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Reactive Dye Printing on Wool with Natural and Synthetic Thickeners

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Abstract - *For printing of wool with reactive dyes; modified natural thickeners like sodium alginate, guar gum are typically used as thickening agents. The work deals with application of two synthetic thickeners for printing of wool with two different dyes. Printing trials with Sodium Alginate as natural thickeners; also synthetic thickeners have shown that the use of synthetic thickeners improve fabric handle and color yield. The use of synthetic thickeners provides good quality prints compare to natural thickeners*

Key Words: **Reactive Dyes, Synthetic thickeners, Wool printing**

1. INTRODUCTION

Textile printing is an important art of creating decorative textile fabric. The coloration is achieved either with dyes of pigments in printing paste. A successful print involves correct colour, sharpness of mark, levelness, good hand and efficient use of dye: all of these factors depend on the type of thickener used. The thickener must be compatible with other ingredients present in printing paste[1,2].

Wool fabric is the most commonly printed substrate for foreign countries with cold region, and reactive dyes are the dyes used for wool printing. Natural thickeners viz. sodium alginate is widely used for wool printing with reactive dyes[1,3,4]. The relatively high cost and limited supply of natural thickeners has spurred efforts to find alternatives. Acidic medium is necessary for wool printing and natural thickeners used for reactive dyes are not stable in acidic media, which also lead to find alternatives.

Synthetic thickeners, predominate in the printing of pigments due to their low solids content. They additionally offer advantage over natural thickeners in quick and easy paste preparation and viscosity adjustment, and consistency of quality and supply[5].

Today the pressure to print reactive dyes economically with high quality has led to the commercial development of synthetic thickeners in this application[2,6]. The aim of present work is to examine the printing properties of a reactive dye pastes based on natural thickeners and two formulated synthetic thickeners, and to determine if such synthetic thickeners are able to overcome disadvantages, while not losing the advantages for which each is known. There are many variables that might be examined, but generally a printer is looking for a paste that is simple to prepare, stable, prints level and sharp, minimizes the use of dye and auxiliaries, and easy to remove[3,5].

2. EXPERIMENTAL

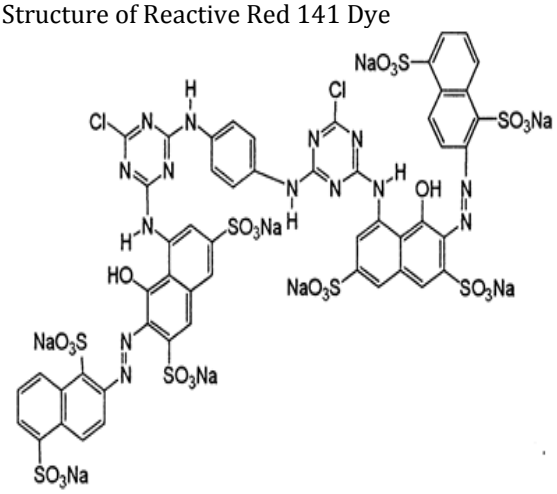
2.1 Materials

Wool fabric was procured from the market with the specifications shown in table. Sodium alginate (SA) (Natural thickener) was used for preparation of paste. C.I. Reactive Red 141 Dye is used for coloration. Two synthetic thickeners (ST1 and ST2), formulated by thermal polymerization were also used for preparation of paste for comparative study.

Specifications of Wool Fabric

Weave	Reeds/inch	Picks/inch	GSM (g/m^2)
2/2 Twill	2/100 wool	1/60 wool	280

Structure of Reactive Red 141 Dye



2.2 Thickener (paste)

A paste of sodium alginate was prepared by soaking overnight in distilled water followed by thorough mixing. A paste of each synthetic thickener was prepared by soaking in distilled water with adding ammonia, followed by thorough mixing.

The rheological properties of each paste were measured at 20 ± 1º C, using Brookfield Viscometer (6 No. Spindle, 20 rpm).

2.3 Printing recipe

The printing of reactive dye was carried out by direct style on wool; three different thickeners were used for study viz. Sodium alginate (SA) and formulated thickener (ST1 and ST2)

Printing paste was prepared as follows[8]:-

X g Reactive dye (1g, 3g and 5g)
30 g Urea
12 g Water (at 70ºC)
1 g Resist Salt
2 g Acetic acid
50 g Thickener (6 % Paste)
100 g

The paste was uniformly mixed with an electric stirrer.

Wool was printed with above paste using screen printing method, dried and then steamed for 45 minutes at 3 psi pressure. The sample was then back washed as follows:

Washing Bowl	Solution
I	2 ml/litre liquor ammonia at 60ºC
II	Water at 80 ºC
III	Water at 40 ºC
IV	1 ml/litre formic acid 85% in the cold
V	Water at 40 ºC (rinsing)
VI	Water wash

2.4 Color Value

The printed samples were assessed for the depth of color by reflectance methods using 10 degree observer. The absorption of printed samples was measured on Premier Spectrascan 5100. The K/S values are determined using expression:

$$K/S = (1 - R)^2/2R$$

Where, R = reflectance at complete opacity, K = absorption coefficient, S = scattering coefficient.

2.5 Fastness Testing

For washing fastness, light fastness and rubbing fastness, AATCC Test Method 61 – 2006, AATCC Test Method 16 – 2004 and AATCC Test Method 8 – 2005 were used respectively.

3. RESULT AND DISCUSSION

Table – 1 shows the effect of storing on the apparent viscosities of the pastes in comparison with that of natural thickeners. It is notices, regardless of the shearing rate, that all the pastes show an increase in their apparent viscosities and the longer the storing time is, the higher the increase in apparent viscosity; the greatest increase in viscosity occurs during the first day of storing. It is probable that storing permits better swelling, compatibility and uniformity of the macromolecules of the pastes, which in turn increase the apparent viscosities.

TABLE – 1 :- Effect of Storing on the Apparent Viscosities (in poise) of the pastes at Different Shearing Rates

Paste	Storing Time (days)	Shearing rate (s^{-1})				
		80	160	240	300	400
Sodium Alginate	0	20.6	17.2	14.8	13.0	11.6
	1	26.6	18.1	15.6	13.6	11.9
	8	28.3	19.5	15.9	13.8	12.0
ST1	0	21.5	17.2	14.6	13.0	11.6
	1	26.6	18.1	15.2	13.4	12.0
	8	28.3	19.4	15.6	13.8	12.4
ST2	0	20.0	16.2	13.3	11.0	9.3
	1	23.8	17.5	14.9	12.0	10.3
	8	26.3	18.1	15.1	12.5	10.6

The effect of different thickeners (Used for preparation of paste) on color value has been shown in Table –2. Table – 2 suggest that K/S value of samples printed with formulated thickener (ST1 and ST2) is outstanding compare to other samples printed with different thickener, such as sodium alginate (SA). This happens due to the presence of ammonia in formulated thickener (ST1 and ST2) paste, which was used for neutralization. At steaming stage it helps in improving color absorption at printed area on wool fabric. Strength data of all the samples also clearly indicating that formulated thickener (ST1 and ST2) comparatively show higher range to other thickeners.

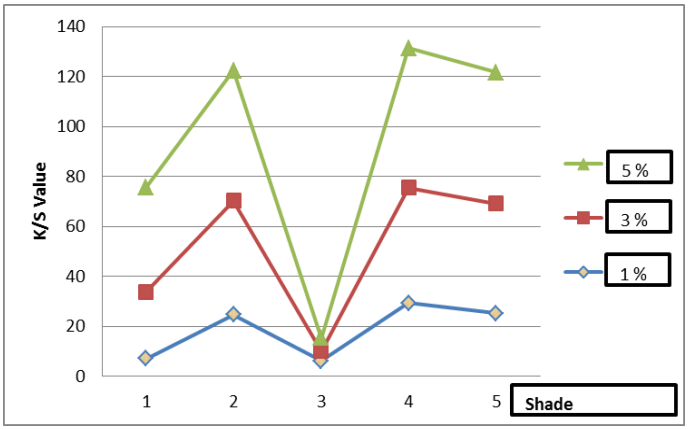
TABLE – 2:- K/S value and strength of samples printed using different thickeners

Thickeners used for paste		SA	ST1	ST2
Shade				
1 %	K/S value	24.7	29.4	25.2
	Strength (%)	100	118	105
3 %	K/S value	45.6	46.1	44.0
	Strength (%)	100	109	98.6
5 %	K/S value	52.1	55.8	52.4
	Strength (%)	100	107	102

Chart – 1 also indicates that the K/S value of synthetic thickeners is much higher compare to natural thickeners.

Table – 3 show the overall fastness properties of screen printed wool fabric using natural as well as formulated thickener (ST1 and ST2) thickeners. Data suggests that the overall fastness properties directly depend on types of thickeners used.

Chart – 1 :- K/S Value for different Shade of printing



Fastness properties analysis indicates, washing fastness of the samples, where formulated thickener (ST1 and ST2) is used, shows fairly improved result compare to sodium alginate used widely in industries. Also SA shows vary poor washing fastness, indicates for negative approach towards idea of using SA in acidic medium. In rubbing fastness, both dry and wet conditions, formulated thickener (ST1 and ST2) is showing the result same as sodium alginate and also in light fastness the result shows that both the thickeners ST1 and ST2 are comparatively gives good result.

TABLE – 3 :- Fastness Analysis of various samples printed with different thickeners

Thickeners used for paste			SA	ST1	ST2
Shade	Fastness				
1 %	Washing		4	4/5	4
	Rubbing	Dry	3/4	5	4/5
		Wet	4	4/5	4
	Light		4/5	5	4/5
3 %	Washing		4/5	4/5	4
	Rubbing	Dry	4	4/5	4
		Wet	4	4	3/4
	Light		4/5	5	4/5
5 %	Washing		4	4/5	4/5
	Rubbing	Dry	4/5	5	5
		Wet	4/5	4/5	4
	Light		5	5	4/5

Where, 1 = Very poor, 2 = Poor, 3 = Good, 4 = Very Good and 5 = Excellent

4. CONCLUSION

Experiment indicates that some novel formulated thickener (synthetic polymer, ST1 and ST2) based on thermal polymerization can be used safely for preparing printing paste for screen printing of wool textile fabric with reactive dye.

The highest K/S value obtained in case of paste is prepared using formulated thickener, also fastness properties; ranging between excellent and good compare to samples which are printed using natural thickener such as sodium alginate. The synthetic thickeners perform better than natural thickeners in reactive printing on wool.

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