Sarex

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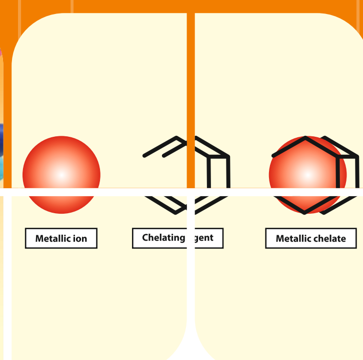
Saraquest

Exclusive Insight



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Chemistry Behind Good Feelings

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Sarawash-345 *- Low temperature washing off Agent*

Textile industry, the world's oldest branch of consumer goods industry, is severely intertwined with environmental issues, especially in its wet processes, where dyes, auxiliaries, and finishing agents are consumed to convert the raw materials into finished products.

The Textile industry is dependent on water in virtually all steps of manufacturing. The textile industry generally consumes massive amounts of freshwater for processing raw textile substrates in wet conditions, such as dyeing, printing and finishing. In India alone, the textile industry uses 425,000,000 gallons of water daily and approximately 500 gallons of water is used in the production of just one pair of jeans. At the same time, significant waste effluents are also generated. No matter which wet processes are applied, they cannot make full use of dyes and/or auxiliaries. Thus, some of these chemicals would remain in water baths and have to be disposed with the hosting baths, generating the highly-polluted wastewater.

By over viewing textile production processes, reactive dyeing for cellulosic substrates has been regarded as the most critical step contributing to the massive consumption of freshwater and also the discharging of waste colour effluents. Although reactive dyes have been developed drastically to fulfill requirements from different perspectives, the shortcoming of the low fixation rate onto fabrics has not yet been fully resolved. It was estimated that the effective utilization of reactive dyes could be as low as 40% of the initial dosage, which suggested that the remaining 60% of dyes may be present on fabrics by physical adsorption or in the dyeing bath in dissolved ionic forms. Regarding the residual dyeing bath containing most of dissolved ionic dyes, it will be disposed after appropriate treatments to reduce its adverse impact into the environment. For those unfixed dyes attached onto the fabrics, multiple rinsing processes are essentially required to strip the loose dyes from the wet fabrics. This hydrolyzed dye has to be removed after dyeing by thorough washing to ensure good washing fastness. This process is vital for the final quality of the dyeing., otherwise, these dyes will seriously decrease the colour fastness of the final product, which is highly likely to be rejected by the market consumers.

It is estimated that approximately half the cost of usual reactive dyeing may be attributed to the washing stage and the treatment of the subsequent effluent. The consumption of water in the final rinse is significant, as about 75% of total water consumption is related to the rinse. The extensive rinsing processes inevitably lead to a high consumption of freshwater, and meanwhile increases the volume of wastewater discharged. Thus, minimization of water usage is an urgent consideration in textile industry.

Reactive dyeing require a multi-step wash off process after dyeing involving various aqueous rinses and washing's, in order for the dyeing to achieve high wash fastness. This wash off and subsequent effluent treatment, to remove the resultant colouration pollution, can account for up to 50% of the total cost of reactive dyeing. Another extremely important sustainability consideration is the amount of water used in the wash off process where seven separate rinsing stages is not uncommon. High volumes of water and numerous repeated individual washes are often required to effect a dilution in electrolyte and alkali concentration in the wash off bath at various temperatures and as such using a high level of energy to bring the water up to the correct temperature.

The washing process, as far as reactive dyes are concerned, contains more complex factors than the washing process used with other group of dyestuffs. Normally, washing process includes first rinsing, washing, second rinsing, and drying step. Typically, soaps, such as phosphate-based detergents, are added during the washing step to assist in removal of unreacted reactive dyes. However, the liquid alkalis used during fixing have not been considered for use during soaping since they would not be expected to assist in excess dye removal. In addition, if the reaction mixture is too hot or alkaline, such as is seen with pure sodium hydroxide, the sensitive-type reactive dyes will hydrolyze with the water in the rinse bath and form a non-reactive pigment that has no effect on the fabric colour. Furthermore, phosphate and silicate based soaping agents are not accepted by European countries due to their bio-degradability issues.

Traditional washing methods cannot achieve the purpose of complete elimination of the unfixed dyes because of the substantivity between dyes and fibres. Some surfactants used in the traditional washing agents are forbidden because of their environmental pollution and toxicity. It is necessary to develop new washing agents to accord with environmental protection demand and that can strike a balance between the removal of unfixed dyestuff and prevention of re-deposition.

Role of washing-off agents in Reactive dyeing:

- Washing-off agents are necessary to remove the unfixed hydrolyzed dye from the dyed material.
- Washing-off agents disperse hydrolyzed dyestuff and keep them in the water bath, preventing their re-deposition on the substrate.
- Washing-off efficiency of dyes would depend upon the amount of unfixed dye and ease of removal of unfixed dye.
- Washing-off agent should facilitate the diffusion of unfixed dye molecules from the fibre into the water.

Need of Low temperature washing of agents:

Growing world population demands an increasing amount of fresh water and energy, therefore reducing the usage of these resources has been a hot topic lately. In the process of reactive dyeing of cellulosic fibres, there is a huge potential for saving energy and water in the wash-off process. Setting of a high temperature seems preferable for removal of hydrolyzed reactive dye, however, washed-off dyestuff often diffuses and penetrates into the yarn, resulting in re-adsorption and staining. The use of a special washing-off agent, capable of producing maximum effects in a quick strong soaping at a small bath ratio, while preventing re-deposition and staining of white ground regardless of rinsing temperature or any difference in process conditions, is considered most rational.

Keeping in mind the need of the dyer, Sarex has developed a product **"Sarawash-345"** which is low temperature washing-off agent. Sarawash-345 shorten and reduce the washing-off process during reactive dyeing to achieve good fastness ultimately reducing the time, energy and water against conventionally used washing-off agents.

Unqiue features:

- Low temperature washing off agent for Reactive dyed fabric.
- Achieves desired fastness results with no increase in chemical cost.
- Most suitable for Vinyl sulphone and Bi-functional Reactive dyes.
- Lower steam and power consumption.
- Reduces process time and increases productivity.
- Lower water consumption and effluent load.

Materials and Methods:

Materials	: 100% Cotton knits (RFD) Single jersey
Chemicals	: Sarawash-345
Reactive Dyestuff	: Reactive Black GDN, C.I. Reactive Red 180, C.I. Reactive Yellow 145

Experimental:

Reactive dyeing is carried out as per the standard recipes. After the completion of dyeing, the washing-off procedure was followed as given below:

Step wise process to be followed: (for MLR above 1:6)

After dyebath drain:

- Cold wash for 10 min. and drain.
- Warm wash at 50°C for 15 min. and drain.
- Neutralize with acetic acid, make bath pH 5.0-6.0, run for 5 min., raise temp to 60°C for 10 min. and drain.
- Warm wash at 50°C for 10 min. and drain.
- Treatment with 0.8% Sarawash-345 at room temperature for 20-30 min. and drain.
- Cold wash for 10 min. and drain.

Evaluation:

The washing-off efficiency of Sarawash-345 was evalauted by performing washing fastness test (ISO 105 C10) as per the standard test method.

Results and Discussion:

Fig.1 shows the drain baths of washing-off process with Sarawash-345. It can be clearly seen that upto neutralisation and warm wash step, their is considerable bleeding of unfixed dye however after washing the fabric with Sarawash-345, the drain baths are almost colourless.

8% Reactive Black GDN	6% C.I. Reactive Red 180 + 2% C.I. Reactive Yellow 145

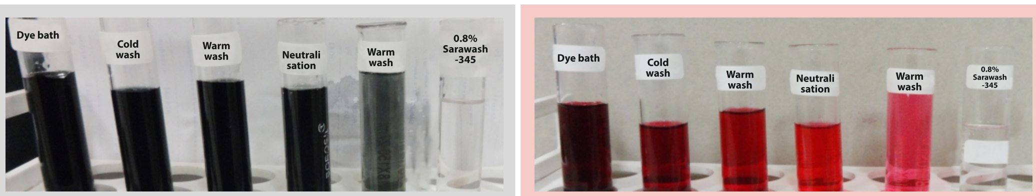
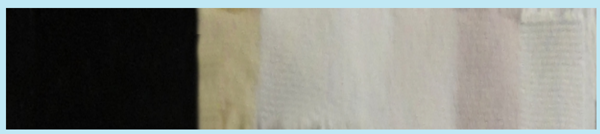


Fig.1 Exhausted bath after each washing-off steps

The fastness results as can be seen from Table-1 indicates that Sarawash-345 is an effective washing-off agent. Moreover, washing with Sarawash-345 is carried out at 40°C for 20 min unlike conventional process where washing process is carried out at 90-100°C resulting in the saving of energy.

Table 1: Fastness testing

Washing fastness : ISO 105 C10	
Samples	**Staining on Multi-fibre**
Blank	Sample WO PAN PES PA CO ACE 
0.8% Sarawash-345	
Blank	Sample WO PAN PES PA CO ACE 
0.8% Sarawash-345	

ACE : Acetate, CO : Cotton, PA : Nylon, PES : Polyester, PAN : Acrylic, WO : Wool

Conclusion:

- Sarawash-345 is a low temperature washing-off agent which effectively reduces washing-off process during reactive dyeing to achieve good fastness properties.
- Shows 20% saving in time thereby increasing the productivity; saving in water hence contributing in protecting the environment.
- These potential savings make Sarawash-345 process a highly recommended integral part of sustainable textile production.

Sarex

Polydye-CLC - *Polyester leveling agent*

Before the First World War, almost all dyes were applied from aqueous dyebath to substrates such as cotton, wool, silk and other natural fibres. However, the introduction of a manmade fibre, cellulose acetate, with its inherent hydrophobic nature, created a situation where very few of the available dyes had affinity for the new fibre. Disperse dye were invented to dye the first hydrophobic fibre. The development of disperse dyes for dyeing secondary cellulose acetate fibres in the early 1920's was a major technological breakthrough although their major use today is for the coloration of the most important group of synthetic fibres, Polyester. Disperse dyes have extremely low water solubility and to be applied from this aqueous medium they must be (i) dispersed in water using a dispersing agent and (ii) milled to a very low particle size (1-3 microns). These non-ionic hydrophobic dyes then can be used on acetate, triacetate, polyester fibres and their mechanism of fixation is by solid-solid solution. A fine dispersion is essential for rapid dyeing and avoids deposition of larger dye particles on the substrate.

Disperse dyes are substantially water insoluble dyes which have substantivity for one or more hydrophobic fibres and are usually applied as a fine aqueous dispersion. These dyes are milled or grounded with a dispersing agent (e.g. polymeric forms of sodium napthylmethane sulphonates) to a fine dispersion (0.5-2 μm) so that they can be supplied as grains, powders or liquid dispersions. Dispersion stability is of prime importance in exhaust dyeing since failure of the dispersion will result in agglomeration and possibly precipitation of the dye which in turn will result in unlevel dyeing and also dye will get deposited in machine. The property to dispersion failure is greatest in the case of HT dyeing hence additional dispersing agents are added to the dyebath which prevents agglomeration and crystallization of the dye and maintains dispersion stability.

The inclusion of dispersing agent in the dyebath is a crucial factor in the application of disperse dyes. Once the dispersing agent is added to water, its dual character results in the formation of micelle above critical concentration. Anionic products such as sulphonic acid salts of naphthalene/formaldehyde condensates and lignin sulphonates are widely used as dispersing agents. The hydrophobic group of the dispersant is adsorbed onto the surfaces of disperse dye particles. The sulphonate groups are solvated by the water with the formation of electrical double layer. Mutual repulsion of the negatively charged dye particles inhibits breakdown of the dispersion.

Leveling Agents:

Uniform and consistent dyeings is always a big challenge for the dye house. Even a modern process house equipped with the latest machinery and systems, face the problem of shade variation in the same lot or in between different lots of the same fabric due to innumerable variables such as fibre substrates, machinery, dyes, auxiliaries, procedures and the skill of the work force. Selection of dyes and chemicals is as important as machinery used in dyeing. The leveling characteristics of a dye while dyeing a substrate is generally governed by the exhaustion behavior during initial period of dyeing and migration of dye. If a dye has good migration properties, the unevenness caused during initial phase gets leveled out rapidly under dyeing conditions and a level dyeing is obtained. In other words, the leveling capacity of a dye is its ability to even out variations by the dye distribution in the substrate. In actual practice, the requirements of dyes with uniform exhaustion, diffusion and adequate automation with minimum supervision cannot be met by all the processing units and hence a range of leveling agents for different dye-fibre systems have been developed by the textile auxiliary manufacturers to meet the quality requirement. The primary objectives of using leveling agent in polyester dyeing is to obtain level dyeings with optimum colour value.

Dispersing agents are known to improve the leveling of disperse dyes on polyester fibres to certain extent under HT dyeing conditions by inhibiting the breakdown of dispersion.

Leveling agents can be nonionic or anionic surfactants or an anionic/nonionic surfactant blend. Dyeing levelness depends on the strike rate of dye and the extent of migration at the maximum dyeing temperature.

Hence, there are two fundamental mechanisms that can contribute to a level dyeing;

i. Equalizing the rate of exhaustion of the dye by forming dye-leveling agent complex
ii. Migration of the dye after initial uneven sorption on the fibre.

Nonionic agents appear to act by reducing the rate of the dye exhaustion. These compounds increase the solubility of the dye thereby lowering the initial strike rate and overall rate of dye uptake which can also cause a retarding effect that result in a loss of colour yield. Careful consideration must be given to the type and amount of nonionic leveling agent used owing to the often marked retarding effect exerted by these compounds on dye uptake. Anionic leveling agents, typically polycondensate dispersing agents, exhibit little if any retarding effect on dye uptake but can induce dye migration and functions by increasing the solubility of the dye hence retarding dye uptake. Irrespective of nonionic or anionic leveling agent, the complex formation is usually the same and as the temperature of the dye bath increases, the complex gradually breaks down, progressively releasing dye for more gradual sorption by the fibre.

Sarex has developed an innovative leveling cum dispersing agent **Polydye-CLC** for polyester dyeing. Polydye-CLC is recommended to control the rate of dye uptake under adverse conditions of dyeing to obtain level and uniform dyeing.

Unique features of Polydye-CLC:

- Works as dispersing cum leveling agent.
- Ensures gradual exhaustion of dye form dye bath.
- Improves migration of disperse dyes to achieve level dyeing.
- Does not affect shade.

Materials and Methods:

Substrate	: 100% Polyester fabric
Chemicals	: Polydye-CLC
Disperse dye	: C.I. Disperse Black 3, C.I. Disperse Blue 354

Experimental:

a) Dispersion behavior of Polydye-CLC

Dye solutions were prepared with 1g/l C.I. Disperse Black 3 in 300ppm hard water (CaCl2). The dye solutions were prepared with and without Polydye-CLC. The pH of dye solution was adjusted to 4-4.5 with acetic acid. Temperature of the dye solutions were raised to 130°C with the temperature gradient of 3°C/min for 20mins. The dye solutions were cool down to 80°C and filtered under vacuum using Whatmann filter paper-2 and Whatmann filter paper-4. The filter paper was evaluated to study the dispersion behaviour.

b) Migration behavior of Polydye-CLC

1gm dyed (2% C.I. Disperse Blue 354) polyester fabric was attached with equal weight of undyed polyester fabric and treated with and without 1-1.5g/l

Polydye-CLC at 130°C for 30min. The depth differences between dyed and undyed fabrics were determined and compared.

Results and Discussion:

Figure 1 shows that 1g/l Polydye-CLC shows uniform dispersion of the dye. Figure 2 and Table 3 shows 25-50% migration of dye from dyed to undyed fabric with good leveling behaviour indicating good migration property.

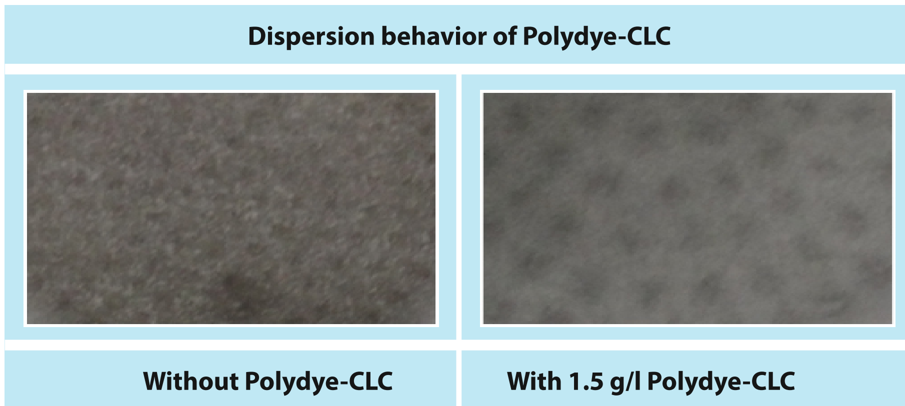


Figure 1: Dispersion behaviour of Polydye-CLC with C.I. Disperse Black 3

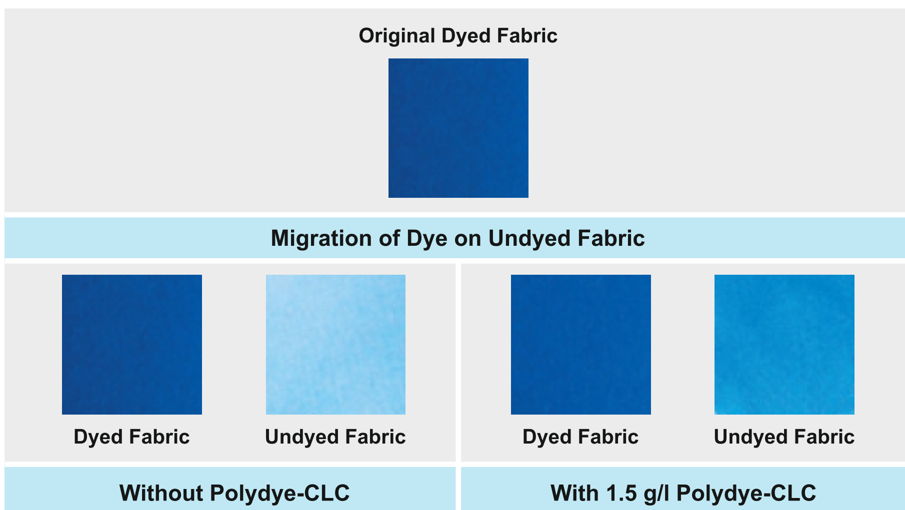


Figure 2: Migration behavior of Polydye-CLC with C.I. Disperse Blue 354

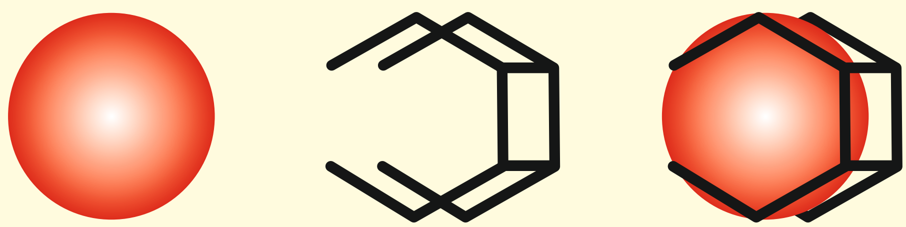
Table 1: Colour strength of dyed and undyed fabric with of Polydye-CLC

Samples	**Colourant strength (%)**	
	Initial	Migration of dye on undyed fabric
Untreated	100	8%
1g/l Polydye-CLC	100	25%
1.5g/l Polydye-CLC	100	48%

Conclusions:

The results indicates that 1-1.5g/l Polydye-CLC is an effective dispersing cum leveling agent for disperse dyeing.

Hiquest-AO *- Economical sequestering agent*



Sequestering agent is a textile auxiliary which is used during pretreatment, bleaching and dyeing to eliminate water hardness and heavy metals (impurities present in fibres which comes from fertilizers), such as calcium, iron, magnesium, copper etc. Sequestering agents combine with calcium and magnesium ions and other heavy metal ions in hard water. They form complex in which the ions are held so securely that they can no longer react.

The most undesirable impurities in Fibre, Common salt, Glauber salt, Caustic Soda and Soda ash are the di- and tri-valent cations, e.g., Ca^{++}, Mg^{++} Cu^{++}, Fe^{+++} etc. These ions increase hardness of the process bath and generate iron oxides in the bath. Calcium and Magnesium reacts with alkali and precipitates as a sticky substance on the textile material, which creates patchy dyeing and discoloration of the fibre.

To overcome these deleterious effects in the scouring and bleaching bath, adequate amount of sequestrant must be used. Sequestrants prevent di-and tri-valent metal ions, e.g., Cu^{++}, Fe^{+++}, Mn^{++}, Ca^{++}, Mg^{++} etc from interfering with the chemical processing of the textile material. It prevents catalytic damage of cellulosic fibres in bleaching bath during hydrogen peroxide bleaching.

The sequestering agent should chelate offending metal ions under the given condition and should form a stable complex, which does not decompose over a prolonged processing period.

Solution from Sarex:

Sarex has developed economical sequestering agent Hiquest-AO for scouring as well as bleaching of cotton and polyester/cellulosic blends. Hiquest-AO is also suitable as a dye bath conditioner.

Hiquest-AO has a high chelating action for calcium under alkaline conditions and high temperature. It prevents precipitation of insoluble hydroxides and carbonates which are formed due to alkali used in scouring and bleaching. Hiquest-AO is suitable for exhaust as well as continuous operation.

Unique features:

- High chelating efficiency for calcium.
- Suitable for processing with hard water.
- Good sequestering action under alkaline pH and high temperature.
- Suitable for scouring, bleaching and as dye bath conditioner.

Application:

Sr. No.	Application	Dosages required
1.	In scouring, bleaching as well as combined scouring and bleaching of cotton and blends by batch process	2.5-5 g/l Hiquest-AO can be added with usual recipe to prevent white deposits due to calcium. When Hiquest-AO is added in the recipe, concentration of organic stabilizer can be reduced due to stabilizing action of Hiquest-AO.
2.	For combined scouring and bleaching on continuous bleaching range	2.5-5 gm/kg Hiquest-AO is recommended
3.	For Dye bath conditioner	2.5-5 g/l Hiquest-AO is recommended

	Ca Chelation Value (mg $CaCO_3$/gm)
Hiquest-AO	150-200

Contact Us

501 - 502, Waterford Building, 'C' Wing,
C. D. Barfiwala Marg, Juhu Lane, Andheri (W),
Mumbai - 400 058, India.

N-129, N-130, N-131, N-132 & N-232,
MIDC, Tarapur - 401 506, India.

+91 22 6128 5566
+91 22 4218 4218

+91 22 4218 4350

www.sarex.com

tcexn@sarex.com
tcexp@sarex.com

CERTIFICATIONS

M & S	REACH	OHSAS 18001:2007	ISO 17025:2005	ISO 14001:2004	ISO 9001:2008	TWO STAR EXPORT HOUSE	GOTS