NC STATE UNIVERSITY

JTATM

JOURNAL OF TEXTILE AND APPAREL, TECHNOLOGY AND MANAGEMENT

Volume 3, Issue 4, Winter2004

AUTOMOTIVE INDUSTRY A HIGH POTENTIAL MARKET FOR NONWOVENS SOUND INSULATION

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Abstract

This paper highlights the increasing penetration of nonwovens in automotive sector and their suitability for certain applications (e.g. sound insulation). Suitable technologies and raw materials to process insulations are discussed and remarks regarding their advantages and disadvantages are pointed out. As the recyclability is one of the main drivers of automotive industry, especially in Europe, a deeper insight has been given to natural, renewable resources, and their advantages and downsides have been underlined, in comparison with some traditional materials.

Keywords: automotive, nonwovens, sound insulation, technologies, renewable resources, recyclability

1. Automotive industry- a high potential market for textiles

Textiles are used in cars for a wide variety of purposes: to enhance comfort, thermal insulation, design, vehicle safety and more often required, acoustic properties.

Despite of the fact that textiles represent only 3% of the raw materials used in motor vehicle (compared with 60% steel, 20% plastics, 15% aluminum, etc.)[1], considering the amount of existing vehicles worldwide (table1) one can see that automotive industry represents a high potential market for the textile industry. The worldwide growth of automotive textiles, disseminated by group of products is shown in table 2 and it can be seen that is likely to increase for nonwovens, as well as for woven strucures, composite and others group of products.

Table 1 Production of motor vehicles and amount of existing motor vehicles worldwide (in million units) [2]

Type	2001	2008
Annual production of automobiles Trucks	38.5 15.5	43 17
Amount of existing motor vehicles	700[1)]	885

[1)] 1990: 300

Table 2 World growths of automotive textiles (in 1,000 tonnes) [1]

Type	Quantity				
	1985	1990	1995	2000	2005
Wovens	953	1125	1170	1221	1214
Nonwovens	95	109	107	111	114
Composite materials	284	443	521	736	976
Other	76	97	119	152	179

2. Nonwovens in automotive industry

Nonwovens are used in automotive industry for a variety of purposes due to their advantages: lightweight, sound efficiency, flexibility, versatility and easily tailored properties, moldability (easiness to conforms to irregular shapes), recyclability, low process and materials costs as well as and attractive cost/performance ratio.

According to INDA (Association of the Nonwovens Fabrics Industry) the most common technologies used to process nonwovens for automotive applications are the following (sqm): spunbonded (66%), needlepunching (27%), hydroentangled/resin (6%), others (1%).

According to the same source, the dissemination of nonwovens on product group shows that *insulations* represent 17% (sqm) from the total applications. Others applications are: carpet related products (43%), trunk (13%), hoodliner (10%), seat (6%), headliner (6%), rear shelf (3%), door (1%), others (1%).

3. Nonwoven sound insulation: applications, technologies, raw materials

Within a car the acoustic materials can be used in structures such as: door panels, headliners, A-B-C pillars, luggage compartment, under bonnet/hoodliner, floor-carpet underlay mat. According to the specific destinations, automotive nonwovens insulations can have different appearance and can be separated into three categories:

1. composite /laminates used as replacement of PUR
2. pressed /molded interior components from renewable raw materials
3. bulky wadding, acoustical parts

3.1. Nonwovens as replacement of PUR

Textile composite used in cars refers to combination of one or more textile and/or non-textile materials, e.g. foam and warp knitted fabrics used as upholstery or interior trim materials. However, three-dimensional nonwovens are lately considered as replacement for PUR foam. Some of the advantages of such “textile foam” are:

- reduced fogging and unwanted odours
- environmental-friendly laminating process
- surface material uniformity
- possibility of using reclaimed fibers
- recycling into reclaimed or recycled fibers

Some technologies to process bulky, compression-elastic nonwovens are:

- carding and vertical lapping: e.g. STRUTO, WAVEMAKER
- stichbonding processes: KUNIT, MULTIKNIT, MALIVLIES; e.g. Caliweb is a trademark of products manufactured by use of Kalitherm technique. It refers to mechanical (Kunit and/or Multiknit), thermal bonded and calibrated nonwovens as well as for the composite lamination of such nonwovens with any surface fabric.
- 3D Weblinker, NAPCO technology for 3D structures

3.2. Pressed /molded interior components from renewable raw materials

After having been almost completely replaced by their synthetic counterparts in 60’s and

70's, natural materials are gaining ground in automotive applications as moulded fiber part components: interior trim parts/door panels, roof linings, luggage compartment linings, parcel selves.

Fibers with high strength and low elongation properties are required for composites, and most of the bast fibers fulfil these requirements. With a good availability and a comparatively low price, flax, sisal, jute and coconut play the most important role. Though hemp provides stronger fibers than flax, as the processing of hemp fiber is not yet sufficiently sophisticated, flax remains the commercially most important plant fiber. Some comparisons between flax and other reinforcing fibers can be seen in table 3.

Table 3 Properties of flax compared with other reinforcing fibers [3] [4]

	Strength	Ecological compatibility	Specific mass	Industrial safety	Cost
Glass fiber	++	+	+++	+	++
Carbon fiber	+++	++	++	+	+++
Flax fiber	+	+++	+	+++	+

+++- high; ++- medium; +- low

Another major reason for this renewed growth is an increased awareness for environment, reflected in phrases such as *protection of resources, reduction of* CO_2 *emission* and r*ecycling*. Other further advantages/disadvantages of natural fibers versus their counter parts can be seen in figure 1.

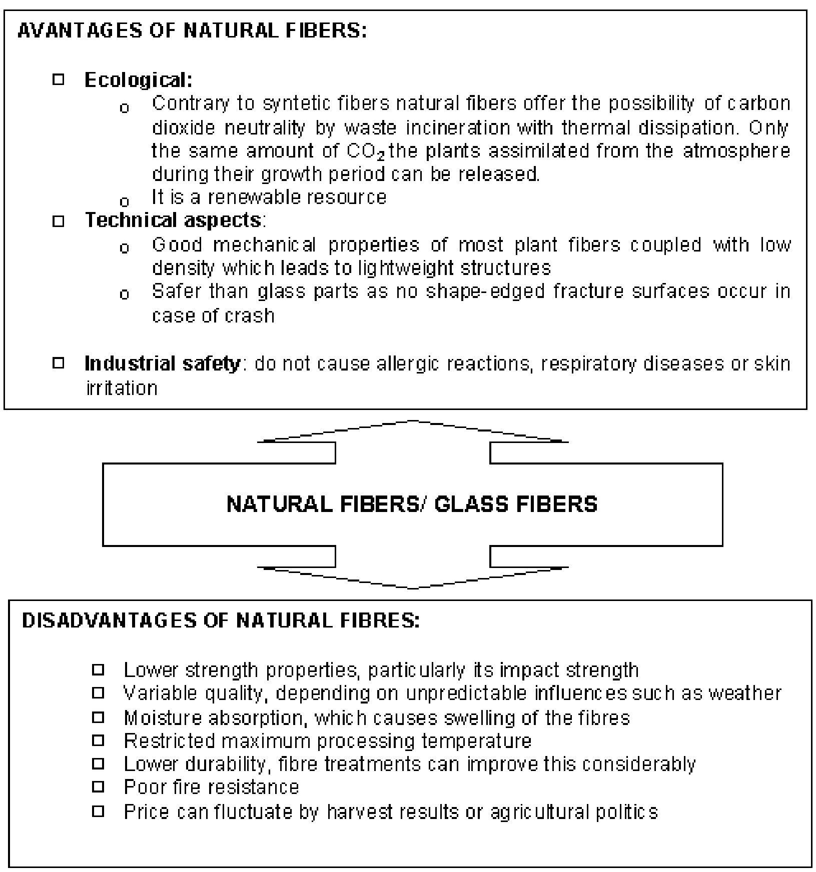

Figure 1 Advantages/disadvantages of natural fibers used in automotive applications

In order to be molded natural fibers are used in mixture with *thermoset* or *thermoplastic* polymers.

- T*hermoset polymers* such as PF (phenolic resin) or (EP) epoxy are binders for cotton or similar fibers for applications such as inner trim parts or damping materials. Some of their *advantage*s are: sufficient mechanical properties (stiffness and strength), comparable with the glass composite, have a superior thermal stability, lower water absorption compared with thermoplastic polymers (PP) and acceptably low prices levels. Their *disadvantages* are related to the moisture and air: moisture can affect the chemical reaction therefore the fibers have to be dried before down to 2-3 percent; the air present in the fibers leads to many voids in matrix thus a poor fiber matrix interface. Another downside of PF refers to ecological problems: the thermal disposal needs high temperature as an incomplete combustion occurs at lower temperatures.
- *Thermoplastic polymer* (e.g. polypropylene PP)

The main problems refer to a high viscosity, which leads to a difficult wetting while high temperatures can damage or destroy the fibers. Nevertheless a low price, reasonable processing temperatures and recyclability are reasons for a growing interest in thermoplastics and they are likely to replace the thermosets.

The manufacturing process mostly takes place in two steps, one for structuring the fiber arrangement and one for consolidating the structure. *In the first step* “hybrid fleeces” are produced by nonwoven technologies (e.g. carding/airlaid and needlepunching). *In a second step* the hybrid fleece is heated mostly between two heated plates using certain compression. Sometimes a preheating either using hot air or radiation is combined. The heat is necessary to melt the thermoplastic material or to start the reaction of this thermosetting material, when a phenolic resin is used.

The main manufacturing processes presently used for the production of plant fiber composites are:

- ❑ Compression molding, applicable to resinated fiber mats, hybrid mats (PP/natural fibers), NMT (Natural fiber Mat reinforced Thermoplastic) comparable to GMT (Glass fiber Mat reinforced Thermoplastics)
- ❑ Structural Reaction Injection Molding (S-RIM)
- ❑ Injection Molding with short fiber reinforcement [5]

Compression molding is most used, in different variants: (1) using a pre-melted polymer, (2) using a fibrous polymer that is combined with the plant fibers into a hybrid mats before compression molding and (3) others use polymer powders that are introduced into the fiber mats before compression molding. Some typical productions lines are: Hermann Process (Laroche), Fibroline, etc.

3.3. Bulky wadding acoustical parts

Air laid is the most appropriate technology to process such high loft products due to the following advantages: equilibrate MD/CD ration, suitability to process any type of automotive fibers (especially recycled fibers) and a thick, voluminous product can be produced with a high productivity. Machine manufacturers such Fehrer, Laroche, Fibroline, etc offer complete airlaid lines. Example of application: on the door panel.

4. Summary

There is already a high penetration of nonwovens in automotive sector and the present papear only refers to the specific case of sound insulation. For each application there is still room for value added products and that will only further consolidate nonwovens’ position.

When they have to choose between varieties of products, manufacturers consider following criteria: economics, durability, aesthetics, processibility, moldability, added benefits (e.g.: acoustics, flame retardant, recyclable, etc.), which are main *driving forces* of nonwoven in automotive industry worldwide. However, some studies [6] highlighted certain differences regarding the driving forces of different market (e.g. European and NAFTA), thus the penetration of nonwovens for some applications will be different: e.g nonwovens are highly penetrated European headliner&floor surface applications and weight save (gas reduction) pressure is higher in Europe while acoustic performances and cost save pressure are equally higher in Europe&NAFTA.

Recycling is at the moment a significant Europe driver not yet U.S. driver. *EU regulations on the disposal of used cars* are effective from 1st July 2002. They focus on the re-use of textiles from used cars and on recycling materials in new cars. It requires that by the year of 2006 at least 85% of an automobile's weight to be recycled.

As the textile materials currently used in motor vehicles represent low quantities, one cannot expect them to become economically recycled because themselves consist of 2 to 5 fiber components blends and they are moreover combined with non-textile materials (metal, plastic materials) thus not very cost-effective to dissemble. Besides that, due to ageing and contamination, these textiles have, in many cases, no value with regard to recycling. In this respect, EU regulation offers the framework to solve these problems and open up a chance for the textile industry.

The main challenge for automotive textiles manufacturers can be synthesised as following: process recyclable materials *today***,** optimally recycle them *tomorrow* and optimally dispose them *the day after tomorrow*.

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