

Cotton knits that were meant only for sportswear have gained acceptance with India's urban youth as casualwear, worn along with cotton trousers or denim.

In the past, T-shirts were considered only as menswear – hence very little attention was paid to their colour or finish. But with more women participating in all spheres of life, T-shirts have gained popularity among Indian women as a choice of casualwear. As a result, more attention is now given to the shade, appearance, feel and wearing comfort, since women are more discerning than men.

Softer hand and brightness of hue, which were once considered feminine, have become the 'in' thing. Knits for kidswear are also becoming popular, with soft feel and eye-catching colours. Since kidswear and womenswear fetch better prices, newer and more shades and better finishes are being introduced in these categories.

Instead of traditional finishing with cationic softeners, by the exhaust method, modern dyehouses are now finishing cotton knits in open-width form by the padding method. This has opened up avenues for silicone finishes and other finishing chemicals, which, due to their low or no affinity and poor shear stability, could not be applied on softflow machines. Thus, in the initial years, silicone finishing with conventional poly dimethyl siloxane (PDMS) replaced traditional cationic softeners.

However, the novelty soon wore off. PMDS-based silicone softeners certainly gave better handfeel, which is fast to home laundering compared to conventional cationic softeners, but they are also hydrophobic like cationic softeners. End users who were ready to pay more for soft handfeel with comfort properties forced chemical manufacturers to look for new formulations, based on hydrophilic softeners that are fast to home laundering. Another problem that the finishers faced was dulling of the shade or yellowing of whites during or after finishing, due to softeners.

# Evaluation of Softeners for Cotton Knits

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Hydrophilic anionic and non-ionic softeners could offer both, i.e. hydrophilicity to the finished cotton knits as well non-yellowing finish; but these could not confer the required softness. It is more apt to these call as finishing chemicals rather than softeners.

We at Sarex studied this problem in detail. First we tackled the problem of yellowing. It is a well-known fact that products containing free amino groups have a tendency to oxidize on storage or at acidic pH and high temperature – for example, the yellowing of wool or yellowing of nylon. Thus, if the yellowing problem could be isolated to the free amine group in a softener, it could be solved by eliminating that free amine group by suitably blocking it or using a formulation where the amine group cannot be easily protonated.

Initial experiments yielded encouraging results and soon we were able to launch, for first time in India, Gamasoft KA, a 'Zero-Yellowing' silicone softener.

Simultaneously, efforts were made to introduce economical organic softeners, which are weakly cationic or pseudo cationic. During the experiments we also noticed that these zero-yellowing or low-yellowing products also confer either hydrophilic or non hydrophobic finish to the treated cotton.

In this study, we evaluated various softeners based on different chemistries, both silicone based and organic type, for finishing of cotton knits by the pad-dry method.

The details of the experiments are given below:

- Material – bleached, optically brightened cotton single jersey
- Finishing by pad-dry method using laboratory pneumatic padding mangle and laboratory mini stenter
- Padding with 60% pick up, pH6.5, dry at 130°C for 90 seconds
- Evaluation of whiteness by spectrophotometer and that of hydrophilicity by wicking method; softness by hand feel, by 5 independent observers, in blind testing.

The following softeners were used for the study.

1. Sarasoft DP – a conventional cationic softener, based on fatty amide condensation products
2. Sarasoft GA – a weakly cationic organic softener, based on fatty acid
3. Sarasoft UK – a pseudo cationic organic softener, based on fatty amide
4. Sarapeach AM – a reactive polyurethane derivative for hydrophilic finish and good drapability and dimensional stability

5. Sarapeach MR – a formulation based on reactive polyurethane
6. Sarasoft 1367 – an economical silicone macro-emulsion with low amine value
7. Megatouch – a concentrated silicone micro-emulsion with low amine value
8. Gamasoft KA – a piperidine modified silicone emulsion with zero yellowing property

The concentration of each product was selected in such a way as to have similar active content in the finishing bath. pH was purposely kept at 6.5 to avoid yellowing of OBA due to acidic pH, which could interfere in the results. Drying was also carried out at 130°C to avoid yellowing due to heat.

## Experimental results & discussions:

From the results (shown right) it can be concluded that:

- a) Sarasoft DP, conventional cationic softener reduces whiteness to the maximum and gives the most hydrophobic finish, though the handfeel is very soft and better than other organic softeners.
- b) Sarasoft GA, a weakly cationic softener, gave better performance than the conventional cationic softener, Sarasoft DP; but whiteness is still lower than untreated.
- c) Sarasoft UK, a pseudo-cationic softener, gave better results than the weakly cationic softener, Sarasoft GA, as far as whiteness is concerned and better wicking than untreated, indicating hydrophilic finish.
- d) Sarapeach AM, which is reactive polyurethane, gave the best hydrophilicity among all finishing chemicals studied here and little or no effect on whiteness. However, handfeel is not very soft.
- e) Sarapeach MR, which is a proprietary formulation of polyurethane, gave lower wicking than polyurethane alone but with similar whiteness.

No.	Product	Conc (g/l)	Whiteness index	Capillary rise (mm)	Softeners rating
1.	Unfinished	–	155	450	9
2.	Sarasoft DP	30	138	120	3
3.	Sarasoft GA	30	148	390	4
4.	Sarasoft UK	30	151	465	6
5.	Saraspeach AM	20	153	790	7
6.	Sarapeach MR	30	153	720	4
7.	Sarasoft 1367	20	155	430	1
8.	Megatouch	15	153	640	2
9.	Gamasoft KA	20	155	590	2

However, handfeel is better than Sarapeach-AM.

- f) Sarasoft 1367, which is macro-emulsion, gave very good handfeel among the silicones due to the surface smoothness it imparts. It showed very little or no change in whiteness as it is of low amine value, but wicking is slightly lower than untreated. This finish can be termed a non-hydrophobic finish.
- g) Megatouch also showed no effect on whiteness. Handfeel is a little inferior than with the macro-emulsion, but wicking is much better than with Sarasoft 1367 and other organic softeners.
- h) Gamasoft KA showed no change in whiteness, with handfeel similar to Megatouch but wicking slightly lower than Megatouch.

Thus, for cotton knits, finishing by the pad-dry-method, Sarapeach AM, a polyurethane based formulation, gave the best wicking, whereas Gamasoft-KA, a piperidine modified silicone emulsion, gave zero yellowing.

A macro-emulsion gave the best handfeel which does not affect whiteness and has very little effect on wicking. Reducing the ionicity of organic softeners progressively improved whiteness as well as wicking. However, the softness of these products was found to be inferior to that given by silicone softeners. ○