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Nanotechnology to improve Printing of Cotton with Reactive Dye

KEYWORDS: Nanotechnology, TiO_2, cotton fabric, printing

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ABSTRACT *Thickeners like Guar gum and Sodium Alginate, which are used in printing of cellulose substrate (cotton) with Reactive dye. The results shows that the thickeners can be used safely with TiO_2 in preparing printing paste for coloration of cotton and that also improves fastness properties and wrinkle resistance property of cotton.*

Introduction

Reactive printing is not only oldest but also very popular printing method as its reactivity towards cotton substrate. In cotton industries 75 % print goods are based on reactive printing due to its obvious advantages, such as fastness, durability of print.

From the last two decades, the nano particles have become quite popular in various fields. These nano – particles are applied to the textile by padding to impart water repellency, wrinkle resistance, anti bacterial, anti static, soil resistance, UV – protection and improvement in dyeing. From various application of nanotechnology in textile, some imparted by nano treatment are critically highlighted in this paper.

The present study is aimed to use water soluble guar gum and sodium alginate thickeners with TiO_2 nano particles in preparation of printing paste for coloration of cotton to improve fastness and wrinkle resistance properties.

Materials and Methods

Fabric

Mill Scoured and bleached cotton fabric (118 g/m^2) plain weave with ends/inch 112 and picks/inch 72 procured from local market and further thoroughly washed, neutralized and air dried.

Dye and chemicals

One commercial Reactive Dye namely Reactive Red C.I. No. 180 was used. Gaur gum (T_1), sodium alginate (T_2), TiO_2 nano particles of 50 nm size, Urea (Mol. Wt. 60), Sodium carbonate (Mol. Wt. 116), Resist salt L were used for making printing paste.

Paste Preparation

Aqueous paste of guar gum and sodium alginate (with desired viscosity for printing) was prepared.

Printing

The printing was prepared using following recipe:-

50 g	Reactive Dye
200 g	Urea
350 g	Thickener Paste (T_1 / T_2)
25, 50 & 100 ppm	TiO_2 nano particles
10 g	Resist salt L
15 g	Anhydrous Sodium carbonate
Z ml	water
1000 g	

This printing paste was applied on cotton fabric using flat nylon screen. The printed samples were passed through steam ager at 150 °C for 5 minutes for fixation.

Measurement & Analysis

The crease recovery angle of the sample was determined as per AATCC test method 66 – 2003 using B – TEX Engineering crease recovery tester (India).

The printed samples were assessed for K/S values using computer color matching system (Spectrascan 5100 RT Spectrophotometer, Premier Colorscan Instrument, India)

The light fastness of the printed samples was tested on fad – o – meter (B – TEX Engineering, India) after partially exposing the sample to the Xenon arc lamp for 16 h.

The wash fastness of the printed samples was measured according to ISO – 2 test method in launder – o – meter (Digi. Wash, Paramount Scientific Instrument, India)

The rubbing fastness of the printed samples was measured according to AATCC test method 8 (2005).

Result & Discussion

Effect of TiO_2 Concentration on K/S value

The effect of TiO_2 nano particles concentration with thickeners T_1 & T_2 on color strength (K/S) of screen printed cotton fabric is shown in Table – 1. It is clear from the table, as the concentration of TiO_2 nano particles increases the K/S value of the printed fabric also increases. The increase in K/S leads to more fixation of dye that in paste containing thickener (T_2) shows the excellent result as compare to the paste containing thickener (T_1).

Fastness properties

Table – 2 shows the fastness properties of cotton fabric printed using T_1 & T_2 thickeners and TiO_2 nano particles. It is clear from the table that overall fastness properties improve by using TiO_2 nano particles in printing paste. This may be due to the fact that TiO_2 enhances unsaturated site in reactive dye which is responsible for the fixation of reactive dye. The color fastness of washing, rubbing and light is good – very good.

Wrinkle Resistance

The effect of TiO_2 nano particles concentration on crease recovery of printed samples of cotton fabric is shown in Table – 3. Table shows that crease recovery angle increase with increase in TiO_2 concentration.

Conclusion

- Use of TiO_2 in printing of cotton with reactive dye increases color strength and also improves color yield.
- The paste with TiO_2 also improves the crease recovery angles with almost no effect on rigidity of the material.

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- The overall fastness properties improved by using TiO_2 nano particles in printing paste.
- Use of sodium alginate with TiO_2 gives better result compare to guar gum with TiO_2 nano particles in printing paste.
- TiO_2 nano particles can be used safely with the appropriate thickeners in printing of cotton with reactive dye.

TiO_2 concentration (ppm)	Colour Strength (K/S)	
	With T_1	With T_2
0	4.06	5.21
25	7.29	8.09
50	9.67	10.55
100	10.93	12.05

Table – 1 Effect of TiO_2 nano particles concentration on K/S of cotton fabric printed using Reactive dye steam aged at 150 °C for 5 minutes

Table – 2 Fastness Properties Reactive dye printed cotton fabric using TiO_2 in printing paste and steam aged at 150 °C for 5 minutes

TiO_2 concentration (ppm)	Light Fastness		Washing Fastness		Rubbing Fastness			
	With T_1	With T_2	With T_1	With T_2	With T_1		With T_2	
					Dry	Wet	Dry	Wet
0	3	4	3	3 – 4	3	3	3	4
25	3	4	3 – 4	4	3	3	3 – 4	4
50	3	4 – 5	4	4 – 5	3 – 4	4	4	4 – 5
100	3	4 – 5	4 – 5	4 – 5	4	4 – 5	4 – 5	4 – 5

Table – 3 Crease Recovery Angle of Reactive dye printed cotton fabric using TiO_2 in printing paste and steam aged at 150 °C for 5 minutes

TiO_2 concentration (ppm)	Crease Recovery Angle	
	With T_1	With T_2
0	176	179
25	184	190
50	191	198
100	186	188

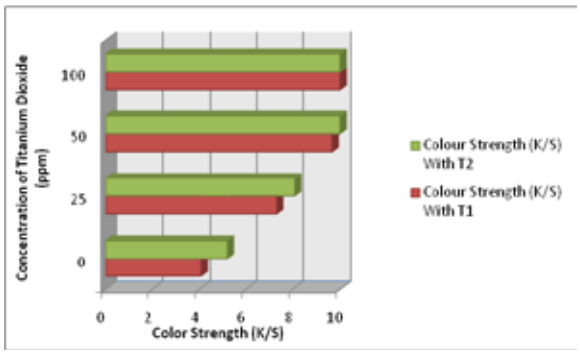

Fig. : - 1 Effect of Concentration of TiO_2 on Color strength (K/S) of Printed Sample

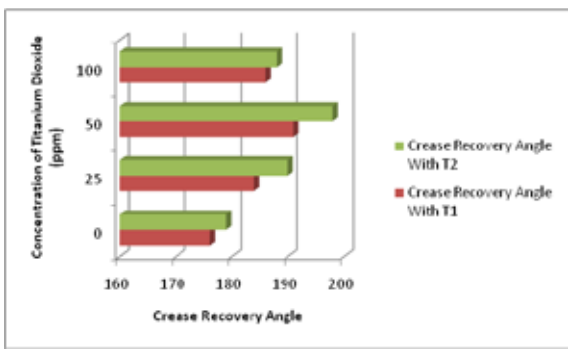

Fig:- 2 Effect of Concentration of TiO_2 on Crease Recovery Angle of Printed Samples.

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