P: ISSN No. 2231-0045 RNI No. UPBIL/2012/55438 VOL.-IV, ISSUE-III, February-2016
E: ISSN No. 2349-9435 Periodic Research

Eco-Friendly Printing of Cotton and Silk Fabrics Using Natural Dye from "Nyctanthes Arbor-Tristis's (Parijat)"

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Abstract

Cotton and silk fabric samples were printed with dye obtained from Nyctanthes arbor- tristis's using block printing technique was investigated. The effect of different factors that is quantities and concentrations of mordant were studied. The printed samples were evaluated by measuring the K/S Value and the overall fastness properties. The results showed that the color strength (K/S value) of alum (5%) was the best printed result and the next sample result was obtained in the order of concentration 7% and 3%. The color fastness results were ranging between fare and good level.

Keywords: Nyctanthes Arbor- Tristis's, Mordent, Natural Dye, Block Printing, Cotton, Silk.

Introduction

Natural dyes have been used since ancient times for colouring and printing fabrics, until the middle of last century most of the dyes were derived from plants or animal sources by long and elaborate processes. The art of dying and printing has an important role in adding beauty to the textile, the craft of printing occupies a technique place in Indian civilization. It is believed that the process of printing with natural dyes has been in practice since 10th century.

Common Natural Dyes are

Logwood

The most important of all these dyestuffs, and the only one still used on a large scale, is logwood, a dye extracted from the wood of quite a large trees, the *Haematoxylon Compechianum* (the "blood-red wood form Cam peachy"), Which grows freely in the West Indies and Central American States. It was discovered and used by the Spaniards early in the sixteenth Century.

Indigo Blue

Available from indigo cake real indigo always floats on water. It gives Very good discharge effect.

Turkey Red

The use of madder which, as before mentioned, was probably known to the ancients, was greatly developed during the seventeenth and eighteen centuries, Turkey-red process for obtaining, upon cotton and wool very fast and very brilliant shades of scarlet. The process took some three months, and consisted of an elaborate series of mordanting operation.

Manish Sticks

We get from the stem Nodes on the stem yield maximum colour. It gives pink colour; Manish is synthesized and converted in to alizarin.

Rattan Jot

The stem of the plant is used loose barks of stem give maximum color. This has a good affinity for animal fibre. It has a very good fastener to light, wash and bleach etc. It gives light grey to dark black colour.

Turmeric Powder

It gives yellow colour and its shades.

Marigold Flower

It gives very good yellow colour. It liberates oxygen and acts as air purifiers.

In this study Nyctanthes arbor- tristis's (Parijat) stalks were used for printing paste. This dye was produced from the orange color tube of petals before falling of flower on the ground which was separated from the

petals and dried. Once they were dried, they were used for making the saffron colored dye.

The aim of this present work is to investigate the suitability of using stalks of Nyctanthes arbor-tristis's (Parijat) as a natural dye in printing cotton and silk fabric using the block printing technique. The color strength (K/S) and overall fastness of the prints were also studied.

Review of Literature

Natural dyes have been used since ancient time of colouring and printing fabrics. Until the middle of last century most of the dyes were derived from plants or animal source by long and elaborate processes. Ancient Egyptian hieroglyphs contain a thorough description of the extraction of natural dyes and their application in dyeing further development extending over many thousands of years led to rather complicated dying processes and high-quality dyeing.

(Smith J.L. 2003)

Printing is a key sector of garments industry. The expansion of garment industry and its widening market scope have transformed this sector from just designing, preparing screens and imparting designs on garments to a more complex activity involving many combinations of design with different types of printing to make the garment truly appealing to fast changing fashion demands. There is an endless scope for innovations to bring new styles and effects on garments.

(Dr. Rao. J.V. 2008)

China follows the traditional block printing and modern Machine Screen-Printing Method. A printing factory usually employs 5,000-10,000 workers, mostly women. A band of qualified designers create designs from the current fashion trends in the international market and prepare screens. Hand block printing is ideal for silk. The fabric is rolled on the table and screens are presented into fabrics with colours, dried, stamped and soft ended.

(Datta. R.K. and Nanavaty M. 2007)

Materials and Methods

Selection of the Dye

Parizat flower's were randomly collected from various location of Bhopal, separated stalks from flower and dried them in shade and grounded to make powder.

Selection of Fabric

Silk and Cotton fabric were used.

Thickening Agent

Guar-Gum was used as a thickening agent.

Mordant

Alum (potassium aluminium sulphate) mordant is used in the experiment.

Methods

Parizat Dye

Stalks of parizat dye where dried in shade and grounded to powder were used as a dye source in the standardized printing paste.

Printing Paste

The optimised printing recipe was used for preparation of printing paste. Optimum variables to prepare printing paste using Parizat dye. Dye material concentration- 6gm/100ml of water extraction time 45 minute: extraction ph-7, dye paste- 7.5ml, ph of Guar-Gum paste-6, dye paste and Guar-Gum ratio-1:5 fixer concentration-1.5%.

Procedure

6gm dye powder was boil in 100ml of water at 7ph for 45 minutes and the solution was stirred frequently. After removal from water bath solution was strained through nylon cloth. The extracted solution was heated and concentrated to 7.5ml to make the paste.

The printing paste was prepared by mixing dye paste and guar-gum in the ratio of 1:5 it was stirred vigorously to produce a uniform printing paste. Four mordant indentified of the basis of literature used for printing the sample were copper sulphate, ferrous sulphate, stannous chloride, alum. Simultaneous mordanting technique was used and the mordant were added on the basis of weight of printing paste. Printing was done on pre-scoured cotton and degummed silk fabric.

The fabric was then dried and after 24 hours it was steamed at 100°c for 45 minutes in a steaming chamber. The printed samples were given a old rinse to remove superficial printing paste.

Pre-Printing Process

Scouring of Cotton and Silk

Silk and cotton fabrics were washed in a solution containing 0.5g/L sodium carbonate and 2g/L non-ionic detergent solution at 50°c for 25 min, keeping the material to liquor ratio at 1:40. The scoured material was thoroughly washed with tab water and dried at room temperature. The scoured material was soaked in clean water for 30 min prior to dyeing or mordanting.

Bleaching

Then, the fabric was treated with 35% hydrogen peroxide (3mL/L) solution, maintaining a material to liquor ratio of 1:50 at pH 9and temperature 60°c for 60 minutes followed by wash with 2g/L detergent at 65°c for 10 min.

Optimization of Mordant Concentration

Alum (potassium aluminium sulphate) was used for mordanting. To optimize the concentration mordant was tried at different concentration viz. 3%, 5%, 7%. Simultaneous mordanting technique was used and the mordant was added on the basis of the weight of the printing paste.

Printing of Tablemats by using Parijat Dye

Total twelve tablemats were printed by using blocks. The size of tablemats was 16"x12". Printing was done on pre scoured cotton and silk fabric. The fabric was then dried and after 24 hours steamed at 100 degree centigrade for 45 minutes.

Evaluation of Colour Strength and Fastness Properties

Measurement of Colour Strength

The light that is shined on a sample, as from the light source of a spectrophotometer is reflected by back to the instrument detector, some is absorbed by the colorants in the sample, and some of it is scattered in all directions within the samples.

Colour strength, or tinctorial value of a pigments is defined as its ability to impart colour to

other materials. The lower the concentration of a coloured pigment required to achieve a defined impression of colour that is a given depth of a shade, the greater is colour strength of coloured pigments. It depends on the absorption coefficient (K) of colorant. The higher the absorption coefficient, the higher will be the strength of colorants, on the other hand, reducing power of TiO2 white (Tinting Strength of white) depends on the scattering coefficient (S). More the scattering, better will be reducing power. Black scatters least and absorbs most, while white scatters most and absorbs least. Some of the pigments such as yellows, reds and oranges scatter a lot and one cannot neglect their scattering power. One has to use both the optical parameters (K and

Strength of any colorant (dyestuff / pigment) is related to absorption property. We measure reflectance and not absorbance. It is known to us that when reflectance is more, absorbance is less and when reflectance is less, absorbance is more. Kubelka – Munk theory gives us the following relation between reflectance and absorbance:

$$K/S = [\{(1-R)^2 / 2R\}]$$

Where R is the reflectance, K is absorbance and S is the scattering. K/S Vs Wavelength curve is always characteristics of every colorant.

Colour Fastness Properties of Natural Dyes

Colour fastness is the resistance of a material to change in any of its colour characteristics or extent of transfer of its colorants to adjacent white materials in touch or both for different environmental and use conditions or treatments like washing, dry cleaning etc or exposure to different agency heat, light etc. Fading means changes in the colour with or without loss of depth of shade for exposure to particular environment/agency/treatments either by lightening or darkening of the shades. Bleeding is the transfer of colour to a secondary material in contact accompanying white fibre material of similar/dissimilar nature.

Colour fastness refers to the resistance of colour to fade or bleed of a dyed or printed textile materials to various types of influences e.g. water, light, rubbing, washing, **perspiration** etc. to which they are normally exposed in textile manufacturing and in daily use. We have written a lot of articles on colour fastness.

Fastness to Washing

In the test, change in colour of the textile and also staining of colour on the adjacent fabric are assessed. A 10 x 4 cm swatch of the coloured fabric is taken and is sandwiched between two adjacent fabrics and stitched, The sample and the adjacent fabric are washed together. Five different types of washing are specified as different washing methods.

Rubbing Fastness Test

Colour fastness to rubbing is a basic test used by customers to determine the quality of a coloured fabric and has been an area of concern for processors for many year. The processor has to be aware of the required standards and relate them to the possible limitations of what can be achieved on the finished products.

It helps to understand the test itself, since there are few areas which are missed by in house laboratories which may lead to differences in results.
This test is designed to determine the amount of colour transferred from the surface of coloured textile material to other surfaces by rubbing. It is applicable to textile made from all fibres in the form of yarn or fabric whether dyed, printed or otherwise coloured.

The rubbing fastness was determine by using method IS:766-1956.

Light Fastness Test

British Test Method (ISO 105/BO2)

The light fastness of dyed fabric is evaluated by exposing the fabric samples to xenon ARC. Even though the light sources are same, other conditions are different.

Grading

The fastness to light is tested in accordance with DIN 16525. The degree of fading is assessed by comparison with the blue scale for wool (DIN EN ISO 105-B01).

Result and Discussion

Effect of Printing on Color Strength by K/S Value

The color value results obtained is presented in table:

Table - 1
K/S Value Result with Alum Mordant

S. No.	Mordant Name	Fabric	
		Cotton	Silk
1.	3% Alum	0.0394	0.0431
2.	5% Alum	0.0389	0.0450
3.	7% Alum	0.0253	0.0403

Effect of mordant on fastness properties

Washing Fastness

Wash fastness was evaluated according to the IS:687-1979 test method using an Atlas launder-o-meter.

Table - 2
Washing Fastness with Alum

S. No.	Mordant	The numerical rating for the Change in Color		The numerical rating for the Two adjacent White fabric	
		Cotton	Silk	Cotton	Silk
1.	Without mordant	1	1	1 to 2	2
2.	Alum 3%	1 to 2	1 to 2	2	2 to 3
3.	Alum 5%	1 to 2	1	1 to 2	3
4.	Alum 7%	1	1	1 to 2	1 to 2

It is inferred from table no. 2 that 3% and 5% alum mordant on cotton had less dye loss in comparison to 7% alum and without mordant sample. The two adjacent white fabric had very strong to strong staining on cotton mordant with 5% and 7% alum, without mordant had also very strong to strong staining only 3% alum had strong staining.

Silk sample printed without mordant and 5% and 7% alum shows loss of dye too much. Only 3% alum had very strong to strong staining. The adjacent white fabric shows loss of dye more in without mordant sample in washing fastness test. 3% alum shows loss of dye more to loss of dye visible. 5%

alum had loss of dye visible only 7% alum had loss of dye too much to loss of dye more.

Wet and Dry Rubbing Fastness

Table - 3
Color Fastness to Rubbing with Alum Mordant

S. No.	Mordant	Color Fastness to rubbing			
		Dry		Wet	
		Cotton	Silk	Cotton	Silk
1.	Without mordant	1 to 2	2	1	1
2.	Alum 3%	4	3 to 4	3	3
3.	Alum 5%	4	4	2 to 3	3 to 4
4.	Alum 7%	4	4	3	3

It is found from table no. 3 that 3%, 5% and 7% alum mordant on cotton had loss less dye in comparison to the sample without mordant (loss of dye too much to loss of dye more). In (wet) rubbing test also had maximum loss of dye in sample that without mordant, 3% alum had marked staining, 5% alum had loss of dye more to loss of dye visible. Only 7% alum had marked staining.

Light Fastness

Table - 4
Color Fastness to Light with Alum Mordant

S. No.	Mordant	Color fastness to light			
		Cotton		Silk	
		White Color	Yellow Print	White Color	Yellow Print
1.	Without mordant	4 to 5	3	4 to 5	3 to 4
2.	Alum 3%	4	Above 5	Above 5	Above 5
3.	Alum 5%	Above 5	4	4 to 5	Above 5
4.	Alum 7%	Above 5	4 to 5	Above 5	Above 5

It found from table no.4 that color fastness test to light on cotton sample mordant with 3% alum had excellent on grey scale. 5% alum had good and without mordant had fair on grey scale. Pilling rating on white color mordant with 3% alum had good 5% and 7% alum had no pilling, without mordant had slight to n pilling.

All the silk samples printed with 3%, 5% and 7% alum had excellent score on grey scale. Only without mordant had fair to good on grey scale. Pilling rating on silk white fabric mordant with 3% and 7% alum had no pilling. Without mordant and 5% alum had slight to no pilling.

Conclusion

From the results obtained, it could be concluded that natural dye extracted from Nyctanthes arbor- tristis's (Parijat) selected dye-yielding plants are of textile importance. The color fastness properties of the natural dye investigated indicated potential use in the textile industry. The use of alum mordant showed the effectiveness of dye fixation by metal complexation. The specific objective of the present work to extract the dye, use it to print cotton and silk fabrics and the results show that the objectives were achieved.

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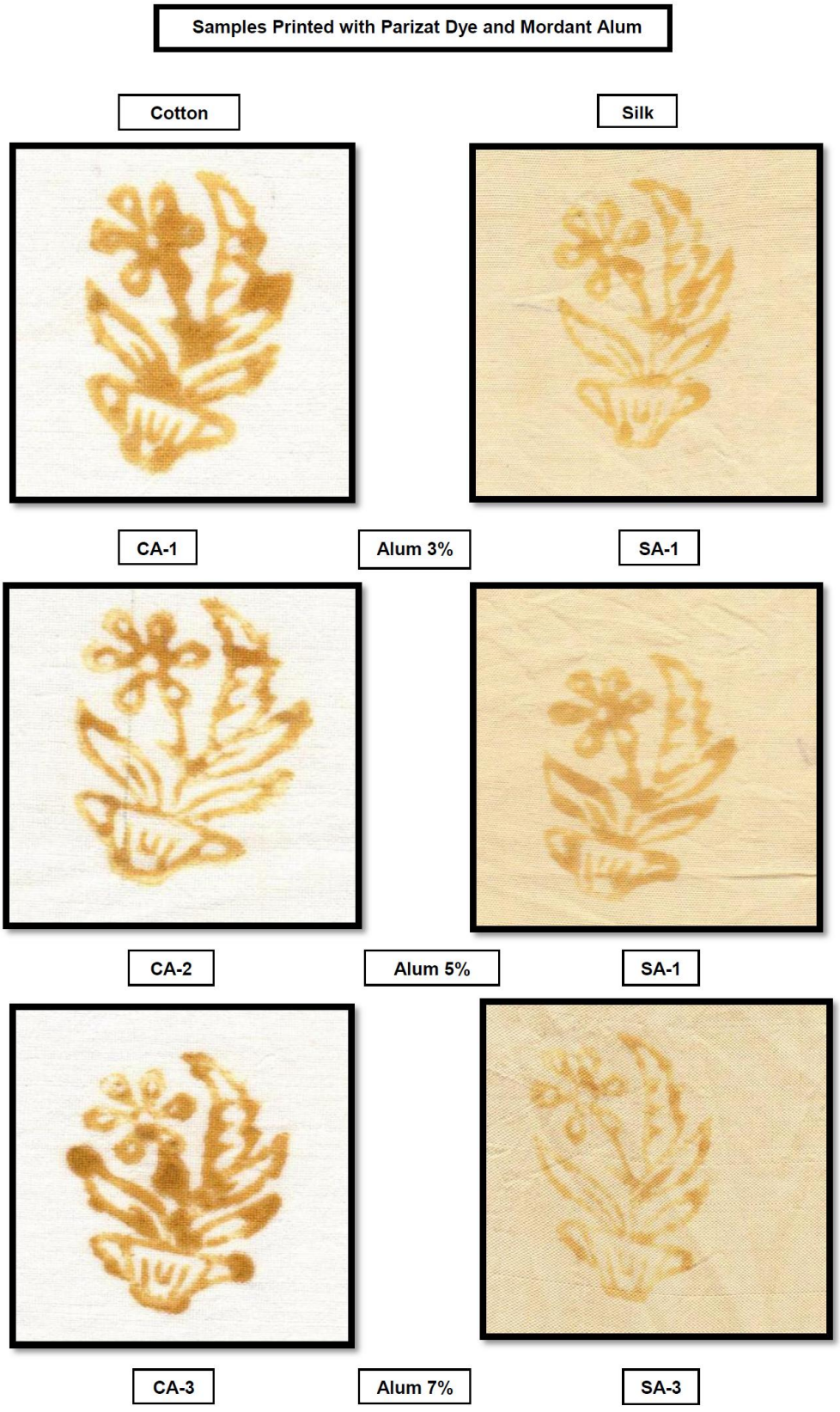
Samples Printed with Parizat Dye and Mordant Alum
Cotton
Silk
CA-1
Alum 3%
SA-1
CA-2
Alum 5%
SA-1
CA-3
Alum 7%
SA-3