Sarex

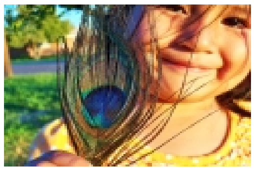
Vol. 6, Issue 24, October 2013

Saraquest

Exclusive Insight

Chemistry behind good feelings

Contents



REDUCTION CLEARING AGENT FOR POLYESTER

CLEARNON-GRE

Although synthetic fibres are the product of 2nd generation, in present global scenario, they are vastly employed in both apparel and non apparel sector. Among the synthetic fibres polyester is the most important and widely used due to its high strength, good elastic recovery, dimensional stability, abrasion resistance, resiliency, as well as suitability for blending with natural fibres.

Polyester is a term often defined as "long-chain polymers chemically composed of at least 85%by weight of an ester and a dihydric alcohol and a terephthalic acid". In other words, it means the linking of several esters within the fibers. Reaction of alcohol with carboxylic acid results in the formation of esters.

Polyester fibre is one of the important synthetic fibre. Polyester has high chemical resistance , high moth proofness , excellent wash and wear and permanent press characteristics. Polyester fabric when blended with cotton and wool , gives rise to high quality fabric. These unique properties make it the largest commodity fibre in the synthetic fibre world, thereby polyester production exceeds than both polyamide and polyacrylic fibres

Polyester fibres are hydrophobic and absorb very small amount of water and there is no significant change in their tensile properties in wet conditions. The moisture regain of polyester fibre is approximately 0.4 % at 65 % relative humidity at 20 ^{0}C. Polyester materials dries quickly because of their very LOW water absorption. Polyester fibres show outstanding resistance to damage by most common chemicals under ordinary conditions of exposure and a wide range of substances such as oxidizing and reducing agents

Disperse dyes are the most important class of dye used in dyeing polyester fibres and provide a wide range of hues with good build-up and fastness properties.The rate of dyeing may be raised to the level of commercial acceptability, either by raising the temperature to 130^{0}C, or by dyeing at the boil in the presence of an accelerating agent or 'carrier'. Disperse dyes can also be transferred to polyester by padding application and curing at temperature in the range of 190-210^{0}C.

High temperature exhaust dyeing is the most widespread method of batch coloration. The temperatures require pressurized equipment and impart increased diffusion of the dyestuff (and therefore increased rate of dyeing) by reducing cohesion between polymer chains and increasing the kinetic energy of the dye molecules. The three main phases of the process includes the heating or adsorption phase (from 60 ^{0}C – 125 ^{0}C) and at 130°C diffusion and migration for 20-30min followed by reduction clearing process.

Disperse dyes have limited solubility in water therefore unfixed disperse dyes remains on to the fibre surfaces after dyeing, which will considerably reduces wet fastness, sublimation, dry cleaning fastness as well as dulling of the shades

These dyes particles have to be removed from the surface as it will considerably results in:

- Poor wash fastness
- Poor sublimation
- Reduced dry-cleaning fastness
- Dulling of shade
- Cross staining in case of polyester blends

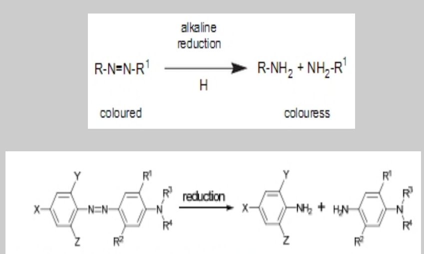
In order to remove unfixed disperse dye conventional reduction clearing is carried out with caustic & hydros (Sodium dithionate) at 70°c for 10-20 mins.

The treatment with caustic & hydros often sufficient to clear the fibre surfaces but the ease of removal varies from chromopore of the dye.

Most of the disperse dye contain the azo group(–N=N–). This group easily gets decomposed into amino groups on treatment with caustic & hydros as a reducing agents. Generally reduced amino residues are colourless to light colour depending upon the chromophore of dye. Disperse dye also contains anthraquinone type of chromophore which is difficult to reduce and is not destroyed during normal reduction clearing treatment but it changes into soluble sodium leuco form of anthraquinone which can be subsequently washed away.

Research indicates that the polyester dyer will typically reduction-clear in the range of 30-50% of production shades and sometimes an even higher proportion in blend dyeing. Minimizing the need for reduction-clearing can lead to substantial productivity improvements and water and chemical savings as well as a reduction on the effluent load and should be a key objective in implementation of a rapid dyeing approach for polyester.

Reaction during Reduction Clearing with hydros



Chemical reaction during reduction clearing

Drawbacks of sodium dithionite :

- Can produce sulphite and sulphate
- High concentrations of sulphate can cause damage to unprotected concrete pipes.
- Toxic .
- Unpleasant odor.
- Corrosion of the effluent drainage system.
- Damage to the treatment works and the often associated high pH

In order to overcome drawbacks of caustic & hydros, Sarex has developed eco-friendly clearing agent Clearnon-GRE for removal of unfixed disperse dyes from dyed polyester fabrics

Unique Feature of Clearnon-GRE

- No obnoxious smell and no sulphur present and product is eco-friendly.
- It works under mild alkaline to acidic conditions thereby reduces TDS
- A separate neutralization step is not require as against caustic & Hydros.
- It reduces time as after dyeing in the same bath Clearnon-GRE is added
- Saves water, energy & time.

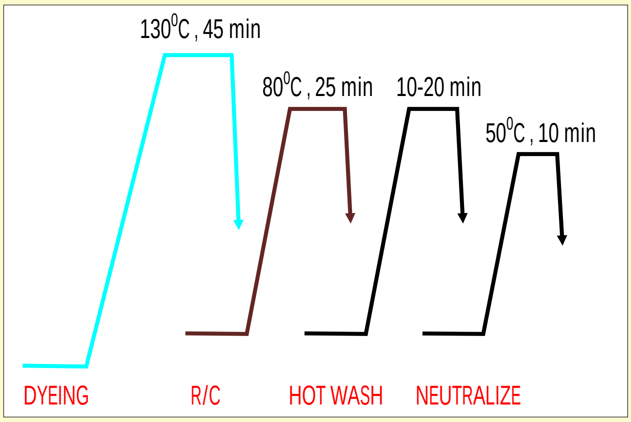
Application:
For medium depth of shade
Clearnon-GRE : 0.5 - 1.5 g/l

For deep shades
Clearnon-GRE : 1.5 - 2.5 g/l
After treat for 10-20 mins at 70-80°C, rinse hot and cold.

Benefits of using Clearnon-GRE:

1. Reduction clearing can be done in same dyebath with Clearnon-GRE.
2. Eco-friendly process.
3. Saves water, energy and time.

a) Reduction Clearing Conventional Process (2 g/l Caustic & 2g/l Hydrosulphite)



b) Reduction Clearing by Clearnon-GRE

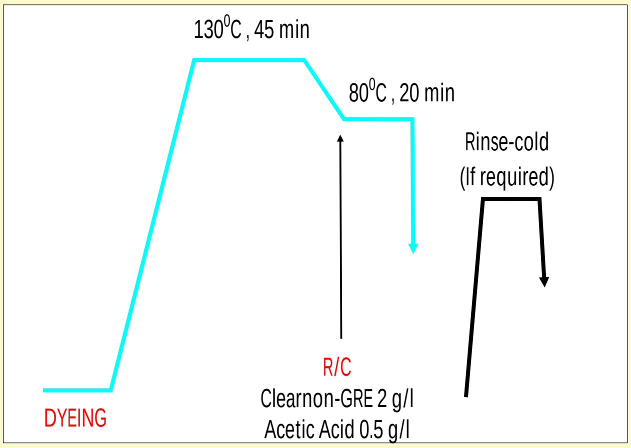


Fig 1 : Process flow diagram of Dyeing of polyester followed by Reduction clearing with a) Conventional method b) 2 gpl Clearnon-GRE

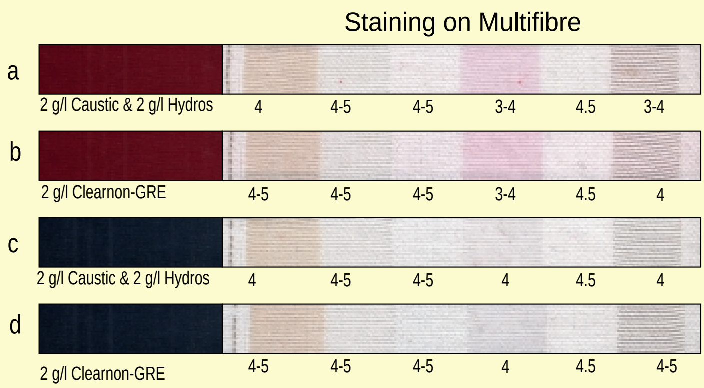


Fig 2 : Wash fastness rating on Multifibre with Clearnon-GRE (ISO 105 C06 C2S)
a) Maroon shade (conventional R/C) b) Maroon shade(R/C with Clearnon-GRE) c) Dark Navy shade (conventional R/C) d) Dark Navy shade (R/C with Clearnon-GRE)

Study of Clearnon-GRE against Conventional Method

Maroon and Dark Navy depth of shades were used for study .

Dyeing of polyester fabric was carried out at pH 4.5 , 130°C for 45 min.

Reduction Clearing:
Reduction clearing was carried out as per process shown in fig 1a(Conventional) and Fig 1b (With Clearnon-GRE)

Washing Fastness: The washing fastness was evaluated by **ISO 105 C06 C2S** (Fig.2)

Fig.2 Indicates that washing fastness of fabric treated with Clearnon-GRE is comparable to caustic and hydros for both the shade studied.

REACTIVE DYEFIXING AGENT FOR COTTON : FIXANOL-CONC

Cotton known as the king of fibres accounts for more than 50 % of fibres usage in textiles both for apparel and non-apparel purpose. Several classes of dyes can be used to dye cellulosic fibres, namely direct, vat, reactive and sulphur. The choice of dye class used depends on factors such as their cost , ease of application and fastness properties.

Reactive dyes furnish a broad gamut of shades with good light and excellent wash fastness on cellulosic fibres, thus are widely used to dye cellulosic fibres. The main drawback is that it can react not only with the fibre but also with water present in dyebath and forms a hydrolysed dye. In order to remove unreacted & hydrolysed dye from fabrics, it is subjected to several washing off treatments or dyefixing agent are applied for fixing of dyes. Although, washing off process is most preferable but it is costly and time consuming than dye fixing of reactive dyed materials.

From 1930 onwards, cationic dye fixing agents have been fully exploited to complex dyes for improving fastness of dyed fabrics. However, these were primarily based on formaldehyde condensation resin products and it is seen that fabrics treated with these products release formaldehyde into the atmosphere directly or during processing and release formaldehyde fabrics/garments. Formaldehyde causes allergic reactions to skin on contact, demand for non formaldehyde based fixing agents increased. However, because of the health problems associated with formaldehyde there is a market demand for non-formaldehyde dye fixing agents. Use of fixing agents on reactive dyed goods lead to improvement in contact water and wash fastness. The extent of improvement will depend on the dye and depth of shade.

Sarex has developed concentrated non – formaldehyde dye fixing agent Fixanol (conc) for reactive dyes.

Unique features of Fixanol (conc)

- Ecofriendly, formaldehyde free.
- Improves washing fastness and water contact.
- Does not effect either light fastness or the shade of treated material.
- Can be applied by exhaust as well as pad.

Application:

Exhaust application

After thorough soaping to remove hydrolyzed reactive dyestuff from dyed or printed material, treat in a fresh bath with:

Fixanol (Conc) = 0.5- 2 %
pH = 5 -5.5
Temperature = 40°C for 15-30 min.

Continuous application:

Fixanol (Conc) = 5-20 g/l

In padding alone or with other finishing chemicals or on continuous soaper in last chamber, pH 5-5.5 with acetic acid, at 35-40°C.

Washing fastness study of dye - fixed fabric.

The fabric was dye fixed with Fixanol (conc)by exhaust application at 0.4 % and 0.8 % concentration , pH- 5- 5.5 , M:L 1: 10 , Temperature 40 ^{0}C for time – 30 minutes

The dye-fixed fabric was evaluated for fastness by ISO 105 C03 and E01(Fig 1)

Fabrics dye fixed with Fixanol (conc) shows no staining to very slight staining on multifibre depending on concentration.

Shade variation study of dye fixed fabric

Cotton fabrics were dyed with various class of reactive dyes and then dye fixed with Fixanol (conc). The shade change were determined.

All the dye fixed fabrics do not show any shade changes irrespective of classes of dyes and concentration of Fixanol (conc) (Table 1-4)

Fig 1 Washing fastness by ISO 105 C03 &E01

FN Class	1.5 %Cibacron Yellow FN2R + 1.5 %Cibacron Red FNR + 1.5 % Cibacron Blue FNR			
Dye Fixing Agent	Strength	DE	Da	Db
Soaped Sample	100	-	-	-
0.25 % Fixanol(Conc)	104	0.480	0.096	0.293
0.5 % Fixanol(Conc)	102	0.287	0.136	0.173
1.0 % Fixanol(Conc)	105	0.719	0.349	0.010

Table 1 Shade changes and colourant strength of fabric dyed with Cibacron FN dyes

ME Class	1 % Yellow F3R + 1 % Red F3B + 1% Blue BRF			
Dye Fixing Agent	Strength	DE	Da	Db
Soaped Sample	100	-	-	-
0.25 % Fixanol(Conc)	103	0.386	-0.270	0.037
0.5 % Fixanol(Conc)	104	0.566	-0.264	0.067
1.0 % Fixanol(Conc)	101	0.321	-0.191	-0.261

Table 2 Shade changes and colorant strength of fabric with ME Dyes

Vinyl Sulphone Dyes	1.0 % G.Yellow RNL + 1.0 % Blue BB + 1.0 % Red CRBL			
Dye Fixing Agent	Strength	DE	Da	Db
Soaped Sample	100	-	-	-
0.25 % Fixanol(Conc)	104	0.651	0.352	0.375
0.5 % Fixanol(Conc)	104	0.559	-0.026	0.215
1.0 % Fixanol(Conc)	104	0.631	-0.239	0.255

Table 3 Shade changes and colorant strength of fabric with Vinyl Sulphone Dyes

HE Class	1 % Yellow HE4R + 1 % Red HE3B + 1 % Blue HERD			
Dye Fixing Agent	Strength	DE	Da	Db
Soaped Sample	100	-	-	-
0.25 % Fixanol(Conc)	101	0.230	0.033	0.163
0.5 % Fixanol(Conc)	102	0.320	0.259	0.016
1.0 % Fixanol(Conc)	102	0.629	-0.017	-0.477

Table 4 Shade changes and colorant strength of fabric with HE Dyes

ACID DONOR FOR POLYAMIDE : ACIDON PA

Polyamide is the first commercially successful synthetic polymer. It is condensation co-polymer formed by reacting diamine and dicarboxylic acid. The fibre has outstanding durability and excellent physical properties. The amide group forms hydrogen bonding between polyamide chains, imparting high strength at elevated temperatures. The polyamide fabric has good strength, compact molecular structure, resistance to sunlight, softer hand, higher melting point, excellent abrasion resistance.

Polyamide fibres have been conventionally dyed using acid and metal- complex dyes by polyamide is temperature – dependent. The fibre takes up the dye at temperatures above the glass transition point at which the segments in the polymer chains become more mobile at higher temperatures. The fibres open and allow the dye , which attracted to the positive charge on the amino end groups in the fibre to penetrate the polyamide. The dye is then bonded to the fibre through intermolecular forces.

At the end of dyeing process, a thermodynamic equilibrium is established between the dye dissolved in the liquor and the dye diffused into the fibre. Incase of polyamide dyeing with metal complex / acid dyes , the two types of processes are used viz. constant pH process and sliding pH process .

During dyeing of polyamide, the polyamide materials are placed in a dye bath initially containing an acid dye and an acid donor sufficient for dye exhaustion. When the dye bath temperature is increased the pH gradually reduces and allow dye diffusion of dyes.

Ideally , the pH of the bath is dropped at a rate which causes the dye to slowly diffuse into the polymer substrate . if the pH can be effectively controlled , the dye becomes evenly distributed throughout the bath and substrate and is absorbed by the substrate uniformly which ensures uniform and reproducible shade against as against the rushing of dyes in a conventional system. Although the pH – sliding takes longer and require s buffer and a control unit , it has proved effective , especially for shades where it is difficult to achieve level dyeing . The process also improves reproducibility because it raises bath exhaustion.

Specifically, increasing the temperature of the dye bath increases the diffusion rate, while controlling the pH controls the number of dye sites that are available for receiving the acid dye. At higher pH's, the dye is not readily accepted by the polyamide fibre. At lower pH, equilibrium shifts and the dye becomes strongly attracted to the polymer.

Features and advantages of sliding pH process against constant pH process

- Constant pH process ensures dye exhaustion onto the substrate by raising the temperature while sliding pH process achieves exhaustion by combination of raising temperature and reducing pH .
- Incase of constant pH process suitable dyes with good compatibility is required and /or auxillary to improve the affinity of the dye . while in case of sliding pH system irrespective of the type of dye we will achieve uniform dyeing.
- In constant pH process rate of bath exhaustion increases but the migration and diffusion requires longer time. In case sliding pH the exhaustion is controlled thus , migration and diffusion requires less time.
- The critical temperature range depends on the pH and in case of sliding pH process critical range temperature is higher than for the constant pH process .
- A higher rate of heating upto the critical temperature range can be used for sliding pH system than when using constant pH process , thus reducing total process time.

Sarex has developed a unique acid donar – Acidon – PA

Acidic pH is obtained with increase in temperature unlike conventional buffer which maintained pH irrespective of temperature. Acidon - PA is used for dyeing of polyamide ,wool and their blends with acid dyes.

Unique feature of Acidon-PA

Robust technology with low maintenance required

User Friendly and can be dosed

Application :

Dyeing of polyamide

Acidon – PA : 0.1 – 0.5 g/l

Table : 1 results of bath pH at different temperatures and concentrations

Concentration	pH of bath at different Temperature (Initial pH of bath 7.5)					
	Room Temperature	50 °C	70 °C	90 °C	90 °C/ 15 min	90 °C/ 45 min
0.1 g/l Acidon-PA	7.55	6.97	6.22	5.89	5.28	5.1
0.2 g/l Acidon-PA	7.5	6.9	6.62	5.43	4.67	4.59
0.5 g/l Acidon-PA	7.54	6.74	6.29	4.73	4.3	4.26

Fig 1. pH versus temperature at various concentration of Acidon – PA

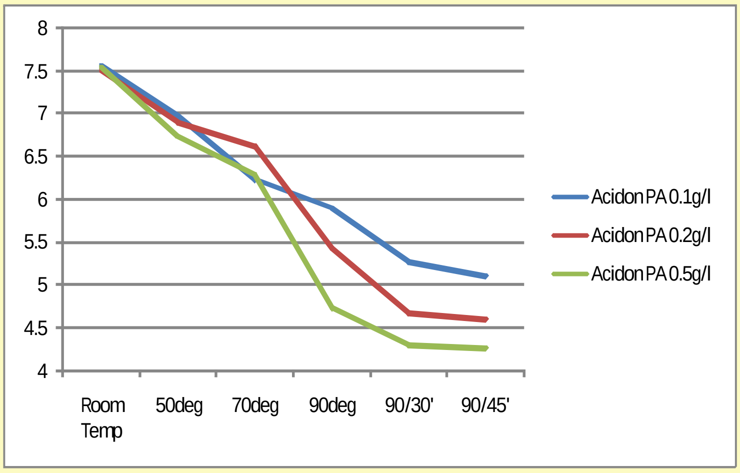


Table 1. indicates that initial pH 7.5 with increase in temperature to 90 °C for 30-45 minutes reduces to pH 5.28 , 4.67 and 4.3 at 0.1g/l ,0.2g/l and 0.5g/l respectively , which is required for the dyeing of polyamide.

HYDROPHILLIC SILICONE SOFTENER HYDROSOFT-142

Softeners have gained great importance in textile finishing; almost no piece of textile leaves the production facilities without being treated with a softener. This softening treatment is to give the textiles the desired handle, A nice, soft handle is often the decisive criteria for buying a textile and is therefore of most vital importance for marketing textiles.

Silicones permits unmatched effects such as softners, hydrophilicity, body to mention just a few. The silicone softeners generally consists of linear aminopolydimethylsiloxanes. Basic units differ in the chain length, the number of functional side groups and the chain ends. The amino functional side groups results in optimum distribution of the silicone on the fibre surface and thus ensures maximum softness. Amino functional silicone fluid impart a soft hand much more effectively than their methyl counter parts or silicone with caboxyl or epoxy group. Addition of polyglycol chains, pyrrolidone groups imparts hydrophilicity. Hydrophilic silicones differ from conventional silicone by greater compatibility with aqueous system.

Functional textiles have to meet ever higher demands. A good towel should be both extraordinally soft and hydrophilic. The same applies to modern clothing textiles: the wearer expects a soft hand combined with optimal moisture management. Nowadays, no consumer will wear a garment which doesn't feel good because it scratches or rubs,due to less softness, although offers perfect hydrophilicity.

The trend in modern textile finishing is definitely toward softness and hydrophilicity – a combination can achieved by right type of silicone softener.

Generally silicones show no affinity towards water. But chemical modification of polydimethyl siloxanes to epoxy and glycol makes it water loving. Also softness and hydrophilicity are at two extreme ends. If we increase softness, hydrophilicity decreases.(Fig. 1)

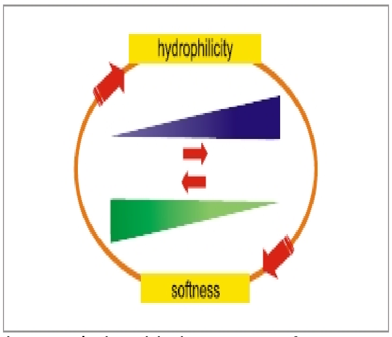
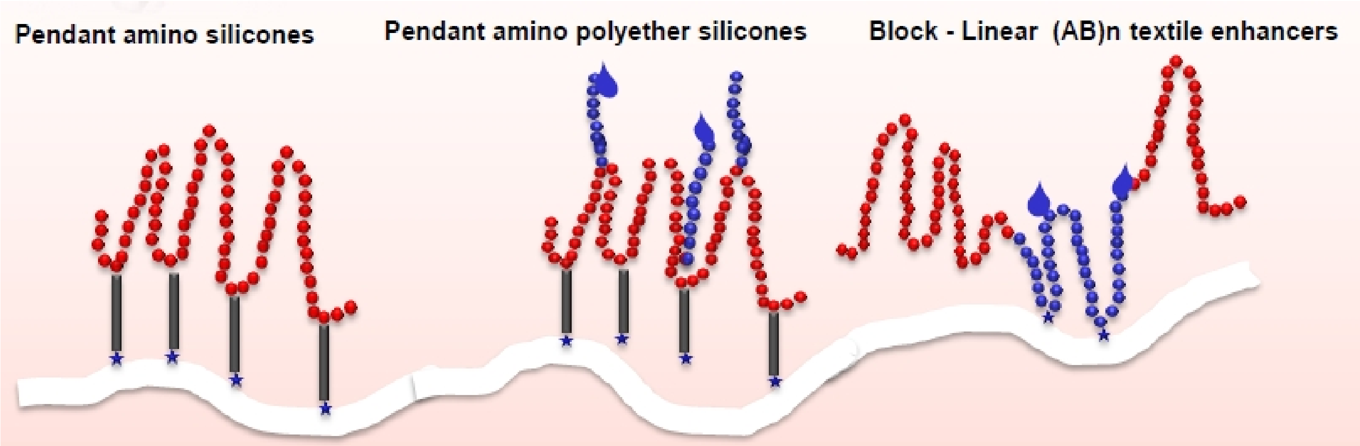


Fig 1. Relationship between softness & hydrophilicity

A unique combination of long chain silicones and polyether glycols gives rise to extremely flexible chains which imparts soft handle coupled with hydrophilicity.

Sarex has developed a new generation hydrophillic micro polysiloxane softener Hydrosoft-142. which combines and optimally balances softness and hydrophilicity.

Fig.2 Relationship between structure and properties of silicons



Polymer strongly fixed on fiber surface
Very high wash fastness
Old technology

Hydrophilic moieties far away from fiber surface.
It is not the best way to get hydrophilicity

Hydrophilic segments directly attached to fiber surface
Very high hydrophilicity.
Silicon segments exposed and far away from fiber surface so got very soft feel
Forms surfactant-like structure results in good stability.

Unique feature of Hydrosoft-142

- It gives inner softness and outer smooth surface.
- It is suitable for exhaust as well as pad application.
- Applicable on terrytowels, cotton knits and woven fabric.
- Fabric finished with Hydrosoft-142 leads to soft, hydrophilic finish.

Application:
Exhaust application
Hydrosoft-142 : 2-4 %

pH 5.5 - 6.0, Temp - 35 to 40°C, treat for 20-30 mins.

Pad application
Hydrosoft-142 : 20-40 g/l
pH 5-6, pad with 65-70 % pick up, dry at 140-160°C.

Sarex

Sarex Chemicals
Sarex Overseas

Want to know more ?

Sarex Chemicals

CORPORATE OFFICE :
501, Waterford Building,'C' Wing,
C. D. Barfiwala Marg, Juhu Lane,
Andheri (W), Mumbai - 400 058, India.
Tel.: (91-22) 6128 5566
Fax : (91-22) 4218 4350
E-mail : sales@sarex.com
Web : www.sarex.com

PLANTS : N-129, N-130, N-131, N-132, N-232,
M.I.D.C., Tarapur - 401 506, India.

GOVT. OF INDIA

ISO 9001:2008 CERTIFICATION | M & S ACCREDITATION | OHSAS 18001:2007 CERTIFICATION | REACH PRE-REGISTRED | ISO 14001:2004 CERTIFICATION | GOTS CERTIFICATION | STAR EXPORT HOUSE

C E R T I F I C A T I O N S