STUDIES ON THE USE OF REDUCING SUGAR AS A SUBSTITUTE OF SODIUM SULPHIDE FOR DYEING OF COTTON WITH SULPHUR DYES

by

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Dedicated

to

my parents

CERTIFICATE

This is to certify that the thesis entitled "STUDIES ON THE USE OF REDUCING SUGAR AS A SUBSTITUTE OF SODIUM SULPHIDE FOR DYEING OF COTTON WITH SULPHUR DYES" being submitted by Mr. Shirishkumar Balasaheb Vhanbatte, to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy in the Department of Textile Technology is a record of bonafide research work carried out by him. Mr. Shirishkumar Balasaheb Vhanbatte has worked under my guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Sulphur dyes represent the best economic alternative for specific fields of application and are preferred because of their good to excellent fastness to washing and light. The entire dye class is known for poor image since the commercial use of sodium sulphide as a reducing agent for sulphur dyes is regarded as foul-smelling and ecologically unsafe. Among the various reducing agents suggested in literature for the replacement of sodium sulphide, glucose along with equal weight of sodium hydroxide found to be satisfactory substitute for sulphur black. In the present thesis the detailed investigations on the use of reducing sugar - essentially consists of glucose and fructose, as a reducing agent for sulphur dyeing have been reported. The research work consists of

- In-house preparation of reducing sugar by acid hydrolysis of sugar
- Comparison of reducing sugar and sodium sulphide as a reducing agent for dyeing of cotton with sulphur dyes which includes various factors like effect of sodium sulphide concentration and temperature, development of reduction potential, stability, their consumption during reduction and dyeing and leuco potential of sulphur dyes.

The sulphur dyes are reduced at lower reduction potential of about – 600 mV. Reducing sugar along with equal weight of sodium hydroxide provides the required reduction potential for reduction of sulphur dyes. This combination of reducing sugar and sodium hydroxide produced lower colour yield and tonal variation of sulphur dyes other than black. The effect of sodium hydroxide concentration and temperature have been studied in detail and it has been found that concentration of sodium sulphide played an important role in development of reduction potential and colour yield in terms of K/S.

Methods for quantitative estimation of sodium sulphide in reduced bath based on complex formation of reduced dye with calcium chloride and in case of reducing sugar acidification method based on precipitation of leuco acid dye have been suggested. The

parameters like effect of sodium hydroxide concentration on development of reduction potential, colour yield, stability of reducing sugar and sodium sulphide at dyeing conditions and their consumption during reduction and dyeing process have been correlated. It has been established that though individual sulphur dye required different quantity of reducing sugar for optimum dyeing, the concentration of sodium hydroxide and reducing sugar in 2.7:1 molar ratio (0.55:1 by weight ratio) gave satisfactory dyeing results. Because of lower stability of alkaline reducing sugar further addition of reducing sugar during dyeing is found necessary to maintain sufficient reduction potential and to obtained better colour yield.

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