Modified non-formaldehyde cross-linking agents for cotton and polyester/cotton blend fabrics

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Previous research[1] demonstrated that very high wrinkle recovery angles (WRAs) can be obtained when Natrium CRA (a non-formaldehyde cross-linking agent) is applied on polyester/cotton blend fabric. Strength loss, at about 10-20% as well as the yellowing caused was within limits.

Mill trials, however, showed some change in tone in certain dyed fabrics. Additionally, a new booster system has been introduced to improve the crease recovery angle and to control the yellowing tendency, as well as change in tone.

This article describes trials of Natrium CRA and Booster CMW (a catalyst), both from Supertex (India) Corporation, on 100% cotton and (67/33)% polyester/cotton blend fabrics. The treated fabrics were tested for wrinkle recovery angles, tensile strength and whiteness index. The durability of the crosslinking effect was also considered by measuring the WRAs after five washes.

The trials used mill desized, scoured and bleached plain weave 100% cotton fabrics and (67/33%) polyester/cotton blend fabrics. The following commercial dyes were used without purification :

Disperse dyes - Terenix Yellow Brown F2RL, Terenix Blue GL and Terenix Brown F3RL (Jaysynth Dyechem Pvt. Ltd.)

Reactive dyes - Reactofix Red MSB, Reactofix Orange M2R, Reactofix Yellow M3R and Reactofix Blue MR. (Jaysynth Dyechem Pvt. Ltd.)

Vat dyes - Navinon Grey 4B, Navinon Brown R and Navinon Brown BR. (Indian Dyestuff Industries Ltd.)

The 100% cotton fabrics were dyed with reactive dyes in a jigger by the exhaust method. The cotton fabrics were also dyed with vat dyes in the jigger.

Blend fabrics were dyed with disperse/reactive and disperse/vat combinations. For this purpose, the polyester portion was dyed in a jet dyeing machine at 130°C for one hour and the cotton component was dyed with reactive dye in a jigger after a reduction clear treatment.

Similarly in the other combination, the polyester fibre component was dyed in the jet dyeing machine at 130°C for one hour and cotton component with the vat dye in a jigger.

Natrium CRA and Booster CMW were applied on the 100% cotton fabric at two concentrations (80g/l and 120 g/l Natrium CRA with 8 g/l and 10 g/l of Booster CMW respectively) by a pad (80% pick-up), dry (110°c for 3 min.), and cure (150°C for 1 min.) method.

Application on the blend fabric was carried out at conventrations of 60 g/l and 80 g/l Natrium CRA and 6 g/l and 8 g/l Booster CMW respectively, also by a pad (80% pick-up), dry (110°C for 3 min.), and cure (180°C for 1 min.) method.

Wrinkle recovery angle (both warp and weft) of the treated fabric was determined on a crease recovery tester.

To test the durability of the crosslinks the WRAs were also determined after five wash cycles (a soaping treatment in a laundrometer at 60°C for 30 min. with 1.5 g/l of nonionic detergent, followed by a cold water wash).

Table 1. Properties of 100% cotton fabric finished with Natrium CRA and Booster CMW and cured at 150°C for 1 minute

Fabric	Concentration		Crease Recovery Angle (Wp + Wt)		Tensile Strength				Whiteness Index
					Finished		Retained %		
	Natrium CRA g/l	Booster CMW g/l	Before wash	After wash	Wp	Wt	Wp	Wt	Hunter's Equation
Bleached	0	0	154		62.84	31.44			87.82
	80	8	204	202	61.00	23.60	97.00	75.00	87.24
	120	12	212	210	54.42	22.56	86.00	71.00	86.57
Reactive	0	0	155		51.34	27.17			
Dyed	80	8	200	197	41.26	15.40	80.00	57.00	
	120	12	205	203	31.50	13.82	61.00	51.00	
Vat Dyed	0	0	156		69.00	34.39			
	80	8	195	192	67.52	26.58	98.00	77.00	
	120	12	217	215	47.80	25.20	69.00	73.00	

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The whiteness index was determined by using Hunter's equation.

Test results

In the case of the 100% cotton fabric (Table 1), it was found that the WRAs increased with the increase in crosslinking agent concentration. At 120 g/l there was a substantial increase in WRA compared with the unfinished fabric. Subsequently, after five washes there was hardly any drop in the WRAs, indicating that the crosslinks were durable.

The tensile strength (W+F) values showed that the strength decreased with the increase in crosslinking agent concentration, to about 86% of the original value at the 120 g/l concentration of Natrium CRA.

The whiteness index of the fabric hardly decreased at 80 g/l concentration, and even at 120 g/l the decrease was not very large. Hence, the deterioration in the whiteness index of the fabric found in early mill trials has been countered considerably with the addition of the Booster system. Also shown in Table 1 are the results of the reactive dyed fabrics. In this case the loss in tensile strength was much more than for the bleached fabric. At the 120 g/l concentration strength values dropped to 61% in the warp and 51% in weft.

The WRAs of the reactive dyed fabric were also less than those of the bleached fabric, but a substantial increase in WRAs was obtained after the treatment with the crosslinking agent. Furthermore, the durability of the finish was very good after five washes as there was hardly any drop in the WRA. The change in tone observed was also marginal and within tolerable limits.

At 120 g/l Natrium CRA with the booster system the vat dyed fabric showed a larger increase in WRA than either the bleached or reactive dyed fabrics. The WRAs were practically of the same order after five washes. At 120 g/l there was a 69% strength retention, but the result at 80 g/l Natrium CRA was much better. There was a significant change in tone with the shade getting a little deeper.

Fabric	Concentration		Crease Recovery Angle (Wp + Wt)		Tensile Strength				Whiteness Index
					Finished		Retained %		
	Natrium CRA g/l	Booster CMW g/l	Before wash	After wash	Wp	Wt	Wp	Wt	Hunter's Equation
Bleached	0	0	200		79.30	61.40			89.18
	60	6	252	250	72.50	49.92	91.00	81.00	88.05
	80	8	260	257	70.86	50.66	89.00	83.00	85.92
Diverse	0	0	209		76.66	55.84			
Reactive	60	6	251	248	72.06	50.00	94.00	90.00	
Dyed	80	8	260	257	70.10	49.50	97.00	89.00	
Disperse	0	0	208		77.80	59.00			
Vat Dyed	60	6	247	243	78.40	55.76	100.70	95.00	
	80	8	260	259	71.40	50.64	92.00	86.00	

Table 2. Properties of (67/33%) polyester/cotton fabric finished with Natrium CRA and Booster CMW and cured at 180°C for 1 minute

On the blend fabric (Table 2), there was also a marked increase in WRA with increasing concentration of the crosslinking agent. This was hardly affected by washing.

There was a marginal drop in the tensile strength with 89% retention even at 80 g/l concentration, although in the case of the weft strength, this was down to 83%. Very little change was found in the whiteness index of the fabric finished at 60 g/l concentration, but at 80 g/l there was a significant drop, indicating that 60 g/l was the optimum concentration for getting the required crease recovery angle as well as the minimal change in whitness index.

The disperse/reactive dyed blend fabric also gave encouraging results with better WRA as the concentration of Natrium CRA increased. After five washes there was hardly any drop in WRA like in all earlier observations. Interestingly, the retention of strength was higher, at about 90%. There was not much change in the tone after finishing.

The disperse/vat dyed and finished fabric gave similar WRAs to the bleached and disperse/reactive dyed fabrics. Also the WRAs were fast to five washes. The strength retention was around 90%. A significant change in tone was observed with disperse/vat dyed finished fabric.

Summary

It can be concluded that the addition of Booster CMW to the Natrium CRA finishing bath substantially increased the WRA of the fabric finished. Also, the yellowing tendency was less when the booster was present. In the case of dyed fabrics, the WRA was of the same order but there was slight change in tone observed with reactive dyed 100% cotton. In the case of the blend fabric the changes in tone were more pronounced in the disperse/vat combination.

1. N. M. Saraf, American Dyestuff Reporter, 83, 1994 (No. 4), 47.