PROCESSING OF AUTOMOTIVE FABRICS

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The automobile industry in India has been expanding in a big way. Along with this automotive fabrics' market share is also rising. Polyester has now become a leading fibre for car manufacture as well. Polyester in various forms like filament, spun and air texturised are commonly used.

Automotive yarn is the yarn used in automobile upholstery. Yarn is 100 % polyester. Yarns should have better pilling, better abrasion and better light fastness.

Types of automotive yarns

There are basically 5 types of yarn:

1. Texturised yarn (155/34, 80/34,225/72)
2. Air-Texturised yarn (840 dtex, 790 dtex, 650 dtex, 630 dtex, 600 dtex)
3. Roto filament yarn (450, 600)
4. Spun 100% polyester yarn (2/24)
5. Flock yarn.

Texturised yarn is supplied by Reliance Industries Ltd. The denier is 155 and the number of filaments is 34. They are manufactured in normal draw texturising machines.

Air-Texturised yarn is obtained from air texturising machines using the following polyester manufactured by Indorama – Butiburi, Nagpur, and Reliance Industries Ltd.

1.235den and 48 No of filaments

2. 235 den and 68 No of filaments

3. 235 den and 34 No of filament

Roto-filament yarn is also manufactured by Reliance Industries Ltd.

Spun 100% polyester yarn is manufactured by RSWM –Lodha, Banswara (Rajasthan), Indorama – Indore (MP)

Flock yarn is a three-component yarn consisting of the carrier thread (technical viscose filament yarn), the acrylate bonding agent and the flock material (Nylon 6.6). It is the latest technology. Flock yarn is not manufactured in India. It is imported from Italy.

All the above yarns are used because they give the fabrics less abrasion, pilling etc. which are required for automotive fabrics used by Maruti, Tata, Honda, General Motors, Toyota and other such car manufacturers

Processing of automotive yarns includes the following steps:

1. Fabrics made of dyed yarn (knitted or woven)
2. Grey fabrics are piece dyed (knitted or woven). Fabrics may be warp knitted using Karl-Mayer

knitting machines from Germany or woven on a Dornier loom from Germany attached with Staubli Jacquard from Switzerland

3. Texturised yarn is used for warp knitting, spun and air-texturised yarn used for woven fabrics.

Only a few units in India are making these automotive fabrics namely:

1. Bhilware Melba Dewitte Ltd, Mordi, Banswara (Rajasthan)
2. Arvind Advanced Materials Limited, Santej, Kalol (Gujarat) joint venture with Adient, the global leader in automotive fabrics.
3. Reliance Industries Ltd , Ahmedabad.
4. Faze Three Auto Fab Ltd, Vapi. (tie-up with Aundee (Germany)
5. Raymond Ltd. (tie-up with Trevas (France) & Kawashima (Japan)
6. Banswara Syntex Ltd, Banswara (Rajasthan)

After the fabric is made, it goes for lamination using polyurethane foam on a laminating machine made in Germany.

Process flow for Knitted Fabric

Dyed texturised yarn /grey texturised yarn -> Warping on Benniger (Germany) Warp knitting machine Knitted fabric (if grey) will go for dyeing in softflow jet dyeing machines.

Dyed Knitted fabric Shearing machine (Vollenweider, Switzerland) The pile will be cut by blade cutters in the shearing machine Then it will go for scouring in Jigger/Jet dyeing machine.

Upholstery piece dyeing is divided into 2 types wherein the headlining is dyed in beam dyeing and upholstery is dyed in jet dyeing using high light fastness dyes and U.V absorber and then finished on a stenter. Due to the inherent property of shrinkage of automotive fabrics, there should be attachment of a weft straightener in the stenter. Lastly, it will go for lamination. The lamination machine is made in Germany where the reverse side of the fabric is pasted with polyurethane foam with the help of a flame. Nylon screen is also used to cover it from the reverse side. In some places they also do acrylic back coating. This foam /acrylic is fire–retardant. The checking and packing into rolls is then done.

Process flow for Woven fabric

Warping -> Warp beam prepared using air texturised / spun polyester yarn. -> Dornier looms -> Woven fabric -> Scouring -> Drying on Stener -> Checking -> Lamination -> Checking and Packing in rolls.

Owing to the high fastness requirements, only selected disperse dyes can be used for this application. Most of the dyes have to be imported and UV absorbers have to be added in the dyebath to further improve the Light fastness.

Dyeing of automotive yarn is critical.

Dye selection: Normal disperse dyes cannot be used in dyeing of automotive yarns because of lower light fastness. Light fastness in automotive fabrics is very crucial because the car upholstery is often subjected to sunlight during long periods of parking. The fabric should withstand sunlight.

Different car manufacturers require different standards.

Light-fastness tests

Method SAE J 1885 (to be tested in Xenon Weatherometer) model Atlas Ci 35 A at 225.6 k-joule (rating should be 4-5) and at 488.8k joule (rating should be 2-3).

Maruti follows Japanese standards and Tata follows European standards.

Dyes used

The following are the Disperse dyes to be used in dyeing of automotive yarn:

1. CI No – Yellow 42
2. CI No – Blue 60
3. CI No – Red 91
4. CI No – Blue 77
5. CI No – Blue 56
6. CI No – Orange 30
7. CI No – Red 167

Huntsman is having special high light fastness dyes known as Teratop dyes. Similarly, Clariant is also supplying Foron AS dyes, and DyStar has come out with Dianix AM dyes. Dohmen, Germany has also full range of Automotive dyes known as Dorosperse K. You can get a light fastness rating of 6-7 using the above dyes for fabric and yarn dyeing of automotive fabrics.

The following are the salient points for automotive yarn dyeing

Soft winding – for draw texturing yarn, the soft package is directly made on axially compressible perforated polypropylene tube (Sonoco, Germany or Mariplast, Italy) in the draw texturising machine itself supplied by Reliance industries Ltd. The package weight is between 1.5 kg to 2.0 kg. The tube length is 225 mm, inner diameter is 60 mm and the outer diameter is 65 mm.

An alternative is for the soft package to be made on a precision soft winding machine with an overfeed attachment with slow speed, using the above dimensions, and made of stainless steel (Dyespring from Madura Coats, Bangalore).

For air texturing yarn, the soft package is made on polypropylene tubes in the air texturising machine itself (Stahle, Germany and Harish, Mumbai), the package weight is 1.5 kg to 2 kg with the above tube dimensions.

Yarn dyeing machines

Normal HTHP dyeing machines are preferred. For the dyeing of such sophisticated yarn, preference should be given to dyeing machines like Thies, Then, Fongs, Lorris Bellini etc that are fully automatic. For the dyeing of automatic yarns selection of chemicals are critical.

The following chemicals are used in dyeing:

1. Acetic acids (98%) – to maintain a pH of 4.5 to 5
2. Soduim Acetate – Buffer
3. Non – silicon based De-aerating agent.
4. Dispersing agent.
5. Levelling cum penetrating agent.
6. UV absorber.
7. Wax based softener.

Nobody in India manufactures this UV absorbers. They have to be imported. Basically, a UV absorber is a Benzotriazol derivative liquid and is anionic in nature. The UV absorber is added in percentage proportionate to the weight of the goods.

Accordingly, other levelling and dispersing agents have to be selected, which are compatible with the UV absorbers. The light fastness has also a link with the substrate. Finer the dyed yarn, lesser will be the light fastness. Therefore, the percentage of absorber has to be increased accordingly. Commonly used UV absorbers are Cibatex APS (CIBA), Fadex F (Clariant) and Dorafast TR liq (Dohmen). By adding UV absorber, the light fastness improvement is about 1 to 2 rating points more.

One has to bear in mind that the fastness levels vary from country to country and car maker to car maker.

The role of UV absorber is very crucial. It will increase the light fastness of automotive yarn and fabric by 1 point more on the grading scale. It is normally tested in a Xenon Arc Weatherometer. An alternative U.V absorber used is Fadex F from Clariant. Or Dorafast TR liquid from Dohmen. The dyeing temperature is 130 degrees Celsius. After dyeing the reduction cleaning has to be done using caustic soda flakes & Hydro -2 gpl at 80 degrees Celsius for 30 mins for dark and heavy dark shades. Then soaping has to be done using non – ionic detergent (1 gpl). Acid wash must then be done. At the end softening treatment using wax emulsion type softener must be done e.g. – Lustraffin BA (CHT)- 2% owg. After the process is complete it goes to the hydro-extractor and then dried in a chamber dryer.

Shade passing in automotive dyed fabrics is very critical. Car manufacturers are very particular about this. Thus, the dyer and matcher have to take utmost care. There should not be any difference in the shade from approved shade to bulk shade. For Foreign markets the computer report delta Evalue is 0.5 for passing and for Domestic the delta E value is 1.5 for passing. The same criteria are for batch-to-batch shade difference.

The following are the quality test conducted for automotive fabrics:

1. Pilling test
2. Rubbing test
3. Abrasion test
4. Heat ageing test.
5. Tensile test
6. Stretch and set test
7. Flammability test
8. Bow and skew test.

Every car manufacturing company uses its own hot light exposure method for testing dyed fabrics.

Some of the companies are trying to bring about a

unification of the test standards.

The following are the properties of these light fastness test conditions:

1 .Type of illumination (daylight, xenon lamp and carbon arc lamp).
2 Degree of exposure (intensity of illumination and exposure time).
3 Test temperature.
4 Humidity
5 Foam substrate.

Based on the above criteria, the following Light fastness test methods are being adopted at various levels:

Fakra test : (DIN – 75202) (DIN –Deutsche Industries Normen)

This test is very common in Germany. There are two types:

1.Xenon 450

2 Xenon 1200.

The following are the parameters for Xenon Test 450:

1.IR filters = 4
2.Windows Glass filters = 3 Nos.
3 Humidity = 20%
4 Test Chamber temperature = 45o C.
5 Black panel temperature = 83o C.
6 Evaluation according to Blue scale
7 Standard exposure time is 80 hrs to 96 hrs (without reversal).
8 Requirement: Blue Scale rating 6-7

Gray Scale rating 3-4

9 Substrate is 10 mm polyurethane foam. In Europe, the company (OPEL) follows this test. Similarly, the parameters for Xeno test 1200 are as follows:

1.Selective reflecting mirror (for UV light)
2.Translucent absorber (for infrared).
3.Quartz glass inner and outer cylinder.
2 Distilled water jacket (to absorb long wave infrared radiation).
3 Humidity = 80%
4 Test chamber temperature = 50oC
5 Black panel temperature = 75oC
6 Exposure time is 48 hrs (without reversal)
7 Evaluation – according to grey Scale.
8 Substrate is 10 mm polyurethane foam. Ford (UK) specifies this test.

SAE J 1885: (Atlas Weatherometer Ci 35 Xenon lamp).

This is normally adopted in USA. This test method is designed to simulate extreme environmental conditions encountered inside a vehicle due to sunlight, heat and humidity for purpose of predicting the performance of automotive interior trim materials.

The following are the parameters of the above test

1.Source – Water-cooled Xenon arc lamp.
2 Inner filter – quartz glass.
3 Outer filter -borosilicate glass.
4 Humidity – 50%
5 Test chamber temperature – 62o C.
6 Black panel temperature – 89oC
7 Exposure time – 300 hrs (without reversal)
8 Evaluation – According to Grey Scale.
9 Requirement – 225.6 kJ/m2 – minimum Grey Scale 4 and 448.8kJ/m2 –minimum Grey scale 3.

10 Distilled or deionized water should be circulated just ahead of the lamp.

11 The samples are fitted on a specimen rack which rotates at 1rpm.

12 Samples are mounted over the 4.8 mm foam.

Ford in USA and Europe and GM (USA) specifies this test.

Jaso test – (Fade – Ometer Carbon Arc. Lamp)

This test is normally followed in Japan.

The following are the parameters of the above test:

1.Souce is Fade-Ometer 18 FR.

2.Filter System -Pyrex glass.

3.Humidity – 40%

4.Test chamber temperature = 50oC

5.Black panel temperature = 85oC

6.Exposure time is 300 hrs

7.Evaluation – according to Grey Scale.

8.Requirement – For change of shade, at least rating 3must be attained.

9.Substrate is 10mm PUE foam.

Renualt/Peugeot D47 1421 test: This test method is followed by the French car manufacturing industry.

The following are the parameters of the above test:

1.Source is Xenon lamp (Xeno test 150 or 150 S)

2.Inner cylinder is quarts glass.

3.Outer cylinder is special UV glass.

4.There are 3-4 IR and 4-3 window glass filters.

5.Humidity – 65%

6 Test chamber temperature = 45oC

7 Black panel tempretature = 90oC

8 Exposure time is 300 hrs

9 Evaluation – According to Grey Scale (Peugeot). According to Blue Scale (Renault).

10Requirement – At least rating 4.

11 Substrate is 5 mm PUE foam.

Conclusion

Car makers update their test specifications from time to time. The requirements normally vary according to where a textile is to be used in a car (seat upholstery, interior trim, head lining, etc). This point has to be made clear to the customer.