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RECYCLED TEXTILES USED IN AUTOMOTIVE INTERIORS. CASE STUDY- FORD MOTOR COMPANY

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Abstract: *The environmental movement is affecting all industries, but the textile and automotive industries are two of the few that are constantly being criticized. The automotive industry is the subject of much research, it is the largest manufacturing activity, there is a complex supply chain, is resource intensive and emits various hazardous gases and waste products. The article reviews the current state of automotive industry regarding the textile application. Automotive textiles have been classified as belonging to a category called "Mobiltech" which is one of the main streams of technical textiles. The term means all type of textile components e.g. fibers, filaments, yarns and the fabric used in automobiles. They are classed as technical textile because of the very high performance specifications and special properties required, different from those used in clothing and other applications. The performance of the automotive textiles depends on the fibre properties, fabric structures and various finishes used in the manufacturing processes. After a short presentation of used fibres in car interiors, with advantages and disadvantages it is presented the sustainable textile solutions for the automotive industry. The paper focuses in particular of the use of recycling of textile waste to highlight how the processes of recycled textiles and sustainable textiles production are linked in the automotive sector. A case study with Ford Motor Company outlines and examines their design, development and manufacture process for automotive textiles for car seat coverings and interiors*

Key words: *Recycling, Automotive, Textile, Car interior, Polyester*

1. INTRODUCTION

The environmental movement is affecting all industries, but the textile and automotive industries are two of the few that are constantly being criticized. The primary environmental concerns associated with textile are water use and pollution, hazardous chemicals use, energy use, and solid waste. The main environmental issues associated with automobiles are fuel efficiency and. air pollution and greenhouse gases that climate scientists say are driving global warming. With customer pressure and regulatory constraints for more fuel-efficient and safer vehicles, the automotive industry play a decisive role in driving innovation and reducing environmental and social externalities of vehicles.

2. CURRENT AUTOMOTIVE TEXTILE STAGE

The automotive industry is perhaps one of the leading when it comes to trying new materials in high volume production.The automotive industry is the subject of much research, it is the largest manufacturing activity, there is a complex supply chain, is resource intensive and emits various

hazardous gases and waste products. It employs about 9 million people involved in making 60 million vehicles, about 5 percent of global manufacturing jobs, and 50 million jobs connected indirectly to the auto industry [1].

As automobiles have become more sophisticated and capable, they have also become more complex. A typical modern vehicle might contain up to 10,000 different parts made of about 1,000 different types of materials that in turn are made from about 10,000 different chemical substances [2]. The automotive industry is one of the largest single markets for automotive textiles. The percentage of textile material used in a motor car is 2.2% of the overall weight of the car [3].

Technical textiles are broadly used in transportation vehicles. Given the rise of the automotive industry and the fact that for the modern car today, uses about 20 to 26 kgs of textiles fabric for interior and exterior purposes [4]. Almost two third of the automobile textiles are for interior trim, i.e. seat cover, carpets and roof and door liners and the rest is utilized to reinforce tyres, hoses, safety belts, air bags, etc .

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The main criteria involved in the development of textiles and components in automotive are: tensile strength, abrasion and pill resistance, air permeability, compression resistance, elasticity, light fastness at high temperatures, stiffness, ease of cleaning, separation force, dimensional stability, flame resistance, anti-fogging resistant, resistance to adverse climatic conditions. The others processing requirements are mouldability, susceptibility to compression, sewability [5].

Table 1: *Fibe used in car interiors, advantages and disadvantages[8,9,10,11]*

Fibre	**Application**	%	Properties
Nylon, polyester, polypropylene	Carpets (Including Car Mats)	33.3	Light fastness, mouldability, ease of cleaning, thermal and acoustic protection, relatively inexpensive; Disadvantage: Limited compressed resilience of polyester;
Polyester fabric (woven/knitted), nylon,polypropylen wool/polyester	Upholstery (Seating Fabric)	18	Abrasion and UV resistance, attractive design and texture; Disadvantage: Low moisture absorbancy of polyester;
Panox (UCF), Aramid (Nomex, Kevlar-DuPont), Inidex (Courtaulds)	Seat fire barriers	14	Very high FR including restrictions of heat release, toxicity and opacity of fumes;
Polyester, nylon 6	Tyres	12.8	- good thermal absorption, -UV resistance poor unless stabilized;
Polypropylene, nylon polyester	Door trim	9.4	Abrasion and UV resistance, attractive design and texture;
Polyester blends	Luggage carrier liners		UV resistance, decorative and functional, relatively inexpensive;
Polyester , PVC foil	Sunvisor		

Polyester	Seat belts	8.8	Tensile strength, extension(up to 25-30%), abrasion and UV resistance;
Nylon 6,6 multifilament yarns	Airbags	3.7	Resistance to high temperature, inflation gases, durability to storage over many years, tear strength, thermal absorption;

Now almost 90% of the fibres used in car seats are polyester [6]. The excellent UV degradation resistance of polyester combined with very good abrasion resistance and relatively inexpensive price ensure that it will keep its prominent position among the available fibres, even if the low water absorbency can result in thermal discomfort. Although this fibre however requires having UV light-absorbing chemicals are added to the dyebath to pass modern rigorous standards of durability. The use of natural fibres in the production of textile materials for automotive interiors is limited in the main to wool. Wool is used in luxury and up-market cars [7]. (see Table 1). In the drive towards lowering weight for reducing both fuel consumption and CO2 emissions, many current developments are including new uses for fabrics, and by 2020, it is predicted that the same sized car will contain 35 kg of textiles [12]. The global consumption of textiles used in automobile industry is estimated to be over 4.5 hundred thousand tonnes.

Automotive textiles are used for enhanced aesthetic of automotives [13] and for sensual comfort and safety. Additionally, few textile products found their applications as design solutions to engineering problems in the form of composites, tyre reinforcement, sound insulation and vibration control [14].

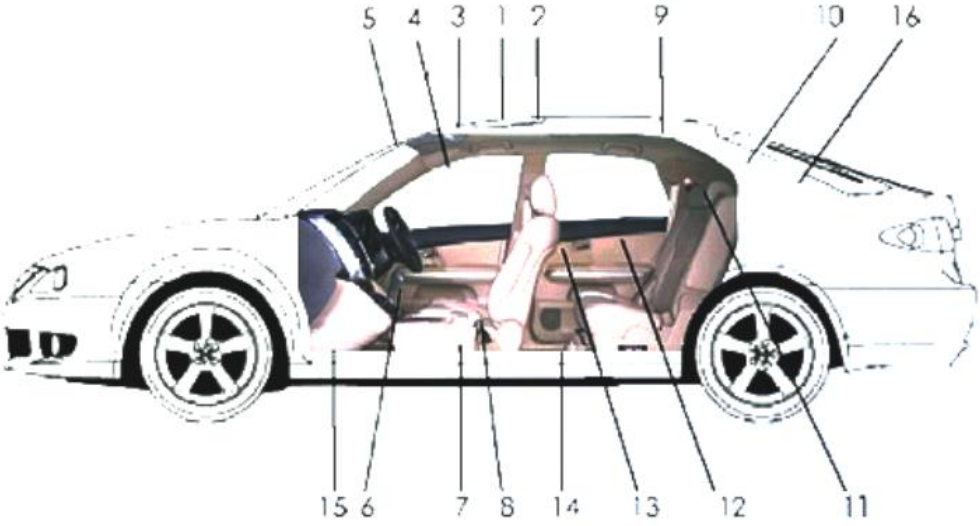

Fig. 1*: Applications of textiles in car (Sunroof-1,headliner-2,convertible tops-3, sunvisor-4,column padding-5, composite panel-6, seat belt anchorage cover-7, seat belt-8,inside roof lining-9, seat cover lining-10, upholstery-11, Insulation-12, windows frames-1, carpet-14,carpet backing-15,rearshelf panel-16) [17]*

The use of textiles (figure 1) in automotive applications includes visible components like floor coverings; upholstery; safety belts; and not visible to the viewers textile materials. The not visible textile materials are mainly used for their functional purpose, and are known as concealed components: tubes and tapes; tyre cord; airbags; components; and filters.

It is estimated that approximately 45 m^2 of textile material is used in the average car for

interior trim, which includes: seats, headliners, side panels, carpets, trunks, door trim, dash mat [15]. There are about 3.5– 4.5 m^2 of carpet in each car, made by either tufting or needle-punching with considerable differences depending on where in the world the car is made. In Western Europe approximately one-third of all cars have carpets tufted mainly from bulked continuous filament (BCF) nylon yarns since in the USA, at present, all car carpets are tufted mainly from BCF nylon [16].

2. CASE STUDY- FORD MOTOR COMPANY

2.1. Ford Motor Company Bussines

Henry Ford did not invent the car, but the motor industry did not really take off until he produced an automobile that was within the economic reach of the average. Out of his determination came in 1908 at Detroit the mass-production assembly line, and in 1913 at Old Trafford, Manchesterhe his Model T Ford and - two innovations that revolutionized American society and molded the world we live in today.

Ford Motor Company, a global automotive industry leader based in Dearborn, Mich., manufactures or distributes automobiles across six continents. With about *201,000* employees and about 62 plants worldwide, the company's core business includes designing, manufacturing, marketing, and servicing a full line of Ford cars, trucks, and SUVs, as well as Lincoln luxury vehicles. The company provides financial services through Ford Motor Credit Company.[18]

2.2. Ford Motor Company Sustainability

Ford Motor Company has been a leader in the use of recycled materials, starting in 2008 with the upholstery in the Ford Escape hybrid. The company has been working for many years to increase the use of recycled and renewable materials and to reduce the use of unwanted materials. Vehicles in the USA are composed of 20-25% post-consumer recycled material by weight, for the most part due to the extensive use of metals with recycled content.

With each global vehicle program, Ford has been able to increase its use of sustainable fabrics by researching new technologies and identifying suppliers that share its commitment to sustainability. At the beginning Ford had to go outside the auto industry to find a textile manufacturer capable of producing recycled fabric. Now, Ford have teamed up with one of the world's largest and leading organisations involved in sustainable textile solutions, Unifi Inc.[19]

Since 2011, Unifi Company launched its „textile take-back" program in which it obtine fabric scraps from textile manufacturers and using them in REPREVE, a polyester fiber containing recycled materials that have the same look, feel, and performance of virgin polyester fibers. Five major apparel customers — Eddie Bauer, Quiksilver, North Face, Patagonia and Polartec — sell outdoor and sportswear featuring REPREVE. Wal-Mart Stores Inc., Haggar, Sears and Cintas are working with Unifi on Repreve apparel programs but Ford is the only automanufacturer to use this material in its vehicles.

Through their global materials strategy, Ford are increasingly using materials that are more sustainable from a total life cycle perspective, including recycled, renewable and recyclable materials, and working to decrease or eliminate less sustainable materials.

Since the 2009 model year, the seat fabrics in most of new or redesigned Ford vehicles have been made from at least 25 percent post-industrial or post-consumer recycled content. Fifty different fabrics meeting the requirements have been developed and incorporated into 12 Ford vehicles. In addition, many of the non-woven headliner fabrics now contain 50 percent to 75 percent recycled yarns, depending on the color.[20]

Besides Unifi Company, Ford is also working with other innovative companies like Sage Automotive Interiors, based in Greenville, S.C., and Unifi, in Greensboro, N.C., to accelerate development of recycled fabrics. Other recycled items in the Modell Fusion 2013 include soy-based foam in seat cushions; plastic underbody panels made from recycled car battery casings, and sound-absorption materials made from old denim [21]. F-Series trucks used eco-friendly materials like soybeans to make seat cushions, seat backs and head restraints and post-industrial recycled cotton. one 2014 Ford F-150 truck uses the equivalent of about 10 pairs of jeans, 26 bath towels or 31 T-shirts as carpet insulation or sound absorber [22].

Rice hulls are the latest sustainable material used in Ford F-150; the hulls reinforce plastic used in an electrical harness in 2014 F-150. Some F-150 trucks have cylinder head covers made with EcoLon, a nylon resin produced from 100 percent post-consumer recycled carpet**.** A thermoplastic material made from recycled tires and post-consumer recycled polypropylene is used to make shields and some underbody covers on F-150.

While it's a good green message to get out, Ford also happens to save, by its own calculations, approximately 4.5 million USD by recycling materials.

3. CONCLUSIONS

Car manufacturing is a material-intensive process that is impacted by growing resource scarcity and the increasing prices of critical materials.

It is a challange for textile supplier to work with the automotive industry, with its higly complex development process. Appart of the aesthetic requirmetnt, there are many technical regulations and demands: the material should exude quality and harmony, should look the same after tree-four years, will age in a homogeneus way, be easy to clean, whitout smell etc. Aditionally the materials have to fulfil the EPS (Environmental Priority Strategy) and the materials and chemicals containing substances listed in the Restricted Substance Management Standard must not be used.

Ford is currently using REPREVE, a 100% recycled polyester yarn made from both post-consumer and post-industrial waste, in five vehicles around the world, making it a truly global material. It represents Ford's larger commitment to reduce, reuse and recycle as part of the company's global sustainability strategy to lessen its environmental footprint.

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