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Improvement of Light Fastness of Basic Dyes on Jute

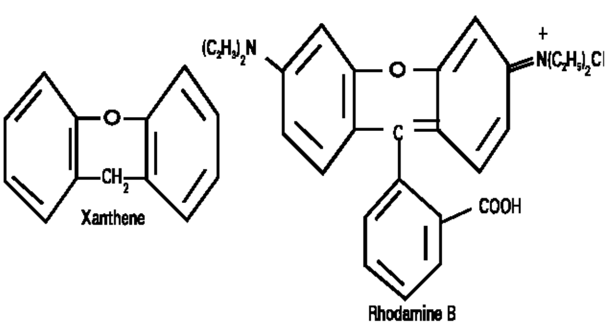
M. Kamal Uddin, M. Ashraf Hussain, Kh. Atiar Rahman and M.M. Alamgir Sayeed
Bangladesh Jute Research Institute, Manikmia Avenue, Dhaka-1207, Bangladesh

Abstract: Scoured and bleached jute fabrics (carpet backing cloth) were padded firstly with basic dyes namely Astrazon Blue B, Astrazon Brilliant Red 4G 200% , Rhodamine B, Remacryl Green 3-B and Remacryl Blue BRL and then padded with ammonium molybdate together with disodium hydrogen orthophosphate, dried and treated with hydrochloric acid. Dyeing was also carried out using the same dyestuffs by applying conventional exhaust dyeing method. Satisfactory light fastness with good penetration and bright shade was achieved by the developed method (Pad-dry).

Key words: Basic dyes, light fastness, exhaust dyeing method, pad-dry method, tinctorial power, lake, xenon lamp

Introduction

Basic dyes are available as cheap synthetic dyes amongst the commercial dye range. They are still the brightest and the most brilliant in hue of the synthetic dyes. They have no direct affinity for cellulose. But jute fibre possesses good affinity for basic dyes due to the presence of lignin (12-14%) and hemicellulose containing peripheral–COOH in the fibre and requires no mordanting prior to dyeing. Their tinctorial power is very high. But from the practice, it has been observed that they possess very poor light fastness on jute. Some investigators were able to improve the light fastness of cellulose dyeings by forming lake with basic dyes. But they have very limited use. The fastness to light of lakes produced with acid dyestuffs was improved which contain both sulpho groups and amino groups or with basic dyes by the use of phospho-tungsto-molybdenum compounds (Carpmaels, 1924,1928). In the study of the physical state of dyes upon their light fastness, some investigator (Richards, 1936) also worked with basic dyes and two lakes, one from an exact precipitation with phospho-tungstic acid and the another from a precipitation with phospho-molybdic acid in order to make cellulosic dyed material photostable. A formulation was invented for simultaneous dyeing and crosslinking of cellulosic fabrics using dimethylol dihydroxy ethylene urea (DMDHEU), the acid catalyst and basic dyes (Harper *et al.*, 1976). Method of applications, economic importance and structure of more than 100 of cationic dyes were described (Roderich, 1984). The original basic dyes were based on acridine, azine, oxazine, thiazine, azo, triaryl



methane and xanthene chromophores (Trotman, 1984; Nunn, 1979; Colour Index, 1976). For example, Rhodamine B (CI Basic Violet 10) was derived from the parent substance Xanthene.

Like this, the chemical constitutions and structures of many basic dyes are found in colour Index. Besides these, many workers carried out experiments with various kinds of dyes and applied those to jute. Some investigators (Patro, 1971; Hossain *et al.*, 1989) observed the effect of various metal salts on colour fastness in dyeing of jute with basic, acid, direct and sulphur dyes. Research on dyeing of raw and bleached jute with Catechu Brown dye using chromium sulphate, alum, copper sulphate etc. as mordants was carried out by some workers (Sayeed *et al.*,1987) and found improvement of wash and light fastness. Some workers (Hossain and Farouqui, 1990) studied the dyeing nature and colour fastness of dyed jute followed by modification with a mixture of metal salts as modifier and also studied the optimum conditions of dyeing of jute with basic dyes and their fastness under different influences (Hossain and Farouqui, 1990).

From the above studies it would seem clear that some works have been done on the effect of different factors on the dye up take of jute fibre. Most of the researchers carried out research to describe the methods of dyeing jute with different types of dyestuffs. But a few scientists tried to improve the light fastness which is the major problem for jute when it is exposed to sunlight. From the properties of basic dyes it is well-known that the outstanding characteristics of the basic dyes on jute are the brilliance and intensity of their colours. Some of the shades are of such clarity of hue that no other class can be compared with them. Only 0.5% to 1.0% of basic dye is sufficient to produce a full shade on jute. In view of the above studies, an attempt was taken to carry out a research work for the improvement of light fastness of basic dyes applying on jute fabric. If the light fastness of jute fabric using basic dyes can be improved upto the reasonably acceptable level, the dyed fabric will get a good position in the world textile market.

Materials and Methods

Scouring and bleaching: In order to remove the wax, oil, resin and colouring matter from the fibre, first of all C.B.C (carpet backing cloth) was scoured by standard method with a solution of 3% sodium carbonate, 0.5% sodium hydroxide and 0.5% wetting agent at 90-95 ^{0}C for 1 hour (Trotman, 1984). It was then bleached by standard method in Jigger machine with 10% hydrogen peroxide (35%, 100 volume) together with 5% sodium silicate, 1% sodium carbonate and 0.2% wetting agent to maintain pH 10.5–11 initially (Trotman, 1984). Percentage was based on the weight of the material. Bleaching was continued for 1 hour at 90-95 ^{0}C. It was then washed and dried.

The fabric was cut into pieces for carrying out the following dyeing methods using five varieties of basic dyes:

Exhaust dyeing method (conventional): Required amount of dyestuff (for 1% shade) was pasted with acetic acid and dissolved by pouring hot water. The dye bath was set with previously dissolved dye and 3% acetic acid (commercial) having liquour ratio of 1:20. The fabric was entered at 50 ^{0}C and the temperature was raised to 90 ^{0}C. Dyeing was continued for 1 hour at that temperature. The fabric was then rinsed and dried.

Developed method (Pad-dry): This method was applied using the following padding recipe and the sequences (I-v):

Recipe: 5g/l basic dye
30g/l ammonium molybdate

Corresponding Author: M.M. Alamgir Sayeed, C/O, Shafiuddin Ahmad, 41/12-A, Chan Housing (4th Floor North Side) Mohammadpur, Dhaka-1207, Bangladesh

15g/l disodium hydrogen orthophosphate (Na_2HPO_4).

Sequences

- Padded with predissolved dye at room temperature giving pick up 100% at a fabric speed of 5 m/min in two bowl padding machine.
- Padded with aqueous solution containing ammonium molybdate and disodium hydrogen orthophosphate at room temperature in a padding machine.
- Dried at 100 ^{0}C temperature for 1 min in a stenter.
- Treated with hydrochloric acid (10g/l) at 40-45 ^{0}C temperature for 15 minutes.
- Rinsed and washed with soap, finally rinsed and dried.

Determination of light fastness: The samples of the dyed fabric along with JSDC dyed standards were exposed to xenon lamp in xenotest machine for 100 hours according to BS 1006, BO2 (SDC Publication, 1978) and were assessed against the standards on the 1-8 blue scale which have the following meanings:

8 = maximum fastness	7 = excellent	6 = very good
5 = good	4 = fair	3 = moderate
2 = slight	1 = poor fastness	

Results and Discussion

The light fastness of the fabric dyed with different dyes applying special technique (Pad-dry method) improved to a great extent rating from 4 to 5 which means fair to good, whereas it was very poor at the conventional method figuring at 1 (Table 1).

Table 1: Light fastness of various basic dyes on jute fabrics at two different methods

Name of basic dyes used	Light fastness rating at exhaust method (conventional)	Light fastness rating at improved method (Pad-dry)
Astrazon Blue B	1	4
Astrazon Brilliant Red 4G 200%	1	4
Rhodamine B	1	4 –5
Remacryl Green 3B	1	4 –5
Remacryl Green BRL	1	4 –5

The effective means of this improving light fastness, of course, is due either to a chemical change in the dye molecules or to their coalescence into large aggregates with the inorganic reagents as used in the experiment. In this method, reaction took place between the functional group of dye (structure given before), ammonium molybdenum and disodium hydrogen orthophosphate in presence of hydrochloric acid and a lake of an insoluble basic dye complex with decrease in chain length was formed in the fibre. This lake has got good photostable effect on jute due to the resultant increase in particle size. It may be noted that increase in chain length in the structure of basic dye is associated with lower fastness to light (Colour Index, 1976). On the other hand, it would be seen that light fastness was improved due to the blockage of substrate pores and imparting screening effect on the fabric by forming lake applying this method (Richards, 1936). As per the opinion made earlier by the workers in this field (Patro, 1971; Sayeed *et al*., 1987) metal salts can improve the fastness properties of dyed jute fabrics. It may be inferred that as the pores of the substrate (jute fabric) become more nearly filled with dye, so light, air and moisture are less able to reach the dye. The fastness properties of the dyes are independent of the nature of dyes. That is why, five varieties of basic dyes were used in the experiments. But no significant difference was observed in light fastness under the same dyeing condition (Table 1).

The Pad-dry method produced deep and bright shade using only 5g/l of basic dye. Good levelness and penetration of dyes were also achieved. So, this method may be used commercially for dyeing jute fabric in order to attain good fastness to light.

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