

Fix the Dye Fixing Problem on Textile Substrates

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Introduction

Dye-fixing agents are of considerable interest in the art of textile coloration. Dyed and printed fabrics often have unsatisfactory wet fastness, especially washing and water fastness. This is found with dyeings carried out using direct dyestuffs, acid dyestuffs and, to a lesser extent, reactive dyestuffs.

All direct dyestuffs are regarded as being substantive to cellulosic materials, whereas reactive dyes are considered substantive as well as reactive. Direct dyes are normally applied from an aqueous dyebath containing an electrolyte. They impart moderate to good light fastness but moderate to poor washing fastness.

Although the dyeing process with direct dyes is simple, it lacks in the wet-fastness properties. In the case of all reactive dyestuffs, part of the dyestuff will react chemically with a hydroxyl group on the cellulosic fibre and part of the dyestuff will react with the water present in the dyebath to form hydrolysed dye. The un-reacted and hydrolysed dye may be removed by repeated washing; however, the washing-off process is more costly and time consuming than the dye-fixing process.

In industry, cationic dye-fixing agents are used to overcome the problem of poor wet-fastness properties with direct and reactive dyeing on cellulosic fabric. Figures 1 and 2 show the type of dye-fixing agents available for cotton and polyamide fabrics.

Most anionic dyes are members of the well-known class of acid dyes. Another type of anionic dyes is pre-metallised or metal-complex dyes, which are the reaction products of chromium or cobalt and selected dyes. Most popularly, acid or metal-complex dyes are used for dyeing and printing of nylon fabrics. The acid dye is held on polyamide by an ionic bond or

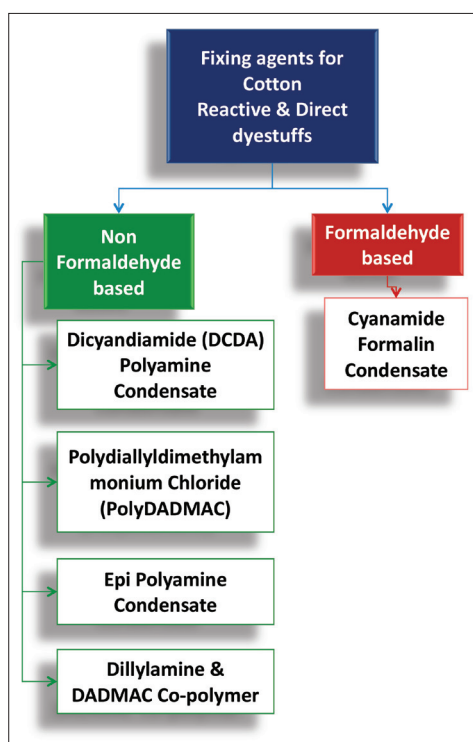


Figure1: Dye-fixing agents for cotton: reactive and direct dyestuffs

by the electrostatic force. The ionic bonding or electrostatic force are relatively weak and can lead to the problem of wash fastness.

A variety of fixing agents are known for application to polyamide fabric to improve wash fastness. These agents, termed 'syntans', are low-molecular-weight polymers with anionic groups which can associate with the nitrogen-containing groups of the polyamide polymer and form a surface layer that reduces diffusion of the dye out of the treated fibre. Syntans are condensation products of aromatic sulphonic acids and formaldehyde derivatives. Syntans are unstable to shear forces and hence not suitable in jet dyeing machine.

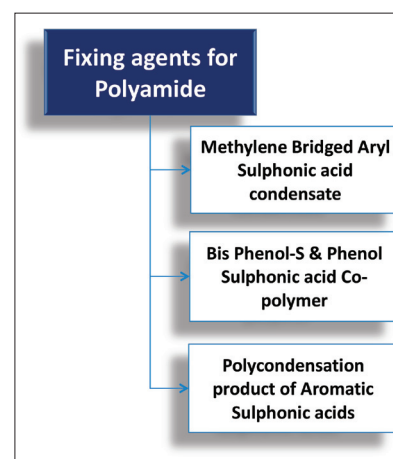


Figure 2: Dye-fixing agents for polyamide: acid dyestuffs

In order to improve the fastness of dyed materials, an aftertreatment 'dye-fixing agent' is typically applied to the dyed material. Due to the non-eco-friendliness of formaldehyde-based dye-fixing agents, the demand for non-formaldehyde-based fixing-agents has increased.

Properties of a good fixing agent include:

- Good capability with cross-linking agents
- Good levelling and migration properties
- No effect on the shade
- Good affinity for the fibre
- Stable to steaming and dry heat
- Improving overall fastness properties

<Technical Briefing> Dye Fixing

It is undesirable that dyestuffs exhibit a lack of wet fastness since the removed dyestuff may be absorbed by undyed textile material being washed in the same washing operation and, in addition, the dyed substrate does not retain its original shade. Textiles are sometimes treated after dyeing with a dye-fixing agent in order to improve the wet fastness of the dyed substrates.

Against this background Sarex has developed various dye-fixing agents, viz: Fixanol (Conc) and Saradye-FN for cotton; Nylofix-993 and Sarafix-NEW for polyamides. Below are the unique features of the mentioned dye-fixing agents, which meet the requirements of customers for improved fastness properties.

Unique features of Fixanol (Conc)/Saradye-FN:

- Fixanol (Conc) is concentrated and Saradye-FN is a ready-to-use dye-fixing agent
- Formaldehyde-free
- Improves washing fastness and water contact
- Does not affect the light fastness
- No effect on the shade of treated material
- Can be applied by exhaust as well as pad

Unique features of Nylofix-993/Sarafix-NEW:

- Nylofix-993 is a powder while Sarafix-NEW is a liquid dye-fixing agent for polyamide and its blends

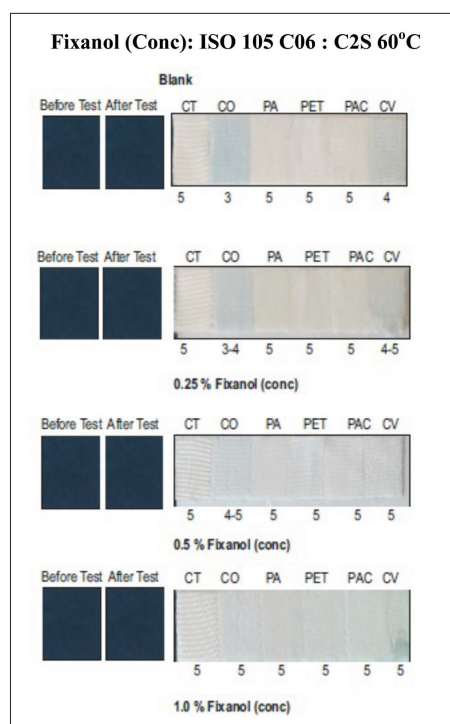


Figure 3: 6% Drimaren Navy X-RBL dyed cotton fabric dye fixed with Fixanol (Conc)

Application of Fixanol (Conc) and Saradye-FN on cotton fabric

Recipe	Fixanol (Conc)	Saradye-FN
Dosage	0.25, 0.5 and 1%	1 and 2 %
Bath pH	5.0 - 5.5	5.0 - 5.5
Bath Temperature	40°C	40°C
Time	20 min	20 min

Application of Nylofix-993 and Sarafix-NEW on nylon fabric

Recipe	Nylofix-993	Sarafix-NEW
Dosage	0.4, 0.6 and 0.8%	0.5, 1 and 1.5%
Bath pH	4.0 - 5.0	4.0 - 5.0
Bath Temperature	70°C	70°C
Time	20 min	20 min

- Improves wet-fastness properties
- Prevents cross-staining during washing-off of printed goods
- No effect on shade or light fastness of dyeing
- Low-foaming formulation, hence can be used in soft-flow machine

Reactive Red 141 (4% shade)
Lanaset Bordeaux 4B (3% shade)
TJ4 Scarlet Red (3% shade)

Experimental

Dyeing of cotton fabric was carried out separately with 6% Drimaren Navy X-RBL and 4% Reactive Red 141, whereas dyeing of nylon fabric was carried out separately with 3% Lanaset Bordeaux 4B and 3% TJ4 Scarlet Red. After the completion of dyeing process, the fabrics were subjected to dye-fixation treatment.

Below are the recipes followed for dye fixing on cotton and dye fixing on nylon fabric. To

Materials and Methods

Materials: Cotton fabric; nylon fabric

Chemicals: Fixanol (Conc), Saradye-FN, Nylofix-993, Sarafix-NEW

Dyestuff:

Drimaren Navy X-RBL (6% shade)

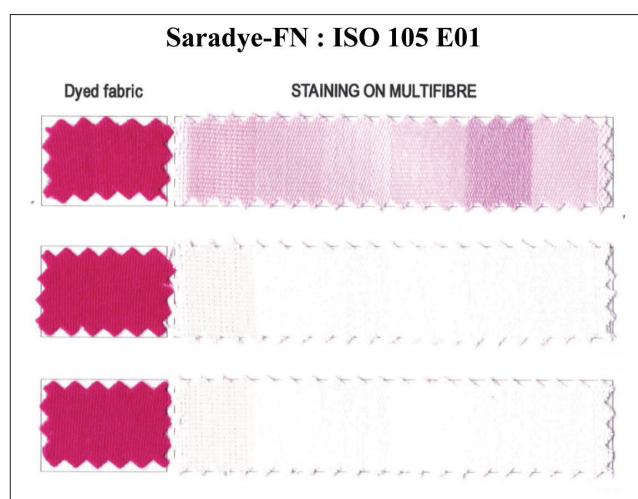


Figure 4: 4% Reactive Red 141 dyed cotton fabric dye fixed with Saradye-FN

study the efficiency of dye-fixing agents, the treated fabrics were subjected to washing fastness tests.

Evaluation of Fastness Properties

The efficiency of the dye-fixing agents was

analysed according to the test methods set out in the following standards:

- ISO 105 C03: Colour fastness to washing
- ISO 105 E01: Colour fastness to water
- ISO 105 C06 : C2S 60oC: Colour fastness to domestic and commercial laundering

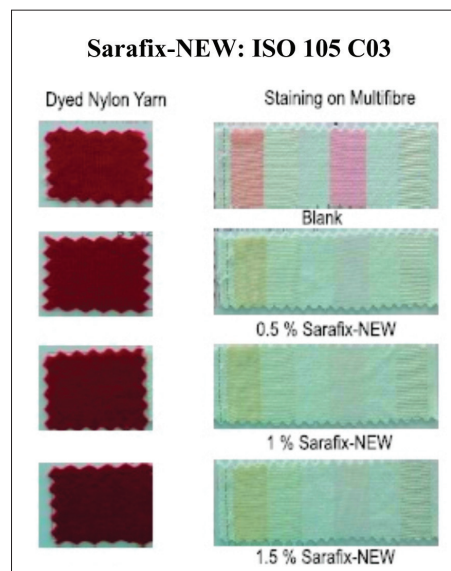


Figure 5: 3% Lanaset Bordeaux 4B dyed nylon fabric dye fixed with Sarafix-NEW

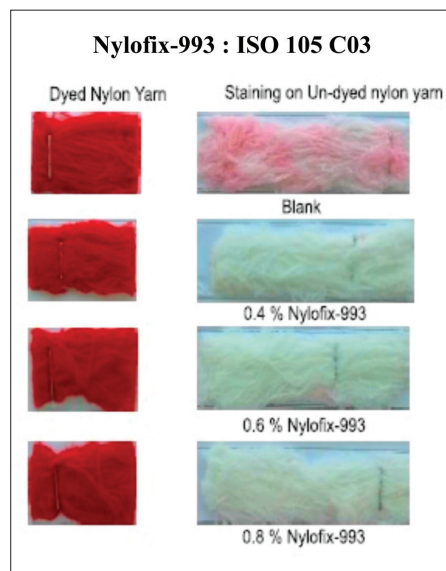


Figure 6: 3% TJ4 Scarlet Red dyed nylon fabric dye fixed with Nylofix-993

Results and Discussion

The results obtained are shown in Figures 3 – 6. Fabrics dye fixed with Fixanol (Conc), Saradye-FN, Nylofix-993 and Sarafix-NEW showed very slight staining on multifibre strip depending on the dosages used. None of the dye-fixed fabrics showed any shade change irrespective of the class of dye and concentration of dye-fixing agent used.

Conclusions

Fixanol (Conc) and Saradye-FN are non-formaldehyde based cationic dye-fixing agents for reactive and direct dyes. Nylofix-993 and Sarafix-NEW are novel dye-fixing agents for dyed and printed polyamide fabric. After-treatment with dye-fixing agents improves the washing fastness of the dyed fabrics. Cotton dyed fabrics treated with 0.25-1% Fixanol (Conc) and 1-2% Saradye-FN and Nylon dyed fabric treated with 0.5-1.5% Sarafix-NEW and 0.4-0.8% Nylofix-993 show very slight staining on the multifibre, thus signifying their utility in meeting the needs of the textile coloration market.

Continuous dyeing





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