Shade Enhancement of Dyed Cotton Knits

By Dr Naresh M. Saraf and Deepak V. Alat, of Sarex Overseas, India

With the growth of branded casual wear in the domestic market and increased orders for cotton knits from overseas buyers, the scenario of cotton knit processing in India has changed. From winch dyeing and hank dyeing units, catering to the lower end of domestic markets, most of the units have metamorphosed into modern dyeing units, using the latest machinery, and dyestuffs and chemicals from reputed suppliers.

Exposure to overseas markets, as well as the stringent requirements of branded apparel manufacturers, has forced processors to redesign their recipes and processes to meet these requirements, such as consistency of shade from batch to batch and high wet fastness properties, particularly wash fastness to Test 3 part CO3 (using multifibre adjacent fabric), ISO EO1 and wet rubbing fastness for dark and medium shades.

As far as shade consistency is concerned, the problem could be overcome by standardising process norms, such as: pretreatment parameters; liquor ratio and the number of contacts per minutes in dyeing; quality of water, salt, alkali, dyes; and chemicals with low tolerance limits and aftertreatment process. However, the required wet fastness properties are still not achievable in some cases. The reasons could be many:

- Basic dyeability of the substrate – most of the dyeing units are using unmercerised cotton material. The dyeability of such material is lower compared to mercerised qualities and also, depending upon the quality of raw cotton, it may vary from lot to lot and may reach saturation value easily.
- Build-up characteristics of dyestuff – depending upon type of dyestuff, and its purity, the dyestuff may show variation in build up characteristics, and many times excess dyestuff is used to obtain the desired optical depth. Efficiency of pretreatment, quality and quantity of salt, fixation pH and fixation time also play a part in building up the final shade.

Efficiency of washing may be inadequate, either due to wrong selection of products or process, or over-economising on the number of washing baths. This leads to a large quantity of unfixed dyestuff present at the end of soaping. Also, hardness in water can lead to insolubility of unfixed dyestuff, leading to poor washing efficiency. This is then forcibly fixed using a dyefixing agent.

Many attempts have been made to improve the wet fastness properties of dyed cotton knits. These include:

- Improving efficiency of pretreatment with Diadavin UNJ/EWN 200% and Baysolex AE.
- Improving dye bath stability by using Sarakol PS and Levegal RL
- Use of high exhaustion and high fixation dyes with good build-up characteristics such as Sumifix HF and Sumifix EXF dyes
- Improving the efficiency of removal of unfixed dyestuff by using Sarakol 1583 + Kalium NNS or Baylase RP / Baylase Assist RP
- Improving efficiency of dyefixing by using Sarafix NF 504

All these attempts, when tried individually or in combination, helped greatly in improving wet fastness properties.

We also tried another radical approach to overcome the problem of poor wet fastness of dark shades on cotton knits.

Blooming agents are known to enhance the depth of shade of the treated material, and our initial experiments with Sarabloom T and Sarabloom 683 have proved that, with 100% polyester filament fabric made from normal polyester, as well as from microdenier polyester, shade enhancement is possible for dark shades and the treatment does not affect any of the fastness properties, including sublimation fastness.

We used this approach for treatment of dyed cotton knits.

In the first set of experiments, we dyed 6% self shades of individual dyestuffs from each dyestuff range from reputed dyestuff manufacturers, under standard recommended conditions given by the individual manufacturer for the given range. Unmercerised cotton knit fabric was used for the experiments, which was purchased from a processor as scoured, RFD cotton knit. Before the dyeing experiment, the material was separately neutralised, rinsed and dried, and pH was checked by the extraction method and found to be 6.5-7.0.

In another set of experiments, 4.8% self shades of the same dyestuffs were dyed on the same material under identical conditions to the first dyeing experiment. Both sets of dyed samples were rinsed and soaped twice, using Kalium NNS and Sarakol PS, to ensure complete removal of unfixed dyestuff, neutralised to pH 6.5 and dried at 95^0c. The efficiency of the soaping was evaluated by the cold DMF method and it was found that unfixed dyestuff was completely removed. We also checked thermal migration of dyestuff after drying and found it to be absent.

The dyed sample of each 4.8% shade was cut into four parts. One part was retained as a control and the other three were finished with 10g/l, 20g/l and 30g/l of Sarabloom SL, a new formulation at pH 5, with 60% pick-up on a laboratory padding mangle, by the 2-dip-2-nip process, and dried at 140^0C on a mini-stenter.

The finished samples, after conditioning, were evaluated visually as well as using a colour computer, and compared with unfinished samples, dyed at 4.8% and 6.0% shades respectively. We found that finishing with 20g/l Sarabloom SL gives the required results.

Using the 6% depth as standard, we compared the results from 4.8% shade unfinished, and finished with 20g/l Sarabloom SL. These results are given in Tables 1, 2, 3, 4 and 5.

Finishing of self shades with Sarabloom SL

Table 1: Sumifix EXF

Colour	Strength As 6%	Strength of 4.8% Without Sarabloom SL	Strength of 4.8% With Sarabloom SL 20 g/l
SX Yellow EXF	100	89	99
SX Red EXF	100	90	99
SX Blue EXF	100	85	90
SX Navy EXF	100	90	96

Table 2: Sumifix HF

Colour	Strength As 6%	Strength of 4.8% Without Sarabloom SL	Strength of 4.8% With Sarabloom SL 20 g/l
SX HF Yellow 3R	100	92	101
SX HF Scarlet 2G	100	92	100
SX HF Red 2B	100	94	102
SX HF Blue 2R	100	86	94
SX Navy Blue 2G	100	88	104

Table 3: Cibacron

Colour	Strength As 6%	Strength of 4.8% Without Sarabloom SL	Strength of 4.8% With Sarabloom SL 20 g/l
Cibacron Red FN-R	100	90	93
Cibacron Red FN-2BL	91	89	89
Cibacron Blue FN-R	104	86	93

Table 4: Remazol

Colour	Strength As 6%	Strength of 4.8% Without Sarabloom SL	Strength of 4.8% With Sarabloom SL 20 g/l
Remazol Yellow RR	100	89	108
Remazol Red RR	100	90	105
Remazol Blue RR	100	85	105
Remazol Black B (8%)	100	91	104

Table 5: Reactive

Colour	Strength As 6%	Strength of 4.8% Without Sarabloom SL	Strength of 4.8% With Sarabloom SL 20 g/l
Reactive Orange HER	100	93	101
Reactive Red HE3B	100	86	97
Reactive Red HE7B	100	87	91
Reactive Green HE4BD	100	89	94
Reactive Navy Blue HER	100	87	96

Table 6

Set 1		Set 2	
Maroon		**Maroon**	
Sumifix HF Yellow 3R	1.92%	Sumifix HF Yellow 3R	1.6%
Sumifix HF Red 2B	4.8%	Sumifix HF Red 2B	4%
Sumifix HF Navy 2G	0.84%	Sumifix HF Navy 2G	0.7%
Bright Red		**Bright Red**	
Sumifix HF Yellow 3R	0.6%	Sumifix HF Yellow 3R	0.498%
Sumifix HF Red 2B	5.0%	Sumifix HF Red 2B	5.0%
Sumifix HF Navy 2G	1.05%	Sumifix HF Navy 2G	0.87%
Green		**Green**	
Sumifix HF Yellow 3R	4.32%	Sumifix HF Yellow 3R	3.6%
Sumifix HF Navy 2G	1.86%	Sumifix HF Navy 2G	1.55%
Navy		**Navy**	
Sumifix HF Yellow 3R	0.45%	Sumifix HF Yellow 3R	0.373%
Sumifix HF Red 2B	0.95%	Sumifix HF Red 2B	0.788%
Sumifix HF Navy 2G	6.1%	Sumifix HF Navy 2G	5.06%
Black		**Black**	
Sumifix HF Yellow 3R	3%	Sumifix HF Yellow 3R	2.5%
Sumifix HF Red G	2%	Sumifix HF Red G	1.66%
Sumifix HF Navy 2G	5.4%	Sumifix HF Navy 2G	4.48%

Table 7

Colour	Set 1 Unfinished Strength	Set 2 Unfinished Strength	Set 2 Finished Strength
Maroon	100	92	101
Bright Red	100	92	100
Green	100	94	102
Navy	100	86	94
Black	100	88	104

In this set of experiments, we used those colours that are used in self shades as well as in combination shades to dye dark shades. From these experiments, we can conclude that, even if you reduce depth by 20%, you can get an optical depth equal to the original shade when you finish it with 20g/l Sarabloom SL.

Encouraged by these results, we also dyed a few popular dark shades using a combination of Sumifix HF dyes on cotton knits – one set dyed with the required concentration of individual dyes in the recipe, and another set in which the concentration of individual dyestuff was reduced by 20%. Recipes are given in Table 6.

After soaping, rinsing, neutralising and drying, the samples with reduced recipes were finished with 20g/l Sarabloom SL. Taking, samples dyed with the normal recipe, as standard, we compared samples dyed with the reduced recipe and finished with Sarabloom SL. The results are given in Table 7.

We also evaluated wash fastness of both sets to Test 3 part CO3 and found that samples dyed with the reduced recipe and finished with 20g/l Sarabloom SL showed better fastness, particularly in relation to staining of multifibre. Wet rubbing fastness properties were also found to be better in samples finished with Sarabloom SL.

From these preliminary experiments, we can conclude that, with the majority of colours used for dyeing cotton knits, finishing with Sarabloom SL has shown shade enhancement. The increase in depth varies from colour to colour. Using the shade enhancing property of Saraboom SL, the concentration of dyestuff in certain difficult shades can be reduced, to obtain the required depth as well as the required wet fastness properties. However, lab experiments are required to adjust the shade in the lab to match the approved shade after finishing with Sarabloom SL.

Sarabloom SL can also be used to upgrade a shade that has become lighter after calendering. Tonal variations after finishing are to be taken into consideration while finishing with Sarabloom SL.

Please note that Sarabloom SL is to be applied only by wet on dry padding to obtain uniform results. ❍

Reprinted from International Dyer, November 03