



X-Lite - Aesthetic lightweight leather

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Several important trends have been observed in the tanning industry during recent years. One of those is the reduction in both availability and quality of hides, leading to a greater demand for leather “upgrading”. Another increasing trend, especially regarding leather destined for use in the transportation industry, concerns weight reduction without compromising the aesthetic characteristics.

X-Lite® technology has proven to be a solution for both market demand. This and the resulting patented lightweight technology have already been reported in detail:

- *The structural upgrading of leather: A new micro-sphere application, Tegtmeier and Tysoe, World Leather Nov 2007 p.27-30.*
- *Genuine lightweight leather: A new micro-sphere application concept, Tegtmeier and Tysoe, World Leather Oct/Nov 2009 p.13-16).*

For this reason only a brief description of the technology is outlined below.

Preparation and production details

Leather preparation for this technology begins with splitting and shaving the grain leather thinner than the current required standard production substance as indicated in *Panel 1*.

During the retannage, the X-Lite product is commonly added in the neutralisation step without any further change of the process flow. The product is comprised of microcapsules that have a thermoplastic shell containing a hydrocarbon propellant. The product is available in different grades which differ in capsule size and expansion force and thus allow tailor-made articles.

After an initial milling, the microcapsules in the crust leather are thermo-expanded by steam to form microspheres with up to 40 times increased volume. This expansion in turn exerts pressure on the fibres and leads to a thickness increase of the leather back to the standard substance. It is followed by a second milling step ensuring better microsphere realignment as well as filling in the voids and loose areas. This gives an overall more uniform leather result. The resulting leather, therefore, has a lower density and thus reduced area weight compared to standard leather of the same thickness.

For thermo-expansion, steam has been identified as the optimum vehicle for heat transfer and a steam expansion machine has been co-developed with Fratelli Carlessi s.r.l.. This is available in two sizes: a lab scale machine with a capacity of up to 60 sides per hour and a production size machine which can expand up to 150 full hides per hour, shown in *Panel 2*.

The special design of the machine ensures delivery of uniform



pressureless steam which is ideal for the expansion process. The machine incorporates an exhaustion mechanism to avoid condensation issues that might be problematical.

Significant weight reduction

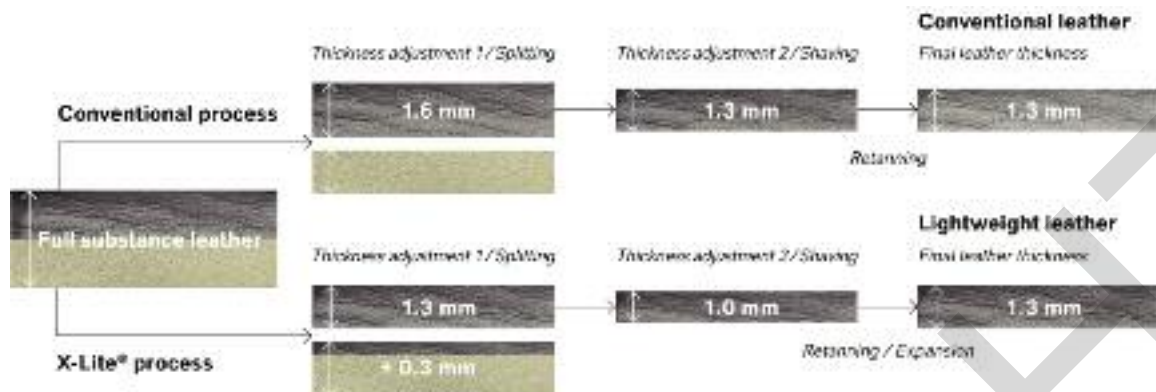
Analytics conducted during the retanning process revealed that the penetration of the microcapsules takes place predominantly from the flesh side and the product uptake is above 98%. These microcapsules aggregate in the voids and other loose areas such as veins, and especially in the voluminous corium layer. After expansion the resulting microspheres completely fill the voids commonly present in bellies and flanks as shown in *Panel 3*.

These generally thinner and emptier areas are bolstered up, leading to an overall increase in substance uniformity, and this unique phenomenon has been confirmed by independent studies.

Basically, the weight reduction of up to 20% is achieved by splitting the grain leather thinner, then the standard required substance is obtained by subsequently increasing the thickness through the application and expansion of the microspheres as shown in *Panel 4*.



Panel 1: Process flow generating lightweight leather compared to standard production.



The aesthetic characteristics are at least maintained and can even be improved, and reduced average weights for a given area can be achieved, such as:

- For automotive leather: 580-750 g/m² (@ 1.2-1.3 mm)
- For aircraft leather: 470-580 g/m² (@ 0.9-1.1 mm)

This fulfils the market need for a weight reduction, but without compromising the aesthetic characteristics of these leathers.

Characteristics and advantages

Leather treated with X-Lite is generally described as soft, tight and appealingly full. Comparison trials demonstrate that the bolstering up of the leather by microspheres leads to a significant increase in tightness. This beneficial effect has even been proven on laminated leather. For these reasons these leathers fulfil the market requirement for an upgrade in leather quality.

There is also an improvement in usable yield. In several trials a pack of full hides was carefully cut along the dorsal line: right sides were treated as usual; the left sides were shaved thinner and treated with X-Lite using absolutely the same retanning system. Loose areas were then marked by skilled auto leather cutting production workers, then the total area and loose areas were measured by a laser cutting system. As a result, the total surfaces of right and left sides were found to be similar but the cutting yield was noticeably increased by the use of X-Lite.

The structural stability of the leather is also increased by using this technology. Total and static deformation of the leather was tested by applying pressure to a small area of leather, followed by relaxation for a defined time comparisons were then made to areas not subjected to pressure. This was repeated on five different parts of the leather following storage at various temperatures. In this trial series the thickness and dimensional stability were also tested.

A leather treated with X-Lite when compared to a leather produced by the same formulation but without the product generally achieves a more uniform substance. Furthermore, both the total and the static deformations are significantly decreased, with greater uniformity upon storage at various temperatures. These leathers are generally more structurally stable and more uniform even when subjected to high temperatures as shown in *Panel 5*.

Panel 2: Production size steam expansion machine.



Panel 3: TEM comparing filling of voids with and without X-Lite.



TEM taken during processing: penetration takes place predominantly from flesh site.



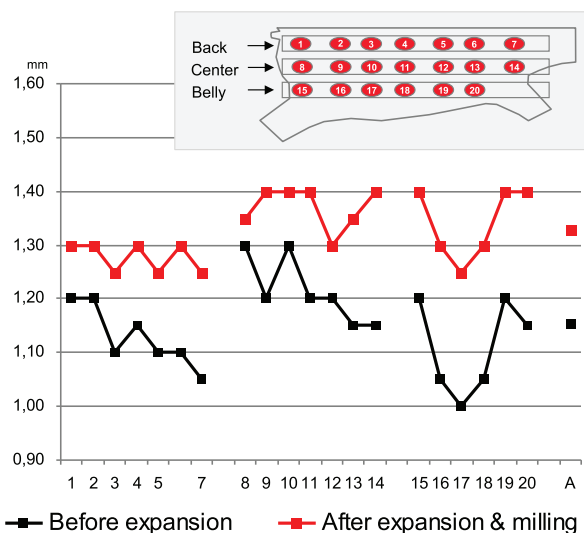
Voids without use of X-Lite



Voids are filled with microspheres



Panel 4: Comparison of substance thickness before and after X-Lite expansion.



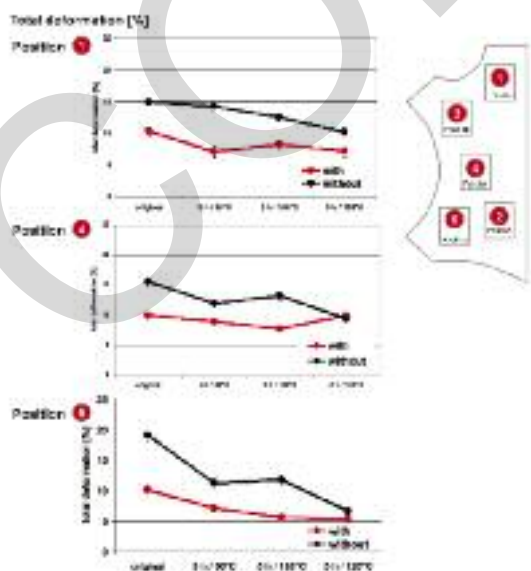
Potential side effects

The possibility of side effects of X-Lite technology were also investigated and measured:

- First and foremost there was focus on the propellant which consists of liquid hydrocarbons – although used in very small quantities – and issues regarding flammability or VOC-tests:
- **Flammability:** Independent flammability studies (FAR 15.853 (a) (ii)) revealed that the product does not increase flammability and leathers treated with flame retardants pass the test.

VOC/emissions: Leather articles which pass common automotive VOC tests (VDA 276/278) still pass these tests following treatment with this technology.

Panel 5: Total deformation comparing leather with and without X-Lite.



- No negative effect have been found on embossing or within heat resistance tests. Although microspheres are resilient, no negative impact on embossing properties have been experienced. The same embossing pattern is achieved on leather where microspheres have been applied when compared to untreated leathers.

- No problems have been found regarding a decrease in thickness of the final leather when subjected to heat over a period of time. In particular, exposure for several weeks to heat at 100° to 120°C as the thermoplasticity temperature of the capsules is ca. 100°C.

This has been studied in depth and no such problem was found. On the contrary, the substance was either maintained or very slightly increased meaning that over time these leathers are very resilient and stable to both temperature and aging.

- A major topic for lightweight leather is the accompanying reduction of tear resistance that can be produced by shaving to a thinner substance. Here numerous studies revealed that an adjustment in the retanning by incorporating special polymers resulted in a significant increase of tear strength. In addition, there were no negative side effects in hardening, or change in the character of the leather article. Tear strength of above 25N (at 1.3mm) for automotive and >20N (at 1.0mm) for aviation leather were achieved.

- There is a dramatic and complete vein filling effect. However, overexpansion can lead to a more pronounced convex (instead of the usual concave) appearance. In this situation dry-splitting of the crust leather results in normal flat appearance.

Commercial evaluation

The commercial impact of the X-Lite technology has been carefully analysed. There are some higher costs in chemistry, steam and energy and an additional investment in machinery is necessary. However, comparing the full costs for the same area of an article with and without application of this technology, the overall cost structure shows benefit. Moreover, these costs are more than compensated by the following advantages:

Reduction in retanning chemicals: Due to the thinner substance a reduced amount of retanning chemicals is needed to achieve the same area.

Thicker and higher value drop split: A thinner shaving of the grain split automatically yields a thicker thus heavier drop split. Drop splits are sold per weight and in different weight classes. A heavier split generates more weight and potentially in a higher weight class – a double benefit.

Higher cutting yield: Filling of the voids, especially bellies and flanks. This provides better filling and tightening in these generally looser structures, and, therefore, increasingly usable and improved yields.

The technology as described has matured toward production process. Machines for production scale are available: the technology is being used in production, and is demonstrated as commercially beneficial. Advantages regarding the leathers produced and their suitability within automotive and aircraft applications have been carefully evaluated and proven. ☺



Automotive leather production has increased by a factor of ten

Dr Dietrich Tegtmeier, vice-president for product development and application in Lanxess's leather business unit, has said on more than one occasion that if it was the job of a previous generation to build up the global economy after World War II, it is the task of the current generation to make the global economy sustainable. "Sustainability is a mandate; it's the mission for our generation," he says.

Within this, he has identified a number of aspects that he believes are important for the leather industry, some of them touching specifically on automotive leather. Carbon footprint is one of them. He describes this as "a big, big topic" for the automotive industry, and says: "It is my belief that a few years from now, a lot of consumer products will not only have a small price-tag, they will also have a CO₂ tag."

These CO₂ tags will represent what Dr Tegtmeier refers to as the key performance indicator (KPI) of the environmental footprint of a car, the leather in the car's interior or any other consumer product. One of the difficulties is that the leather industry is still discussing internally what the boundaries are for calculating its own footprint. Amid much confusion over which standards should apply when the leather industry defines the boundaries of its own environmental footprint, Dr Tegtmeier says he has seen figures emerge, using some methodologies, that put the carbon emissions for one square-metre of leather at 110 kilos of carbon dioxide, coupled with a water consumption of 16,500 litres. This is likely to make leather the loser in most benchmarking exercises against alternative materials.

The Lanxess vice-president describes as "excellent" the findings of consultant Federico Brugnoli in his assessment of all footprint standards and how they relate to leather production. Speaking at a number of industry events towards the end of 2012, Mr Brugnoli concluded that the calculation of the carbon footprint for leather production should begin at the abattoir and end at the tannery gate when the leather is shipped. The effect of this would be to exclude any of the footprint involved in animal rearing from attaching to the hide or skin in most situations. "Leather replaces non-renewable materials in its final applications and demand for leather does not determine the meat and milk industry," Dr Tegtmeier says. "Leather is the ultimate sustainable material."

As for automotive leather, Dr Tegtmeier points to the important role of companies such as his in turning a raw hide into premium finished leather of the quality required by high-end car manufacturers. It's an increasingly important task as the availability of the best raw material becomes more constrained. You can calculate the weight of one square-metre of automotive leather today at 700 grammes, but he says up to 35% of that comes from the chemicals tanners use in production. Lanxess has an overriding principle that means it wants its products to be "benign by design". Chemicals that are going to wash out during the tanning process rather than remain in the finished leather have to be reduced to a minimum as a general rule, he says, and should be easy to separate and biodegrade during wastewater treatment. Functional chemicals, on the other hand, should be designed to have maximum absorption into the finished leather and minimum emissions. There is a third group of products, reactive chemicals, such as synthetic tanning agents or crosslinkers. The aim is to ensure a full reaction, so that the final product is safe for consumption and for the environment.



The car industry now consumes 100,000 hides per day. In the 1980s, the total was 10% of that figure.

CREDIT: FORD MOTOR COMPANY

Pollution, energy-consumption and waste-generation have to be decisive elements of the sustainability strategy of any tannery, Dr Tegtmeier believes. "There is no magic [in managing these topics]," he says. "There is no rocket science. It's mainly about fairly simple things such as using a heat-exchanger and avoiding unnecessary water consumption. It doesn't require a great deal of investment, but mainly just professional manufacturing management. When it comes to waste, only 1% of weight of a fresh hide expressed on dry weight, cannot be used in a sustainable way. Everything else is either transferred into leather or, as a by-product, can be used as a renewable raw material for other products such as fertiliser, sausage skins, animal food and even fuel."

These are matters of great interest to automotive companies, Dr Tegtmeier insists, and part of their decision-making when they are weighing up what materials to use in car interiors; the leather industry has much to gain from addressing them. "Leather was the material of choice for most car interiors until the 1950s," he says, quoting a study from Stahl's business manager, Mike Tomkin. "In the 1960s and 1970s, leather almost disappeared, substituted by an alternative material named plastic. It came back strongly from the 1980s onwards. And while in the 1980s, only 10,000 hides a day were made into automotive leather, today automotive leather production has increased by a factor of ten; now, more than 100,000 hides are converted into automotive leather day by day."

He explains that, following the oil crisis of the 1970s, cars needed to become more aerodynamic and to have a more efficient fuel-consumption. For this reason, they began to look like each other more and more, at least from the outside. And with cars looking increasingly the same on the outside, the way the interior looks has become an important distinguishing factor. Another factor is the growing importance of "extras", including luxury interiors, from a point of view of margin-generation for the automotive brands.

If the leather industry is to maintain this level of success and avoid leather losing out and falling away the way it did in the 1960s and 1970s, it must keep up its efforts in innovation, identity and image, coming up with new ideas and new qualities to meet car companies' and consumers' demands at the same time as working hard to make sure users recognise and value the distinctive qualities of leather.