COVER STORY

PROCESSING OF FLAME-RETARDANT TEXTILES IN INDUSTRIES

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The term flame retardant is used to describe fabrics which will not support combustion and are self-extinguishing. Fabrics of this type, when involved in an accidental fire would not contribute to spreading the flames. Other descriptions, such as flame proof, fire proof and flame resistant, are either meaningless or misleading. Nearly all fabrics are combustible to some degree. The rate of burning ranges from that of guncotton (nitrocellulose), which burns so quickly that it produces an explosion, to that of asbestos, which is virtually unaffected by fire.

Flame retardant fabrics can be produced in two ways.

1. by making them of fibres which do not burn.

2. by chemically treating the fibres to produce the desired effect.

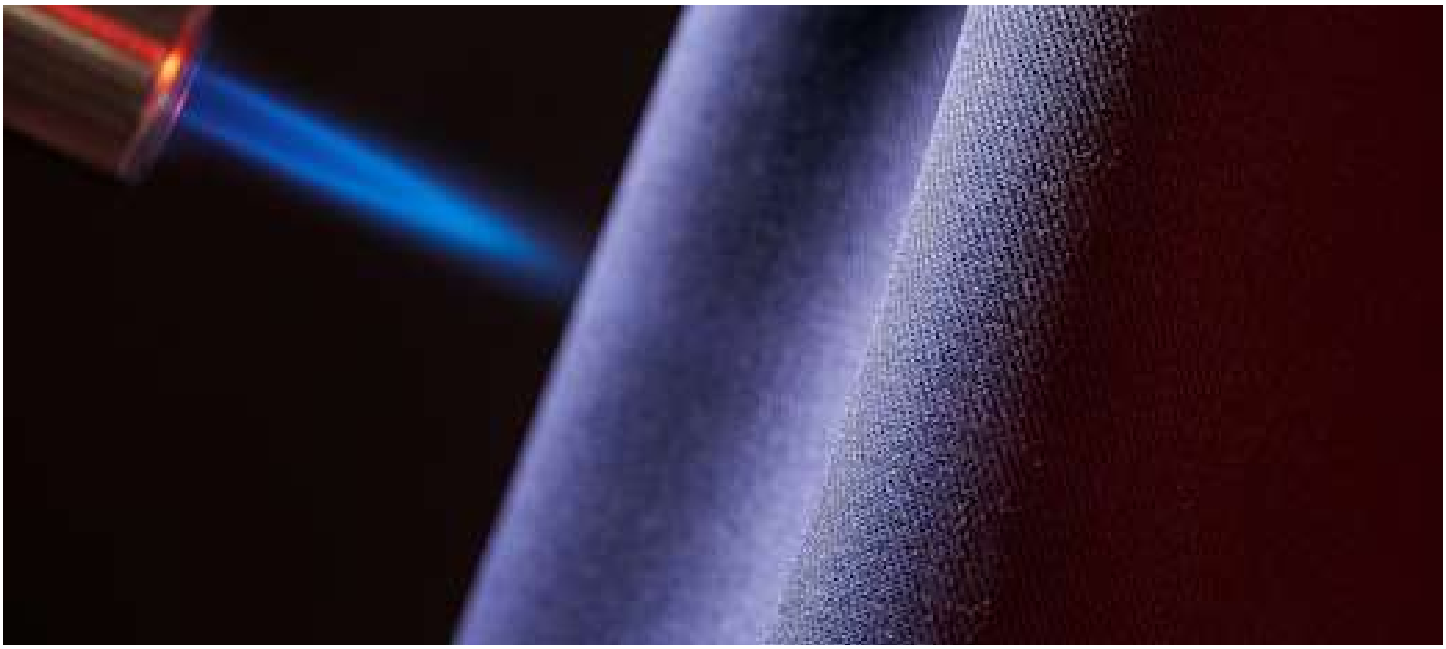
There was a time originally when such materials could only be produced by employing a chemical finish. However, this can often cause problems in terms of durability of the process and its impact on the environment. Strict controls are required to achieve consistency and problems arise likewise with the final look of the material. Even where the flame-retardant quality is guaranteed over a certain number of washes, there can be no certainty of the effectiveness of the procedure, as it is practically impossible to monitor the number of washes in practice.

All such difficulties are avoided by the use of permanently modified chemical fibres. The polymer was invented in 1974. The development of staple fibres and filament took place in 1976-79. It was introduced in the USA in 1979 and Europe in 1980. The permanent flame-retardant properties were due to the organic phosphorous compound incorporated into the polymer chain. As it was a low-level modification the textile properties of the polymer remain unchanged. Fire Retardant polyester fibre came to India by Hoechst AG, Germany by the trade name of Trevira CS (CS stands for Comfort and Safety).

From the outset there was also a large role for home textiles; today the most important sector for Trevira. The product range extends from drapes, decorative and upholstery fabrics to carpet fibres. Yet here too, the portfolio began to change towards specialities early. In 1980 one such was Trevira CS, a flame retardant fibre, which from its launch recorded ever-rising growth rates and is today the star product of the company. With over 1000 flame retardant Trevira CS fabric collections for the home textiles sector worldwide, Trevira is the market leader in this segment. Since then, the range of flame retardant fibres and yarns has undergone a steady flow of changes and innovations. In 2004, Reliance crossed another milestone in its polyester journey when it acquired Trevira GmbH, an erstwhile division of the German giant Hoechst AG, a leading producer of branded polyester fibres in Europe.

Specific moisture absorption of Trevira is around 0.4% at 20 deg C and 65% RH. It can however be made considerably higher by the hydrophilic surface of the material and the capillary effect between the fibres. Moisture penetration is very high, thus releasing humidity, something very important for instance for sitting comfortably. Trevira CS has been tested to German, American and Japanese health standards and being adjudged non-toxic, not allergenic or mutagenic and non-irritant. The Eco-Tex 100 test confirms that Trevira CS is free from harmful substances. Trevira CS has three flame retardant mechanisms like it melts away from the flame, absorbing ignition energy. Flame retardant groups quench reactive species, chain reaction cannot propagate. The polyester modification created by Trevira performs a very important function. Within a flame, highly charged elements called radicals are released which rapidly propagate more flames. The Trevira modification captures and neutralises the radicals before they can propagate more flames. Trevira belongs to the polyester group of fibres, which are rendered permanently flame-retardant by the inclusion of a small proportion of a phosphorous-organic component. They display all the typical properties of polyester fibres and offer industry and consumer considerable advantages. Hoechst (Germany) gave the licence only to Rajasthan Spinning and Weaving mills, Gulabpura (Rajasthan) to use this fibre in India. Trevira supplies 100% Trevira flame retardant fibres or filament yarns.

Trevira CS fabrics are made from flame retardant fibres and used therefore in the home textile and contract furnishing sectors. They are flame retardant to all appropriate fire protection requirements and produce only slight amounts of smoke fume. For the first time, the flame retardant qualities combine with bioactive properties to also provide safety from microbes. These qualities are not lost by cleaning, ageing or wear. Trevira CS is easy care, light, fast, comfortable and kind to the skin. Trevira CS is used in hotels, and hospitals, offices and event rooms and principally where people are traveling on aircraft, buses on



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trains and at sea.

The following are the advantages of using Trevira:

1. Outstanding running properties in spinning and twisting.

2. Very good processability, high yarn uniformity and tenacity for weaving, circular and warp knitting.

3. Excellent dyeability using a variety of methods, environmentally friendly finish processes giving crease resistant fabrics with good shape retention.

4. Good hard-wearing properties.

5. Easy-care.

6. Outstanding light fastness.

7. Permanent flame retardance.

The following are the processes involved in making fire retardant textiles:

1. Spinning
2. Bleaching.
3. Dyeing.
4. Finishing.
5. Printing.

The above processes are discussed as below.

1. Spinning - It is classified into two types:

a. Grey CS yarn

b. Dyed CS yar

Grey fibre is normally available in 1.4 D x 44 mm. The spinning is done in the same manner like 100% normal polyester fibre. The process is as follows:

Blowroom - Carding - Draw frame – Simplex - Ringframe – Winding – TFO – Packing .

The grey yarn goes for weaving and making of soft package for yarn dyeing.

Secondly, the dyed fibre is received from dyehouse. The dyed fibre is sprayed with LV 40 and 2152P and conditioned for 16 hrs. Then it follows the similar route in spinning as prescribed for 100% dyed normal polyester fibre. The dyed yarn is sent to weaving /knitting

Flame retardant Trevira CS spinning yarns can be used in any spinning process, resulting in outstanding with ring spinning, OE–rotor and airjet spinning, as well as with carded yarns and worsteds. A variety of effects is possible for which the product range includes dull, semi-dull and bright types. Extremely fine three-cylinder yarns are used in delicate fabrics, decorative materials and bed linens.

The OE–rotor yarns with a flat, soft structure form the basis for decorative fabrics, vertical blinds and mattress materials. The current demand for soft, transparent and bright yarns is particularly met by filament yarns of the high-capillary type for drapes and decorative fabrics. Degree of fineness range from 50 dtex with delicate goods through to 3000 dtex for cover fabrics with high wear and light fastness properties. With false twist yarn one can achieve light but bulky weaves.

The wide range of fire-retardant Trevira spun yarns enables spinners to offer complete collection of yarns. They have a quality which is not only ideal for their purposes but is fire-retardant as well. The range comprises degrees of fineness for practically every application; from the finest (1.3 >1.7 dtex) for delicate fabrics right through to the extremely coarse (13 dtex) for carpets.

2. Bleaching - Bleaching is not required prior to dyeing of dark and medium shades. It is almost white. But in case of clear and pastel shades bleaching with peroxide is required prior to dyeing.

3. Dyeing - There are four types of dyeing.

a. Filament yarn dyeing.

b. Spun yarn dyeing

c. Loose staple fibre dyeing.

d. Fabric dyeing.

a. Filament yarn dyeing- normally 165 dtex is used in filament dyeing. Soft package of 700-800 gm is made on perforated polypropylene tubes by precision soft winding machine having overfeed attachment. Then it is dyed in HTHP Dyeing Machines at temperature of 120 deg C for 30-45 min depending on shades.

It is Hydroextracted in Dettin package Hydroextractor. It is dried in RF Dryer. It is rewinded on paper cone. The dyed package goes for Weaving or Knitting. The principal applications for flat yarns are in curtains and decorative fabrics, irrespective of whether these are false twist, jet –tax, jet-tweed, multicolour or chenille yarns. A further possibility involves use of texturised filament yarns, where a very wool-like character can be achieved with specially air-textured types for furniture fabrics.

b. Spun yarn dyeing- Similarly spun yarn is made in various counts ranging from 2/5, 2/8 ,2/12, 2/20, 2/24, v2/30, 2/50.Then soft package is made on PS Mettler or SSM winding machines. Package weight is 900 gm to 1 kg. It is loaded in HTHP dyeing machines. It is dyed at 120 deg C. The rest process is as above. An even wider range of design perspectives is opened up by combining filament and fibre yarns. Employing fancy yarns, such as knit-deknit types, produces striking designs. Jet-tex and tweed types are mainly used as upholstery and decorative material and as wall coverings.

c. Loose staple fibre dyeing - Normally 1.7 d x 44 mm Trevirs CS fibre are available for dyeing. The CS fibre is loaded in the carrier. Then the loaded carrier goes into the HTHP Dyeing Machines. It is dyed at 120 deg C at a pH of 4-5. with a leveling agent like Lyogen DFT (of Clariant) is added. Dark shades are reduction cleared with Caustic Soda and Sodium Hydrosulphite. (1 gpl and 2 gpl respectively) . Then hot wash at 85-90 deg C. Then acid neutralised by acetic acid. Then Antistatic Agent Sapcotex F (Henkel)– 0.4 % (o w g). Then the carrier is offloaded. The dyed fibre goes for Hydroextraction . Then it is dried in RF Dryer / Steam Dryer.

Total dyeing time takes about 4-4.5 hrs.

With a 40 deg C wash there are no discernible differences between normal polyester and Trevira CS fibres. At 60 deg C with the same dyeing similar values are achieved on flame retardants as on non-modified types.

d. Fabric dyeing – Trevira CS fabric is dyed in jet dyeing machines. The process is followed as above. After dyeing it is squeezed and dried in stenter at a lower temperature of 140 deg C to 150 deg C. Dispersion dyes take on fire–retardant somewhat faster than the corresponding normal polyester types. Due to these light shades can be dyed at boiling temperature without adding carrier. Medium to dark shades are dyed without carrier at a maximum temperature of 120 deg c. Disperse dyes used are high energy dyes from Dystar, Germany known as Diani FG dyes or Foron RD dyes from Clariant, Basle. In raw white for piece dyeing or as multicoloured yarns, flame retardant textiles can be made in all desired qualities. In general dyeing with coloured and patterned fabric results in adequate wash fastness. Preliminary tests are recommended, however as there is a possibility of staining adjacent material. Dyes on Trevira cs are fast to washing at boiling temperatures in bright shades and with selected dyestuffs. A chlorine-fast finish is possible with the appropriate dyestuffs. Boiling is not recommended for drapes and decorative fabrics.

4. Finishing - Selection of softeners is very critical. It has to be seen there is no negative effects on burning behaviour. Leomin ni of Clariant is the recommended softener to be used for CS fabrics in the dose level from 1 to 5 gpl. Trevira CS materials may be coated with PVC or polyurethane. An antimicrobial or fungicide finish is possible with Dodigen (from Clariant) or Afrotin LC (the Schill and Seilacher company). While maintaining the relevant fire category.

Whilst being processed trevira cs fabrics can be exposed for brief periods to temperatures above 210 deg c. where they are exposed to temperatures for longer times, we recommend a maximum of 150 deg c in dry atmospheres and 100 deg C in humid conditions. With flame-retardant types in deep shades the fastness properties reduce bu ½ degrees as compared to dyes on normal types.

5. Printing - Pigment printing is not recommended for Trevirs CS fabrics because the use of binder and thickeners influence the flame retardant properties negatively.

Transfer printing can be done on Trevira CS fabrics. Any papers printed with dispersion dyestuffs can be employed. Checks should first be made to ensure the Light Fastness of the dyestuffs involved is adequate. Varnish should not be used as part of the residue may adhere to the fabric in printing and exercise a negative effect of the flame-retardant behaviour on Trevira CS material

Wear properties of Trevira CS fabrics

1. Stability – very good.
2. Abrasion resistance - > 60,000 Martindale
3. Durability – very good.v
4. Light- fastness – 7-8 .
5. UV-Stability Hrs – 80% (1400 Xenotest)
6. Washability – 60 deg C.
7. Stain removal – very good.

Trevira CS fabrics satisfies all the relevant and important fire protection standards.