FROM DREAM TO REALITY... RECYCLED CAR SEAT FABRIC

by

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FOREWORD

The Afiler project is based around a consortium of companies and scientific bodies working to overcome a challenge that started life as an off-the-cuff remark. The idea is to innovate and develop an industrial sector in France that sells a technical product made from recycling end-of-life vehicles and PET bottles. This group of industrialists have agreed to establish and organise a consortium to develop a viable and profitable solution to this challenge.

The end goals are to recycle effectively, firmly establish the industry in the Occitania region, and to market the Afiler product to the automotive industry.

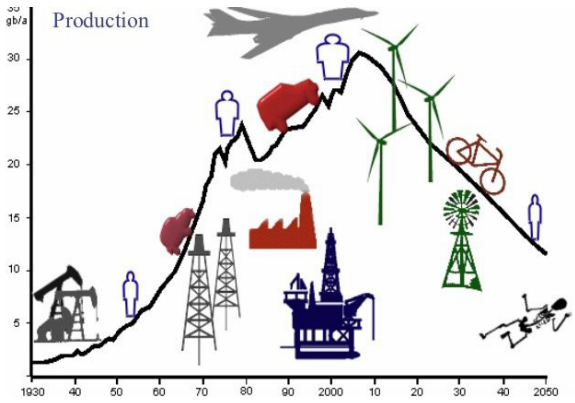
*The Renault Group has taken a proactive approach towards incorporating recycled materials in its vehicles since the Megane II, using an average of 30% recycled materials at the end of 2014. It has also set the bar for recycling End-of-Life Vehicles (**ELVs**) via Indra and the Life+ **"Icarre 95"** project (industrial demonstrator to achieve 95% recycling of ELVs) and also for implementing circular economy schemes (remanufacturing of parts, parts for reuse, material short loops, etc.).*

The recovery rate of used textiles from cars remains very low due to the technical and economic obstacles associated with their disassembly and levels of dirtiness. Renault has already looked into the end of life of textiles (occupational clothing, ELVs and railway carriages) with VALTEX (recycling these textiles as acoustic and thermal insulation).

In light of this, Filatures du Parc launched the Afiler project (a collaborative project supported by the ADEME) to explore ways in which to recycle car seat belts (a material with a good recovered quantity/recovery time ratio).

Resource depletion - a factor we must now all consider

We have seen that an increasing number of financial stakeholders and consumers are keen to find eco-friendly solutions that use as few raw materials as possible. Indeed, non-renewable energy sources such as oil, necessary for manufacturing the majority of synthetic materials, are destined to become extremely expensive in the future. For how much longer are we going to enjoy so much cheap oil? Agreed on a planetary scale during the COP21, most countries are working towards dramatically reducing the harmful footprint of fossil fuels in the near future. In order to reduce the pressure on natural resources, an alternative option is to use ***secondary raw materials***, i.e. recycled materials.

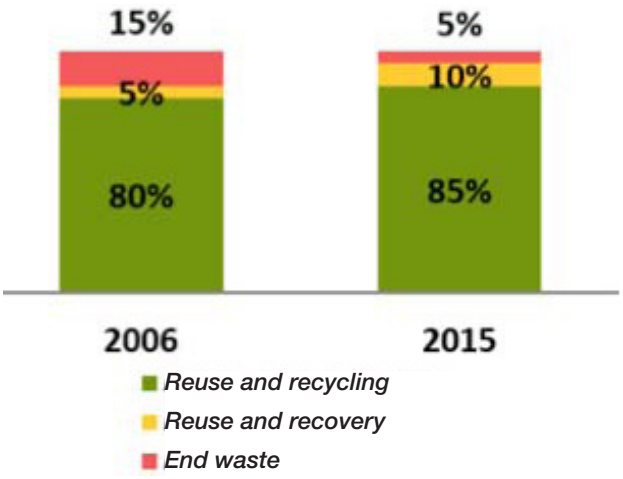


Source: «What is the Energy of the Future?»
Written by: Nicolas Meilhan, Frost & Sullivan

Ambitious regulatory targets

Once they reach the end of their service life, ELVs, deemed hazardous waste in regulatory terms, must be decontaminated and

recycled. In order to meet the requirements of ***European Directive 2000/53/EC***, as of 1 January 2015 handlers are obligated to reuse 95% of ELVs overall: 85% recycled and 10% used for energy generation.



ELV recovery targets according to the 2000/53/EC directive

In line with the principles of Extender Producer Responsibility (EPR), car manufacturers must design and promote processes for managing the waste created by their products.

Material costs - the key to competitiveness

Recycled materials are preferred when their costs are equal to or lower than those for virgin material.

In response to this, the Renault Group is actively working to develop and optimise the recycling channels for ELV recovery. Over one million ELVs are processed in France every year - the equivalent of more than one thousand tons of potential material (in terms of seat belts). There is a dual objective here: increase the recovery of End-of-Life Vehicles and increase the amount of recycled material available for use in new cars.

DEVELOPING SHORT LOOPS

There is a growing demand for the use of recycled parts in cars (cf. Megane II). Filatures du Parc's ambition is to offer an alternative derived from automotive waste. This is what is referred to as ***short loop**** recycling, as opposed to 'open loop' where the recycled material is used in another industrial sector.

The short loop developed for seat belts consists of transforming the belts into carded yarn, which is then woven and used for car interiors and upholstery.

short loop: *a term used in the Renault Group to indicate that the recycling, collection, logistical, preparation and transformation operations are relatively short.*

Fabric requirements for car seats

Above all, automotive textiles must:
- Comply with technical specifications
- Meet Renault design standards for perceived quality and aesthetics

Mace snagging test method

A textile destined for use as upholstery must pass a validation plan. Certain tests considered as being the most critical are subject to systematic checks:
- Severe friction fluffing
- MIE abrasion test
- Mace snagging
- Fire resistance
- Lightfastness

Carded yarn (typically a polyester/wool yarn) was mostly used in car seat fabric from the 1970s until the late 1990s. For financial reasons it was gradually replaced by 100% polyester continuous filament yarn. At the same

time, carmaker specifications have become increasingly stringent over the years, especially in terms of abrasion resistance. The result is an ambitious project from a technical standpoint, as it involves reviving the tradition of carded yarn and, at the same time, ensuring it meets the requirements of modern day specifications.

The obstacles to recycling seat belts

The short circuit put in place for recovering seat belts is the result of close cooperation between the various project stakeholders:

- Renault, with its ability to innovate and launch new automotive designs and products;
- Indra, a joint venture between SITA/Suez Environnement and Renault specialising in car deconstruction (dismantling materials);
- Filatures du Parc, with its 65 years' experience, is renowned for its techniques and expertise in manufacturing classic carded yarn (material preparation and transformation);
- Adient (formerly Johnson Controls), specialising in car seats and interiors (including the production of automotive fabrics).

Les ceintures sont compactées en balle pour faciliter le transport, puis défibrées pour la fabrication de fil.

Les facteurs clés du défibrage sont :

• la longueur des fibres obtenue par le process
• l'absence de points durs

Belt fibre and plastic bottle mixture

The belts are compacted into bales to facilitate transportation, before being separated into fibres to manufacture the yarn.

The key factors behind fibre separation are:

• the length of the fibres obtained by the process
• the absence of hard points

Separated seat belts

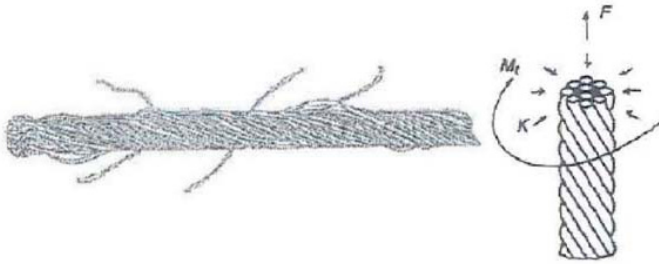
The belt fibres are mixed thoroughly with polyester fibres obtained from recycled plastic bottles. This mixture ensures:

- improved cohesion of the recycled fibres
- the resultant yarn is suitable for industrial weaving
- the yarn has the technical properties needed to meet Renault specifications

The mixed fibres then undergo the carding process. Upon leaving the card, the rovings are stretched out and twisted to produce carded yarn ready for weaving.

These staple fibres are held together by inter-fibre friction, which depends on:

• the fibre contacting surfaces (length and section of the fibres)
• the fibre friction coefficient (fibre crimping)
• the pressure in the fibre slip plane (twist given to the yarn)

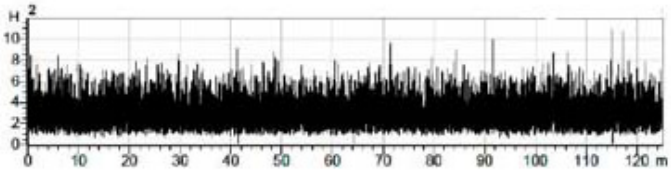


Spinning yarn - a Filatures du Parc manufacturing process

The key criteria needed for recycled yarn to meet the specifications are:

- low hariness (for improved resistance to abrasion)
- no hard points (design appearance and weavability)
- uniform tensile strength (weavability)

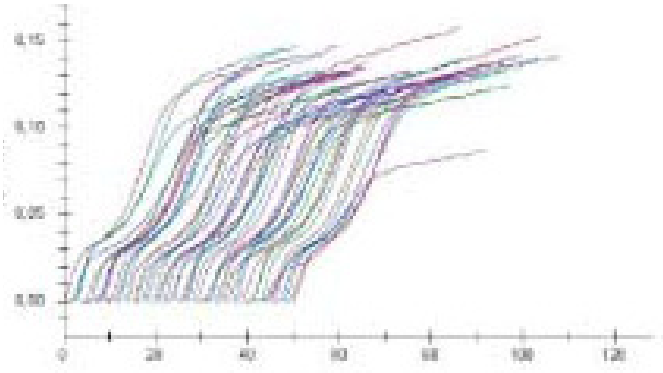
The belt preparation stage (fibre length and absence of hard points) is of vital importance of terms of yarn quality.



Measuring fuzz in recycled yarn

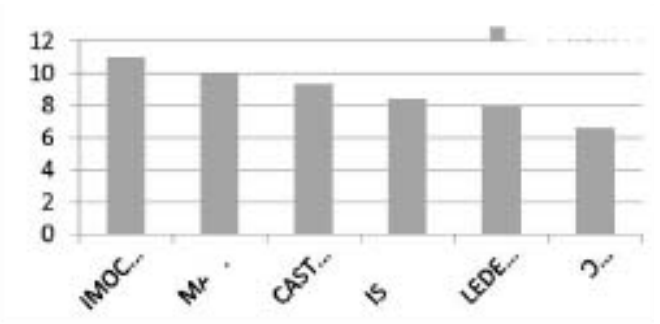
In order for the fabric to meet specification, the technical phases are chiefly focused on the following aspects:

- Yarn composition (proportion of belts/ recycled polyester from plastic bottles, important for quantity and quality of the resource)
- Fibre fineness



Tensile strength of recycled polyester fibres

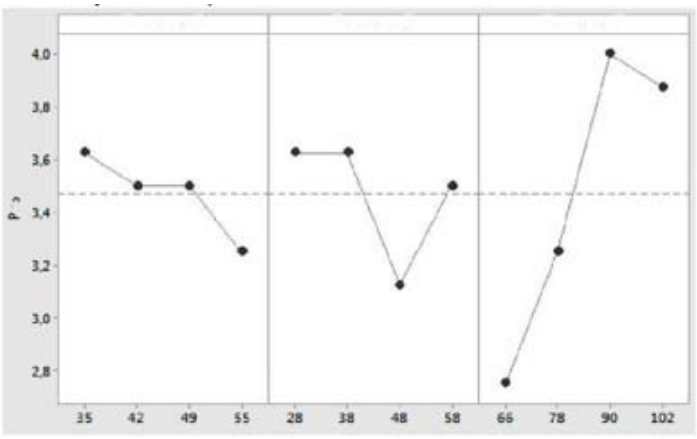
- Yarn count (suitable technical and financial compromise)
- Yarn twist (twist adapted to yarn count)

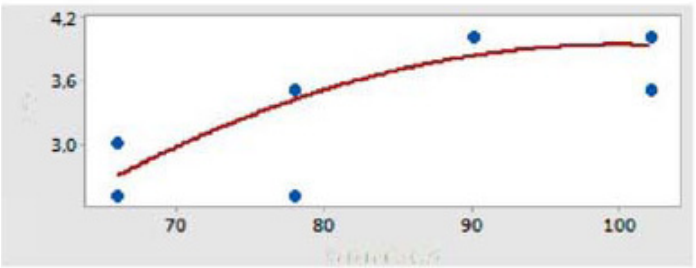


Tensile strength of various yarns

- Weaving (research needed to find the best compromise between textures and density for this product type)

- Design of experiment for fabric finish (need to find a specific finish process suitable to this type of product)





Design of experiment for weave finish

Implementing quality assurance

Today, after 16 months of hard work, we have successfully obtained textiles that pass the critical tests in Renault's specifications.

The Afiler project will enable Filatures du Parc to enter into a new market: cars, a business sector that is highly industrialised and regulated. The SME now needs to improve its quality assurance so that it can meet the requirements of this new industry (laboratory equipment and control processes).

Handling multi-source flows

With a view to optimising the short loop, i.e. using the line's maximum processing capacity, plans are under way to reintroduce waste Adient textiles into this recycled yarn.

LESSONS LEARNED FROM THE AFILER PROJECT

The study highlighted a number of important criteria needed to successfully establish this new business sector:

- an open mind towards industrial ecology
- new applications for these secondary raw material flows
- linking up with key partners for improved control over development

CONCLUSION

It has been demonstrated that it is possible to recycle seat belts for the automotive industry. These recycled materials are competitive due to their optimised process flows, a stronger recycling value chain, and the possibility of new applications. We envisage that major players will see the financial benefits of this environmental approach as the sector continues to grow.

OUTLOOK

When the flows of conventional materials for transformation or transportation have relatively little value, recycled products carry more risk and are harder to be competitive. Developing new recycled technical products targeting higher added value applications, such as parts visible inside the vehicle, can help mitigate this problem.

...EVEN MORE OPPORTUNITIES

Recycled textiles that are currently under development for automotive upholstery offer high technical capabilities and are proving to be cost-effective. One can reasonably predict that they will go on to offer new development opportunities in other sectors besides the car industry: aeronautics, geotextiles, interior design, and many more.