5% owm + Hydrose 1.5% owm, FeSO_4 1.0% owm + Hydrose 1.0% owm, FeSO_4 1.5% owm + Hydrose 0.5% owm, FeSO_4 1.5% owm + zinc 0.5% owm, FeSO_4 1.0% owm + zinc 1.0% owm, and FeSO_4 0.5% owm + zinc 1.5% owm.

The results of vat dyeing on cotton fabric using different reducing agents are summarized below;

The reduction potential of the reducing agent combination FeSO_4 and hydrose combination is good. There is a uniform change in the reduction potential for this combination. This is particularly very good for FeSO_4 1.0% owm + Hydrose 1.0% owm reducing combination compared with other combinations.

There is a good colour strength based on k/s value for the vat dyed cotton fabric using reducing agent combination of FeSO_4 1.0% owm + Hydrose 1.0% owm. Compared to the other reducing agents, FeSO_4 + Hydrose combination gives good colour strength to vat dyed cotton fabric.

Using various reducing agents the vat dyed cotton fabric reveals good dyeing effect which was confirmed by scanning electron microscope photograph. The dyeing effect is very good on vat dyed cotton fabric using FeSO_4 and hydrose combinations, especially for FeSO_4 1.0% owm + Hydrose 1.0% owm, as reducing agent. This dyeing effect on vat dyed cotton fabric was also confirmed by FTIR analysis, as given for original vat dye and for the vat dyed cotton fabric using different reducing agents especially FeSO_4 1.0% owm + Hydrose 1.0% owm.

After vat dyeing on cotton fabrics using various reducing agents the effluent parameters are of different levels. The effluent parameters are less for vat dyed cotton fabric using the combination of FeSO_4 + Hydrose as reducing agents, and they are within the limit prescribed for waste water of textile

chemical processing industries for FeSO_4 1.0% o/w + Hydrose 1.0% o/w combination.

In general the results are convincing for the textile material, as there is no considerable change in the tensile strength of the cotton fabric after vat dyeing using various reducing agents, and the fastness properties (washing, light and rubbing) are also very good relevant to the textile materials.