Dyeing Textiles For Automotive Interiors

A growing market for textiles places new requirements on fibers, fabrics and dye quality.

By T.D. Fulmer
Dyeing and Finishing Editor

Technological advances in automotive design that are producing cars and trucks with features for environmental protection, occupant comfort and occupant safety are presenting consumers with a pleasing and changing product. Interiors are expected to trend toward smoothness and continuity. Panels and seats are moving away from the boxy look of flat planes intersecting at right angles to smooth, flowing curves molded into a seemingly single interior unit.

These consumer expectations for car design are expected to spill over into new requirements for textiles in automotive interiors. Textile yarns and fabrics may very well have to be engineered to meet design requirements for body cloth, floor covering, seat belts, headliners and more.

The Coming Trends

The automotive market is a substantial one. In recent years, about 10 million cars and trucks have been produced in the United States annually. Western Europe accounts for an additional 15 million. Add to these the production of Eastern Europe and the Pacific Rim and the size of this market is readily apparent. One report a couple of years ago placed U.S. textile use for automotive interiors at 319 million square yards.

Another trend developing is the declining use of piece-dyed fabrics. These fabrics have enjoyed an extended period of popularity with automotive producers. But there is now a need to present the consumer with something new. The rising cost of new cars has forced consumers to keep their vehicles longer. In turn, this has forced designers to develop automotive interiors with new color themes, increased durability and other consumer-friendly qualities.

Other factors influencing the switch to yarn-dyed fabrics include the following:

1. Lightfastness requirements are becoming more and more demanding. This feature has about ruled out the cross-dye technique for piece-dyed fabrics. Yarn-dyed fabrics offer a better chance of meeting the newer lightfastness requirements.

2. Style changes that designers are looking for accentuate the advantages offered by yarn-dyed fabrics. Unfortunately, lead time requirements for yarn-dyed fabrics are longer than for piece-dyed goods; at the moment, however, this disadvantage is not stopping the trend.

Automobile interiors are subjected to extreme conditions — light, temperature and atmospheric conditions among them. All play a part in the aging process of textiles. Often the geographical location of a vehicle's use plays an important part in the deterioration of the textiles employed. The varying conditions in which vehicles are used require that demanding specifications be placed on the textile product.

Fibers For The Interior

Polyester and nylon are the principal fibers used in the automotive market today. They have both the colorfastness and the durability to meet the physical stresses imposed by rugged conditions.

There are some specialty uses for other fibers such as wool and polypropylene, but thus far these uses are limited.

Another aspect of fiber contribution to lightfastness is worthy of comment. Yarn size and luster play a part. In general, as denier per filament decreases, the lightfastness properties of the dyed fiber decreases. As for luster, bright and semi-dull polymers tend to have equal lightfastness properties by a simple lab test.

Nylon For Interiors

Nylon has many properties that contribute to its suitability for auto interiors. Among these qualities are high elasticity, good appearance retention, good crease resistance, excellent abrasion resistance and high break elongation.

As with other fibers, there are different versions of nylon. When one enters a nylon dyeing program

for this market, the first question should be whether the fiber is nylon 6 or nylon 6,6. The two differ in their physical and dyeing properties. In dyeing, nylon 6 has the faster strike rate, while color value is generally better on nylon 6,6 because the color is more closely bound.

Due to the lightfastness requirements of automotive interior fabrics, the 1:2 pre-metalized acid dyes are used to color the yarn. This class of dyes produces the highest lightfastness ratings for nylon.

Because of the high affinity of the pre-met dyes to nylon, they have poor migration and yarn variation coverage. Due to these faults and the dyeing behavioral characteristics of these colors, the dye system has to be carefully formulated and controlled throughout a tightly controlled dye procedure. Dyestuff suppliers have available qualified expertise to assist plant personnel in establishing both the proper system and dye procedure.

Polyester Applications

Like nylon, polyester possesses the physical attributes that make the fiber suitable for use in automotive interiors. Resistance to sunlight, resistance to abrasion, high tenacity, durability and high resiliency are among polyester's qualities.

Polyester is a highly crystalline, hydrophobic fiber having no chemical groups that can combine with anionic or cationic dyestuffs. Therefore, polyester is dyed with disperse colors and a few azoic colors. For automotive textiles, dyestuff selection is limited by the high lightfastness requirement.

Producing level, reproducible and on-shade dyeings requires a carefully selected dye system and a procedure that is properly controlled.

The Dye System

Important points to consider are the following:

- Polyester is hydrophobic; therefore, it is difficult to wet-out. This is further aggravated by air bubbles entrapped in the yarn package. The condition leads to poor and uneven flow of the dye liquor during the dye procedure. The use of products combining deaeration and penetration accelerants remove entrapped air and greatly improve yarn wet-out and liquor flow through the packages.
- Proper pH maintenance is important for dyeing polyester yarn for automotive interior textiles. The recommended range for these selected colors is 4.0 to 4.5 set with acetic acid.
- Water hardness is also a factor. The slight presence of a host of metallic elements can be detrimental to disperse dyes. The use of an EDTA-type sequestering agent is recommended.
- Dispersing agents are helpful in maintaining uniform dye dispersion throughout the bath.
- Leveling agents improve dye migration through a solubilizing effect on the dye. This enhances dye uptake.
- Superior lightfastness is the goal for automotive interior fabrics. This being the case, the use of a UV-absorber can improve lightfastness by 1 to 2 points.

Issues In Dyeing

The procedure used for dyeing polyester yarn for this market is so highly subject to finished fabric specifications that satisfying those requirements can only be accomplished by dyeing under pressure at temperatures around 265°F.

Improvements in lightfastness. Through the application of tremendous pressure over the past couple of decades, automotive companies learned that marked improvements could be made in lightfastness of interior textile products. Under current technology the upper limits of achievable lightfastness have been reached.

Yet the car manufacturers strive for more. Non-traditional methods may help — for instance, "easy-cool" glass designed to keep out the hot rays of sunlight, which contribute to an accelerated breakdown of colorfastness.

Another method is the use of solar-powered fans to draw the hot air out of the car when it reaches a predetermined temperature.

Fogging phenomena. Recently the producers of products for automotive interiors have been faced with the fogging problem as a new quality issue. It is believed that volatiles in the interior components of an automobile are released at high temperatures sometimes reached in a tightly closed vehicle. These vapors then collect on the inside of windshields and glass and cause a hazy appearance.

As soon as test methods and equipment are developed and accepted, it is likely there will be restrictions placed on the degree of volatiles permitted in a given product.

Environmental concerns. Protection of the environment is a complex issue for the automotive manufacturer and its supplier — not only from the standpoint of controlling atmospheric emissions, but also the more complex issue of how to "recycle" a car.

The need for textile producers and their suppliers to be in concert in producing products of minimum environmental impact is the challenge of the decade.

Producer-dyed yarn. At the moment, the future of producer-dyed yarn in this market is unclear. There are several negatives attached to its use. However, the demand for better lightfastness may drive the market in this direction, or it may even drive the market in the direction of polypropylene.

Changing, Growing Market

Yarn dyeing for automotive textile interiors is a growing trend. Today's dyeing systems for today's yarn are meeting today's requirements. Requirements 10 years ago and 20 years ago were very much different than today's. Who knows where they will be in the year 2000?

Changes in automobiles are also coming. Today's colors, yarns and fabrics may not measure up to the coming requirements. The textile industry and all its suppliers need to be abreast of the impending changes and be prepared to satisfy new requirements.

How big the market will be is unclear, but as we move forward into the emerging global economy, the opportunity to be a major player in the export market is an attractive challenge.