

Application of natural extracts and mordants on cotton fabrics for printing

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Abstract –

The research work concentrates on printing of natural extracts on cotton fabric using Acacia catechu and Pomegranate by screen printing method. Different mordants like natural mordant Lime juice, synthetic mordant alum and metallic mordant Copper Sulphate were used in this study as simultaneous mordanting. The printed samples using various mordants were then treated with TiO_2 to improve their fastness property. The samples were again post mordanted with the same mordants and tested for fastness to Washing, Rubbing, Perspiration and Light. The samples treated with the mordant lime juice shows better results compared to other samples.

Keywords - Acacia catechu, Pomegranate, Alum, Lime juice, Copper sulphate, Mordant, TiO_2 .

I. INTRODUCTION

Natural colors, dyestuff and coloring are pretty much as old as materials themselves. Man has consistently been working on colors and the specialty of coloring has a long past and a large number of the colors return into ancient times. Earlier dyes were extracted from most of the natural resources like crushed fruits and various parts of plants like roots, leaves, bark, flowers etc. Later, with the advent of

synthetic dyes and due to its durability, simple manufacturing process and cost consideration, its usage has been increased in textile dyeing and printing process.

As these chemicals create more pollution and hazardous to humans and environment, industries turned their interest towards eco-friendly process. Nowadays more research works has been carried out using natural extracts for textile dyeing process along with the use of natural mordants. Since considering the fastness property, application of natural extracts in textile printing process is a challenging one.

Natural dyes from various plant sources, such as Acacia Catechu Wild[1], Sappan wood, Indian madder, Indigo[2], Buckthorn, Walnut Bark[3], Alkanet, Rhubarb[4], manjistha, ratanjot and annatto[5] have already been investigated for textile printing.

Pomegranate peel is a rich wellspring of tannins, phenolics, and alkaloids. Pomegranate rinds are popular for contact dyeing (ecoprints).

The pomegranate rind enclose a considerable amount of tannin, about 19% with pelletierine[6]. Tannin can connect with material substrates like proteins and cellulose. Tannins can shape hydrogen connections between the phenolic hydroxyl gatherings of tannins and the hydroxyl gathering of the cloth. The main coloring agent in the pomegranate peel is granatonine which is present in the alkaloid form N-methyl granatonine [7]. This compound gives colour to the

dye.

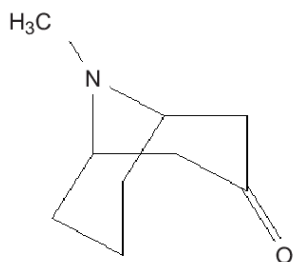


Fig.1. Structure of granatoneine

Catechu natural extract shows excellent fastness on fabrics like cotton and silk. Color produced from catechu is in brown tone. Catechu tannic acid is the main chemical constituent which is responsible for dyeing process. Major chemical constituents of Acacia catechu are catechin, epicatechin, epicatechin gallate, procatechinic acid, tannins, alkaloids quercetin and kaempferol, porifera sterol glucosides, afzelechin gum are also present in minor quantity[8].

This study concentrates on printing the cotton fabric with natural extracts Acacia catechu and Pomegranate by screen printing method using different types of mordants and analyzing the fastness property of all the samples.

II. MATERIALS

A. Materials

In this study Cotton fabric, Powders of Acacia catechu and Pomegranate, Alum, Acetic acid, Urea, Sodium alginate, Natural Glycerin, Titanium dioxide, Copper sulphate, Lime juice and other chemicals were used.

III. METHODS

A. Printing paste preparation

Printing recipes were prepared using various mordants like alum, copper sulphate and lime juice with acacia catechu and pomegranate to obtain several types of printed samples for comparison.

B. Printing paste preparation with natural extracts

Three different printing paste with acacia catechu were prepared with the M:L ratio of 1:20, 20% sodium alginate, 20% urea, 2gpl natural glycerol, 2 gpl acetic acid along with 20% mordant. Three different mordants like alum, copper sulphate and lime juice were used in separate recipes for simultaneous mordanting process.

The same procedure was followed for printing paste preparation using Pomegranate along with three different mordants.

C. Screen printing

All the print recipes were applied on various samples by semi-automatic screen printing machine.

D. Application of titanium dioxide on printed fabrics

As the particle size of TiO_2 is large, it was stirred using magnetic stirrer in a glass beaker for 20 minutes at room temperature. Then 2% on weight of material is taken and treated on printed samples for 20 minutes at $100^\circ C$ and the samples were heat set in curing chamber.

E. Post mordanting

Printed samples treated with titanium dioxide were post mordanted using alum and lime juice respectively at $100^\circ C$ for 30 minutes and the samples were washed and dried. As the samples treated with copper sulphate during simultaneous mordanting did not show prominent effect it was not taken into consideration for post mordanting process.

F. Fastness properties

All the printed samples were tested for fastness to wash, light, rubbing and perspiration.

1) Wash fastness test

This test was carried out under AATCC test method 61:2010. These sped up washing tests are utilized to assess the colorfastness to washing of materials which are relied upon to withstand regular washing. The texture shading misfortune and surface changes coming about because of the cleanser arrangement and grating activity of five normal hand or home launderings, with or without chlorine are generally approximated by a solitary brief test. Examples are tried under fitting states of temperature, cleanser arrangement and grating activity with the end goal that the shading change is like that happening in five hand or home launderings. The sample size taken was about 50×150 mm and it is carried out at $120^\circ C$ with 50 steel balls.

2) Light fastness test

This test was carried out under AATCC test method 16.3:2012. Sample sizes of 70×120 mm were exposed to light source under specified conditions. Xenon arc lamp (water cooled) is used and the samples were exposed for 24 hours where the exposed area is 30×30 mm. The color fastness to light was evaluated using Gray scale.

3) Rubbing fastness test

The test method adopted for Crocking/Rubbing is BS EN ISO 105 X12. A colored test specimen is rubbed with white crock test cloth under controlled conditions. It employs the testing with wet and dry state. The sample size is 50×130 mm. Color transferred to the white cloth is assessed by a comparison with the Grey scale for staining and the grade is assigned.

4) *Perspiration fastness test*

This test was carried out under ISO 105 E04: 2013. The samples are cut to the size of 10x4cm and sewn with a strip of multi fibre fabric of same size. The specimens are wetted out in acid and alkaline solutions for thirty minutes and then placed in between resin plates of perspirometer with a weight on the top equal to the pressure of 12.5kpa. This is maintained at 37°C for 4 hours. Then the samples are removed, dried and assessed for color change and staining with the corresponding Grey scale.

IV. RESULTS AND DISCUSSION

Printed samples shown in the table below were tested for fastness and the results are discussed

TABLE I

PRINTED COTTON SAMPLES WITH MORDANTS

Sample	Mordant	Natural extract
1	Alum	Acacia catechu
2	Lime juice	Acacia catechu
3	Alum	Pomegranate
4	Lime juice	Pomegranate

A. *Rubbing fastness*

The following table shows the fastness property of all the samples to rubbing.

TABLE II

RUBBING FASTNESS OF PRINTED SAMPLES

Rubbing fastness	Sample particulars			
	Printed sample no.1	Printed sample no.2	Printed sample no.3	Printed sample no.4
Dry rubbing	3-4	4	3-4	2-3
Wet rubbing	2-3	3-4	2-3	3-4

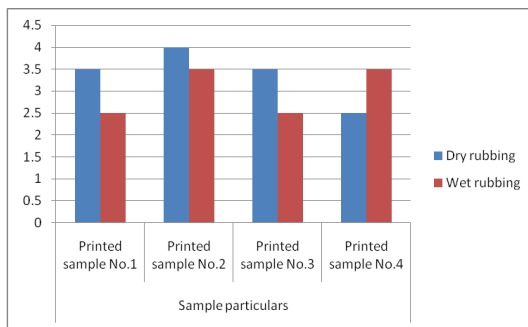


Fig.2. Rubbing fastness of printed samples

According to the above table, the sample 2 and sample 4 has good fastness property to rubbing in both dry and wet stage. Thus the samples treated with lime juice mordant shows better results than alum.

B. *Light fastness*

The fastness property of the printed samples to light is given in the table below

TABLE III

LIGHT FASTNESS OF PRINTED SAMPLES

Samples	Printed sample no.1	Printed sample no.2	Printed sample no.3	Printed sample no.4
Light fastness	3	4	4	4

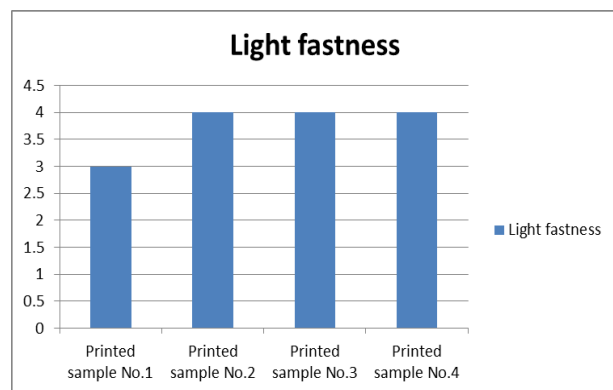


Fig.3. Light fastness of printed samples

It is observed from the figure that three printed samples shows good light fastness property and moderate fastness is observed for alum treated sample with acacia catechu.

C. *Wash fastness*

The following table shows the staining values of all the samples to washing

TABLE IV

WASH FASTNESS OF PRINTED SAMPLES

Wash fastness	Sample particulars			
	Printed sample no.1	Printed sample No.2	Printed sample No.3	Printed sample No.4
Change in color	2	3	2	3
Staining				
Wool	4	4	4	4
Acrylic	4-5	4	4	4
Polyester	4-5	4-5	4	3-4
Nylon	4	4	4	4

Cotton	3	3	3	3
Acetate	4	4	4	4

Wash speed of the color is affected by the pace of dissemination of the color and condition of the color inside the fibre [9]. From the above results it is observed that there is an equal change in color to washing for all the samples and they showed moderate performance in washing. This fastness property can be improved by changing the proportion level, time and temperature in the post treatment process [10].

D. Perspiration fastness

The following table shows the staining values of all the samples to perspiration

TABLE V

PERSPIRATION FASTNESS OF PRINTED SAMPLES

Wash fastness	Sample particulars							
	Printed sample no.1		Printed sample no.2		Printed sample no.3		Printed sample no.4	
	Alkaline	Acidic	Alkaline	Acidic	Alkaline	Acidic	Alkaline	Acidic
Color change	3-4	3-4	4	4	4	4	4	4
Staining								
Wool	4-5	4-5	4-5	4-5	4-5	4	4	4
Acrylic	4	4	4	4	4-5	3-4	4-5	4-5
Polyester	4-5	4-5	4-5	4-5	4-5	3-4	4-5	4-5
Nylon	3-4	3-4	4	4	4	3-4	4	4
Cotton	3	3	3	3	3	3	3	3
Acetate	4	4	4	4	4	4	4	4

According to the results shown in the table, sample1 has less fastness property to perspiration when compared to other three samples. Hence the samples treated with lime juice shows good fastness property with acacia catechu and the samples treated with pomegranate shows good perspiration fastness in case of both the mordants.

V. CONCLUSION

The cotton fabric samples printed with acacia catechu and pomegranate using different mordant like lime juice, alum and copper sulphate under simultaneous and post mordanting technique were evaluated for their fastness property. As the sample treated with copper sulphate does not show prominent print effect on fabric, the samples treated with other mordants were tested for fastness property and the comparison was made.

Hence it is observed from the results that the samples treated with lime juice shows good fastness property to light, wash, perspiration and rubbing when compared to the samples treated with alum. Treatment of titanium dioxide on the fabric samples also increases the print effect on fabric. Thus the fabrics treated with natural extracts and natural mordants provide better results on printing which finds a healthy process to the environment.

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