OPEN ACCESS
Saudi Journal of Engineering and Technology
Abbreviated Key Title: Saudi J Eng Technol
ISSN 2415-6272 (Print) | ISSN 2415-6264 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Study on Continuous Dyeing of Jute-Cotton Union Fabric with Direct Dye

Nazmina Chowdhury[1*], S.M. Farhana Iqbal[2], Khaled Saifullah[3], Tanvir Ahmed Chowdhury[4], Mahmuda Khatun[5]

[1]Pilot Plant and Processing Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207, Bangladesh
[2]Department of Yarn Engineering, Bangladesh University of Textiles, Tejgaon, Dhaka-1208, Bangladesh
[3]Mechanical Processing Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207, Bangladesh
[4]Department of textile engineering, Daffodil International University, Dhaka-1207, Bangladesh
[5]Design and fashion section, jute textile wing, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207, Bangladesh

DOI: 10.36348/sjet.2021.v06i06.004 | **Received:** 23.04.2021 | **Accepted:** 01.06.2021 | **Published:** 11.06.2021

***Corresponding author:** Nazmina Chowdhury

Abstract

This paper studies the direct relationship among temperature, dye fixation, fastness properties and breaking strength of cured dyed jute fabric. Jute and jute-cotton union fabric was dyed with direct dyes by the continuous method with very good fastness properties and dye fixation. By curing the dyed sample fabrics at 150^{0}C for 1 minute, maximum dye fixation of 89% was achieved. The corresponding fastness properties of the dyed fabric such as washing, rubbing and light fastness were found to be 5, 5 and 7 respectively. The findings of the study indicate that jute and jute-cotton union fabrics can be successfully dyed in a continuous dye process with direct dyes.

Keywords: Jute dyeing directs dye, continuous dyeing, fastness property, breaking strength, fixation, textile.

I. INTRODUCTION

Jute is an ancient natural fibre and various products developed from it are continued to be used all over the world [1]. Jute fibers possess unique properties such as high strength, rough handling advantage, environment friendly, biodegradable etc. It dominated the world market for natural fibers for a long time before the aggression of synthetic fibers.

Jute is a lingo cellulosic bast fibre comprising of 58-63% cellulose, 12-14% lignin and 22-24% hemicelluloses. It is naturally harsh, due to its low wax content and also its lignified nature [3]. Minimal processing is required to develop packaging fabrics from the fibers. Cross- bonded products exhibiting durable stiff finishes are produced by reacting cotton and rayon with synthetic resin components [4]. But these fibers can be classifies as belonging to the synthetic – resin group.

The dyeing process involves three steps; adsorption, diffusion, and migration. The surface of cellulosic fibers becomes anionic in the presence of water. Dye is also an anionic compound; as a result a repulsive force exists between the fiber surface and the dye compound. The repulsive force is eliminated by neutralizing the surface with electrolytes. The textile color fastness is the capacity of a dyed textile to keep its original aspect without losing color when being wet, washed or exposed to the light. It is one of the main issues of the textile industry. Though cellulosic fibers have excellent physical properties they exhibit low color fastness properties. In case of cellulosic fibers, swelling in water causes the pores in the amorphous regions of the fiber to open up. The dye compounds travels inside the pores through diffusion and the dye compounds are fixed to the fiber surface with weak H-bond and Van der Waals force resulting in poor fastness properties.

Recently scientists from Bangladesh Jute Research Institute have developed novel technologies for the production of sophisticated textile materials from jute such as furnishing fabrics, blanket, sweater, knitting wool substitute, prayer mats etc. These technologies pave the way for wider horizon for diverse end use of jute fiber.

Dying is one of the main challenges for jute fiber diversification due to its poor color fastness. The one bath dyeing method is a continuous dyeing method. It has commonly been assumed that in continuous dyeing method if the liquor ratio is less than 1:1, the substantively and liquor ratio are not significant [2].

Reaction between dyestuff and fibre can only take place in connection with an adsorption process which contrary to the substantively of cellulose, involves a dyeing mechanism dependent upon p^H [5]. The purpose of the maximum harmonization of the padding and fixation steps is to produce dyed fabrics of high quality with respect to handle, appearance, fastness, optimum dye fixation and good washing off properties. The one bath dyeing requires the least amount of mechanical, electrical and thermal energy compared to exhaust dyeing method. The labor requirements are also very low. Some authors also developed some dyeing methods for jute using different classes of dyes in variable conditions. The behavior of dyes when applied in a mixture is in many cases quite different from their behavior when applied as individual components [6]. For some purposes, high light fastness is essential; but for others it may be inconsequential. Factors considered in dye selection include fastness to light, reaction to washing and rubbing (crocking), and the cost of the dyeing process. Effective preparation of the material for dyeing is essential.

Woven fabric requires both very high level dyeing and excellent fastness properties, the latter being necessary to withstand the remainder of the finishing processes.

In the light of above study the present work has been undertaken to find out an effective one bath dyeing method with pigment dyes and assess the extent of their fixation on jute and the resulting colour fastness to washing, rubbing and light.

2. MATERIALS AND METHODS

Pretreatment of jute fabrics: In order to remove impurities like natural waxes, oils, peptic substances and natural coloring matters present in jute fibre, the fabric was first scoured with 3% soda ash, 1.5% caustic soda and 1% wetting agent at 90^0C for 1 hour and then bleached with 12 g/l hydrogen peroxide (35%), 7 g/l sodium silicate and 1.5 g/l soda ash at 80-90^0C for 1 hour giving liquor ratio of 1:20. The p^H was adjusted to 10.5 initially. The fabric was then washed with hot water followed by washing with cold water and dried. The fabric was cut into pieces for different sets of experiment.

Dyeing with direct dyes by continuous method

The bleached fabric was dyed with direct dyes using the following recipe

Table-1: Recipe of dye liquor

Sl no.	Chemical constituent	Amount
1	Lisapol N (wetting agent)	1 g/l
2	Direct dye	2 g/l
3	Salt	40 g/l

The process temperature for optimum dye fixation was determined by treating the fabrics with the above formulation at different curing temperatures. The fabrics were padded with 80% liquor pick up, dried and cured at different temperatures like 110^0C, 120^0C, 130^0C, 140^0C, 150^0C, 160^0C for 1 minute. The other bleached fabrics were dyed with four kinds of direct dyes with the same process parameters and cured at 150^0C for 1 minute.

Characterization

The dyed fabrics were tested for determination of washing, rubbing, and light fastness applying British standard method. Breaking strength of the fabrics was also measured.

Dye fixation values were determined by repeated extraction of unfixed dye, optical densities were measured at the wave length of maximum absorbance and dye fixation was calculated on the assumption that the dye that was not extracted was fixed on the fabric.

3. RESULTS AND DISCUSSION

The dyed fabrics followed by curing at different temperatures for optimization were evaluated by testing their dye fixation (%), colour fastness properties and tensile strength.

Table-2: Dyeing properties of the dyed fabric for optimization by curing at different temperatures for 1 minute

Dyed samples cured at diff. temp.	Dye fixation (%)	Fastness properties			Tensile Strength kgf
		Washing ISO-3	Rubbing	light	
1.Orginal sample	-	-	-	-	63.40
2. Curied at 100^0C	55	3	3	5	61.12
3.Curied at 110^0C	65	3	4	5	61.23
4.Curied at 120^0C	78	3	4	6	60.44
5.Curied at 130^0C	80	4	4	5	60.54
6.Curied at 140^0C	83	4	4	6	58.14
7.Curied at 150^0C	88	5	4	6	58.18
8.Curied at 160^0C	89	5	5	7	57.50

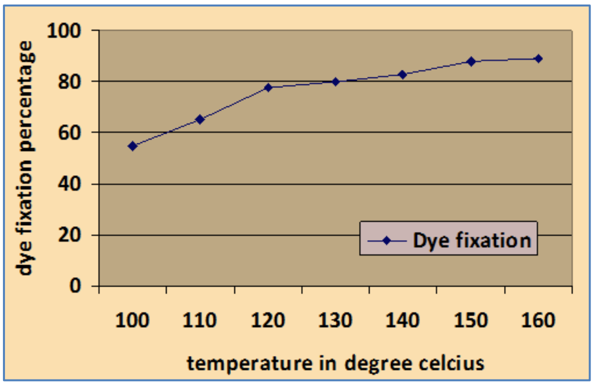

Fig-1: Relationship between dye fixation and temperature

From the graph 1 we observed that increasing curing temperature facilitates increased dye fixation.

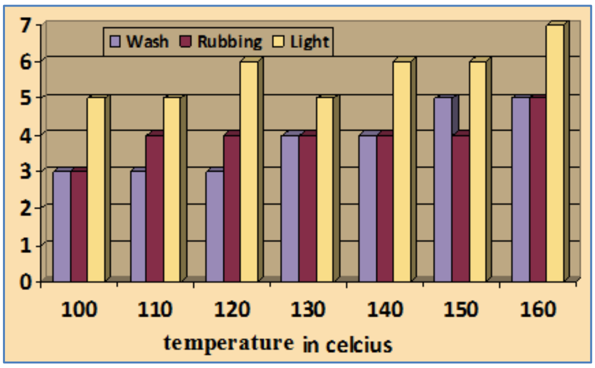

Fig-2: Relationship among wash fastness, rubbing fastness, light fastness and temperature

It is observed from graph 2 that increased curing temperature has a positive impact on the wash fastness, rubbing fastness and light fastness properties of the dyed fabrics. Unlike the dye fixation, washing, rubbing and light fastness properties of the fabrics dyed with different direct dyes were independent of the nature of the dye. There was remarkable difference in the fastness properties of the dyed fabrics.

The washing and rubbing fastness were found to be very good compared to international standards. We achieved washing fastness of 5 where the international highest value is also 5. Light fastness was found to be 6-7 in most cases whereas the international highest value is 8. It is needless to say that these properties are satisfactory.

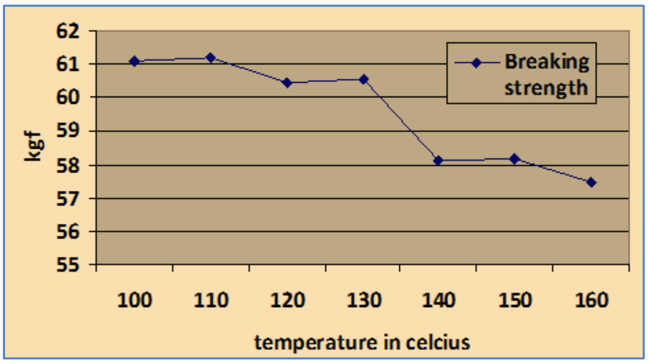

Fig-3: Relationship between breaking strength and temperature

The results of the tensile strength show that increasing the curing temperature results in lower breaking strength.

4. CONCLUSION

The optimum condition for dyeing jute was determined by dyeing jute fabrics with a direct dye by continuous padding method followed by curing at different temperatures. The optimum curing temperature was determined considering the dye fixation (%), fastness properties as well as breaking strength of the dyed jute fabrics. The results showed that a maximum of 89% dye fixation was attained with washing, rubbing and light fastness of 5, 5 and 6-7 respectively for dyed fabrics cured at 150^{0}C for 1 minute. Although the breaking strength of the fabric decreased with increasing curing temperature considering the other parameters the results is quite satisfactory for curing at 150^{0}C for 1 minute. Hence, jute and jute-cotton union fabric can be dyed by continuous method with very good fastness properties.

This dyeing method has the advantage of running continuous production with low dye consumption, uncomplicated processing, and low waste water contamination, saving energy, time, water and labour employment and ultimately increasing the production rate. Hence the method can be considered economically viable for commercial application.

5. REFERENCES

1. Kassem, A.B.M.A. (1992). Jute and its diversification, 53.
2. Vonder, Eltz, H.U. (1985). New techniques of continuous dyeing, JSDC, 101, 5/6; 168-173.
3. Hess, K.P. (1978). Textile fibres and their use, 6; 306.
4. Garner, W. (1949). Textile Laboratory Manual. Resins and Finishes, 2; 39.
5. Venkatraman, K. (1972). The chemistry of synthetic dyes, Reactive dyes, VI; 342.
6. Venkatraman, K. (1974). The chemistry of synthetic dyes, VII; 93.