

WRINKLE FREE FINISHES – A Study of various cross-linking agents

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Popularity of branded cotton shirts has been increasing day by day in tropical countries. Not only it is comfortable to wear but higher cost of fine quality cotton has become symbol of affluence. Though blends of polyester / cotton and polyester / viscose, had some takers in shirting, poor performance in pilling and longer processing time required for blends made them not so popular either with the consumers or manufactures / processors.

Cotton has a inherent drawback of creasing very easily and efforts are always made to make it crease resistant or Easy To Iron type similar to polyester / cellulosic blends without affecting it's comfort properties. Cross linking agents of various types have been developed and various formulations under different brands are being offered to the finishers each claiming to be the Only solution. From initial cross linking agents like urea formaldehyde the industry has moved to Dimethylol - dihydroxyethylene urea type products which gives better results than UF resins with lower formaldehyde on finished fabric. Though DMDHEU is most preferred cross linking agent, it's modifications were made to meet Oekotex Standard 100 requirements by modifying the formulation. Simultaneously, other chemicals capable of cross linking which contain reactive groups and are free from formaldehyde have also been introduced to offer 'Zero Formaldehyde' resin finish. Natrium NFO is one such product introduced first time in India in way back 1990 by Sarex & similar such formaldehydefree resins followed.

Natrium NFO, Natrium CRA gave excellent results on polyester / cellulosic blends with good handfeel, crease recovery angle but were not studied for finishing at 100% cotton.

Here, we have made an attempt to study various cross linking agents based on different chemistry in the finishing of cotton shirting. A brief description of each of the finishing chemical is given below.

1. Saralink ULF - An ultra-low formaldehyde resin based on DMDHEU with very low free formaldehyde in the formulation & also on finished fabric to meet Oekotex Standard 100 requirement. It has very low reactivity due to it's chemical composition & does not contain any in-built catalyst.

2. Saralink 545 – A classical DMDHEU based resin with low formaldehyde with higher reactivity than Saralink ULF. This also do not contain any catalyst in the formulation.
3. Natrium NFO – A formaldehyde-free cross linking agent based on a macro crosslinking compound.
4. Macrobounce – A formaldehyde-free cross linking agent based on glyoxal.
5. Sarapeach AM – A formaldehyde-free cross linking agent based on polyurethane.
6. Sarafinish OST – A novel formulation based on DMDHEU based resin, fibre protecting agent and a wash fast softener in ready to use form.
7. Saralube HP – A Sewability improver with hydrophilic nature, which reduces tensile and tear strength loss, was added with Saralink 545, Saralink ULF.

In this preliminary study, we did simple experiment to evaluate effect of these finishing chemicals on CRA of dyed cotton poplin selected for the project. We also evaluated fastness to 60°C similar to ISO CO6, 5 washes i.e. wash-rinse – line dry cycles without intermediate ironing. Handfeel was checked by 5 independent observers in a blind testing.

The details of experiment are given here.

Material : 120 x 100, 40's x 40's plain weave dyed cotton poplin, dyed with reactives by CPB method and collected from running bulk production in ready to finish state with good absorbancy and near neutral pH.

Table 1

Recipe	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Saralink ULF	60	100	-	-	-	-	-	-	-	-	-	-
Saralink 545	-	-	60	100	-	-	-	-	-	-	-	-
Natrium NFO	-	-	-	-	60	100	-	-	-	-	-	-
Sarapeach AM	-	-	-	-	-	-	60	100	-	-	-	-
Macrobounce	-	-	-	-	-	-	-	-	60	100	-	-
Sarafinish OST	-	-	-	-	-	-	-	-	-	-	60	100
Saralube HP	30	30	30	30	-	-	-	-	-	-	-	-
Mg Cl ₂ , 6 H ₂ O	9	15	9	15	-	-	-	-	-	-	9	15
Citric acid	0.3	0.3	0.3	0.3	-	-	-	-	-	-	0.3	0.3

Experimental conditions – Pad with 65% pick by 2 dip 2 nip process on pneumatic laboratory padding mangle, dry at 120°C for 1 min. on lab stenter. Cure at 160°C for 6 mins. on lab stenter and condition for 24 hrs.

Evaluation – Crease recovery angle was measured as per AATCC Test method 66 – 1990 as such and after 5 washes at 60°C similar to ISO CO6 followed by ironing after drying at the end of 5th washing – rinsing and drying cycle.

Experimental Results – Crease recovery angle of warp + weft before and after washing is given in Table 2 (Average of 3 readings) & Figure 1.

Table 2

Recipe	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
CRA Before washing	190	201	197	217	146	152	137	141	150	182	193	225
CRA After washing	188	200	196	209	144	147	134	140	150	175	184	211

Crease recovery angle (CRA) of unfinished fabric = 122 before washing.
= 99 after washing.

Interpretation of results :

- 1) Among the DMDHEU based formulation, Sarafinish OST, the All-In-One formulation has given the best results for CRA before washing and after washing at 100 g/l conc. Also, CRA increases significantly when Sarafinish OST concentration is increased from 60 g/l to 100 g/l.

This indicates that the formulation is properly balanced and gives similar or better results than Saralink 545, a classical DMDHEU based resin. Softer handfeel is an advantage in case of Sarafinish OST.

- 2) In case of Saralink ULF, no significant increase in CRA is noticed when concentration was increased from 60 g/l to 100 g/l. This is probably due to reaching a saturation limit with Saralink ULF which is having a higher active content & lower reactivity.
- 3) Saralink 545 showed better CRA than Saralink ULF confirming higher reactivity than Saralink ULF.
- 4) Among the formaldehyde free resins, none of the products showed significant increase in CRA even at higher concentration of 100 g/l. However, Macrobounce exhibited the highest CRA in this category at 100 g/l concentration. Thus, for high value shirting with zero formaldehyde finish, Macrobounce is the best choice among these formaldehyde-free resins.

Conclusion – For best CRA & handfeel Sarafinish OST is a well balanced formulation. To meet Oekotex Standard 100 requirement, Saralink ULF is recommended due to ultra-low formaldehyde. Here customer could try a combination of Saralink ULF with Macrobounce or Natrium NFO to bring down free formaldehyde on fabric and at the same time obtain required CRA with soft handfeel. This ofcourse is based on theoretical knowledge of the formulations and customers can try various permutations and combination on their fabrics in their laboratory to obtain best results before conducting any bulk trials.