



Genuine lightweight leather: A new micro-sphere application concept

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The largest source of green house gas emissions globally is through the combustion of fossil fuels such as coal, oil and gas in power plants, automobiles, industry etc. the USA is the world's largest emitter of carbon dioxide (CO₂) and, in 2006, petroleum supplied the largest share of US domestic energy demands, accounting for an average of 47% of total fossil-fuel-based energy consumption⁽¹⁾. The USA and China produced by far the largest CO₂ emissions in the world of 5,987.98 and 5,010.17 million tonnes in 2004 respectively⁽²⁾. There are about 800 million petroleum consuming cars in the world⁽³⁾ which is expected to continue to rise long term, beyond the current crisis. The USA and China are now the world's biggest markets for such vehicles and there is seriously growing concern about sustainability.

Whether it is growing environmental pressure or the drive to reduce costs, the transport industry is increasingly demanding weight reductions for components which can unequivocally lead to reduced emissions and improved fuel consumption. For aircraft producers this has always been high on, if not top of, the agenda. However, other vehicle producers are now also increasingly demanding weight reductions in components and are prepared to pay for new innovation. Reportedly, large Original Equipment Manufacturer (OEM) groups have indicated that they are willing to pay several euros for every kilo in weight reduction. With increasing political pressure (US President Obama recently indicated that cars in the USA should attain minimum 30mpg) and later legislation together with dwindling resources this topic is expected to only grow in importance in the future.

Textile and/or leather – the future?

We all know leather is economical in comparison with textiles due to its durability and longevity. However, leather tends to be heavier than textiles. OEMs have already expressed the opinion that if action is not taken to tackle this issue, as pressure increases to reduce components' weight and thus decrease vehicle lifetime operating costs, the future of leather, at least in automotive applications, is potentially at serious risk.



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This means that the current high interest in our lightweight leather initiative, if this technique proves successful, is expected to only increase in importance. According to tests carried out so far, we can expect to achieve a weight reduction in the treated leather by a minimum of 10% up to a maximum of around 20-25%, depending upon the raw material and its preparation.

Leather processed with the Levotan® X-Cel technology remains real leather, and it is the only genuine lightweight leather concept we are aware of at present.

The role of micro-spheres in leather production

The application of thermo-expandable micro-spheres in leather finishing has already been introduced into the industry by Lanxess. Application and evaluation of micro-spheres for structural upgrading of leather⁽⁴⁾ are now in an advanced stage of evaluation at many large tanneries around the world and test steaming machines have been installed in Europe, Asia, South America and South Africa. The application of micro-spheres in lightweight leather is an innovative concept which promises to produce a new type of article. Initial trials look very interesting and many of the "kick-out criteria" proposed have been overcome. Intensive field trials are now well underway not only at important tanneries but also in leather consuming industries.

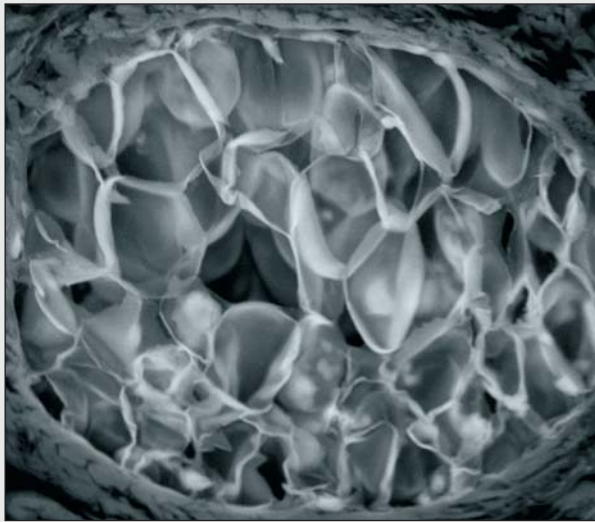
Throughout history tanners could only reduce, or at best maintain, substance during processing. With this unique technique for the first time ever, leather thickness can be increased and this can now be exploited to produce genuine lightweight leather.

Thermoplastic micro-spheres consist of a thin plastic shell and contain a liquid propellant. After steam activation they expand to form a honeycomb structure of "micro-cells" with a gossamer thin shell as shown in *Panel 1*:

The hydrocarbon content converts to gas form and thus the micro-cells become extremely light in weight. The leather can be prepared, and the expansion process steered, to give a substance increase and the resulting leather has a reduced density or weight compared with a conventional leather of the same thickness.



Panel 1 Honeycomb structure of expanded micro-cells



Producing genuine lightweight leather

Leather, suitably prepared for the appropriate transport application, is shaved thinner than the required end substance and then subjected to the X-Steam expansion process. For example, the leather may be shaved to ca. 1.0mm and then the substance is increased to the required ca. 1.3mm. Comparing this expanded leather to conventional leather of the same final thickness, 1.3mm, the density has been significantly reduced, it weighs less as indicated in *Panel 2*.

There are many advantages provided by this unique expansion process:

- The resulting split is thicker and thus more valuable.
- Looser areas, principally the bellies, can expand more than the denser parts, which can result in superior substance evenness over the entire hide.

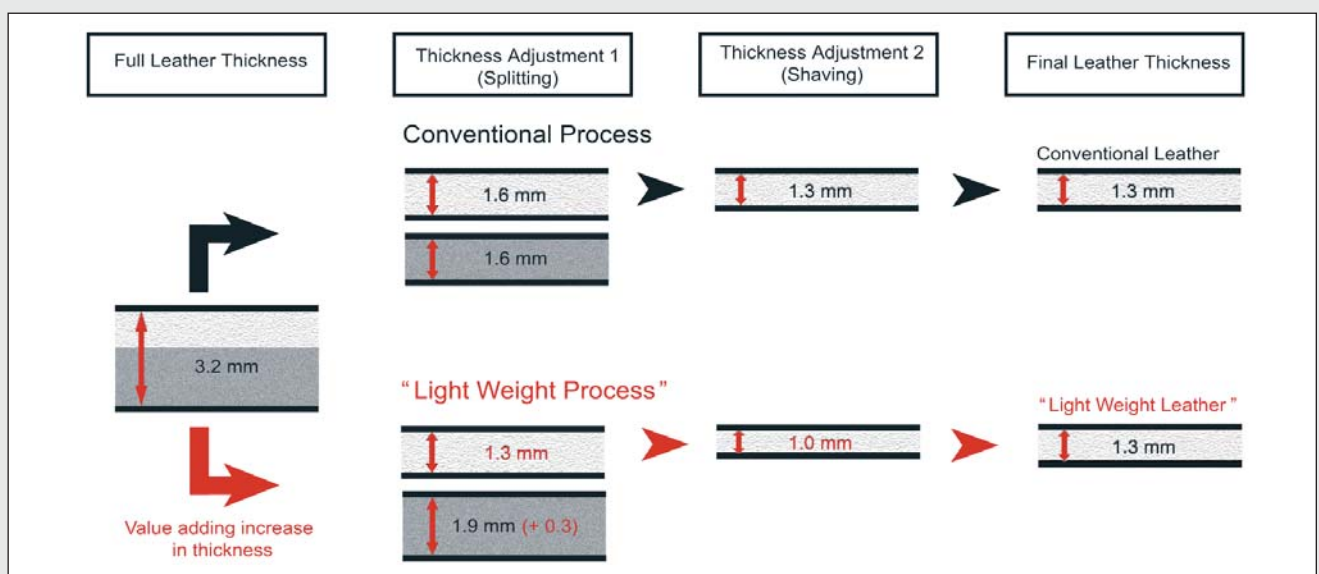
- As a consequence of the above, chemical wastage can be reduced as the splits can be better utilised and the cutting yield of the grain split increased.
- The grain split, having been shaved thinner, also contains less chemicals resulting in a saving, through reduced wastage.
- In elasticity testing, which examines permanent deformation – something of great importance to car seat manufacturing – the treated leather shows better structural stability in the problematical belly and flank areas without being harder. This is indicated in *Panel 3*.

X-Steam expansion process

Many customers have understandably attempted to activate the micro-capsules in leather by using their existing conventional plant such as convection and IR dryers. Unfortunately these employ, in effect, “dry” heat, designed for quickly removing water from surface aqueous finish films. In our experience, so far, these have not proven suitable to activate micro-cells throughout the thickness of the leather. Dry heat from this equipment does not penetrate well, dehydrates leather and consumes much energy. Evaporation, resulting from the use of this drying equipment, actually reduces the temperature of the leather, the reverse of that which is required, and so even more energy is required to compensate. Furthermore, by removing water from leather in this way it is easy to fall below 15% moisture content and area loss will result, which on reconditioning cannot be regained – the loss is permanent⁽⁵⁾.

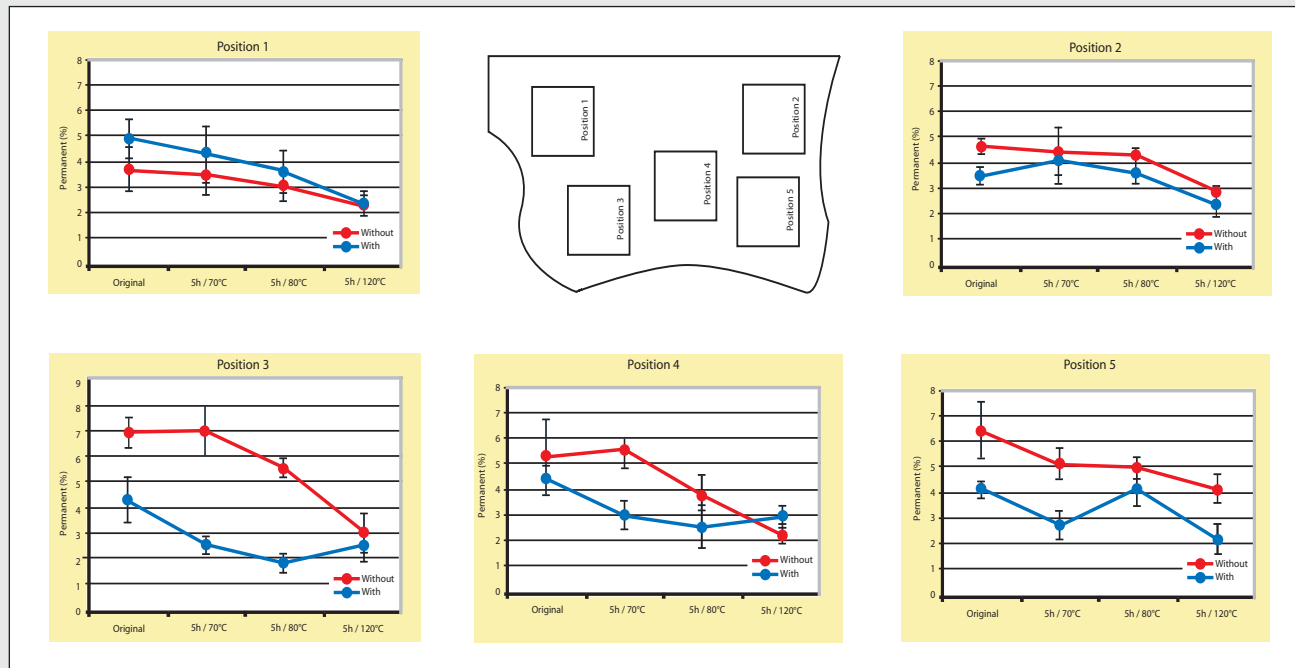
By using the X-Steam machine the humidity in the leather does not decrease and the vapour penetrates the cross-section in seconds, activating the micro-spheres in an instant. This fast reaction time is possible because the steam has a softening effect on the shell of the micro-capsules. Importantly, according to our data incorporating control leather without micro-capsules, there is no loss in area from the actual steam technique itself, and it is relatively economical. The estimated additional energy cost (steam) based on a production scale machine (9 metre/minute speed and 9 second activation time) has been shown to be less than €0.02 per hide.

Panel 2 Shaved thickness: conventional leather and micro-sphere technology

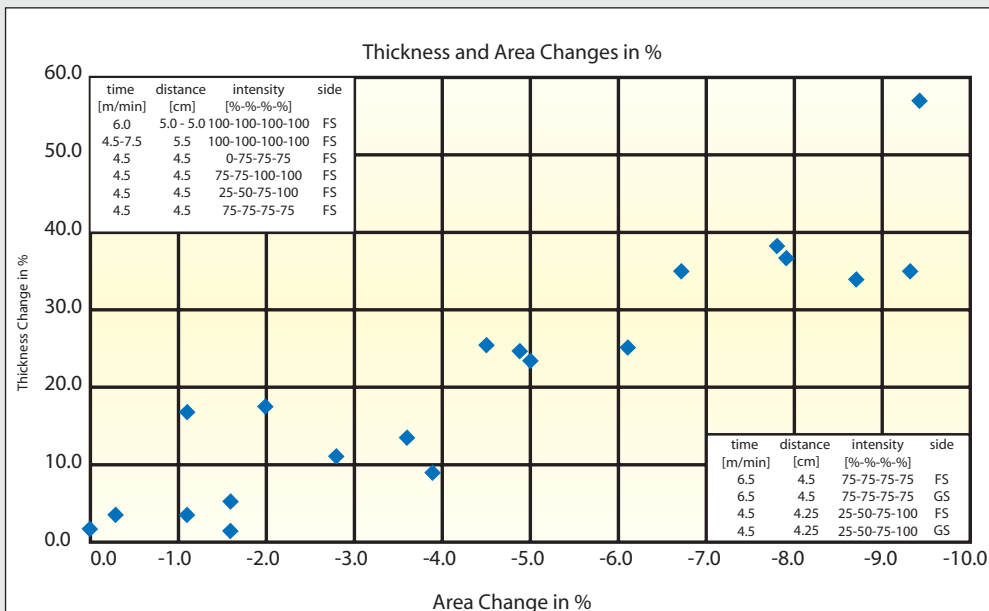




Panel 3 Structural stability of lightweight leather: conventional leather and micro-sphere technology (Permanent deformation determined by elasticity tests)



Panel 4 Percentage thickness and area changes



Flammability

The effect on the burning property of leather is commonly questioned, probably because the propellant inside the micro-capsules is hydrocarbon-based and the shell a type of plastic. This is of course particularly relevant for those involved in the production of leather for aircraft. We have conducted the usual vertical burning tests and we have not seen any significant difference between leather containing these micro-capsules and normal leather. The amount of product added is

relatively small usually between 3-6%, and only a proportion of this product actually consists of the micro-capsules, so they are highly effective. Furthermore, in the case of the softening version of these products, the polymer allows for the reduction in fatliquor offer. As fatliquors are the single biggest contributor to burning in the crust this means that the leather, with the softening version of this product, should, at least in theory, be even more resistant to burning than conventional leather.



Limitations

Technical advantages in this case do not come without any cost. Logically there will be some area reduction as thickness is correspondingly increased. We have studied this and results are illustrated in *Panel 4*:

However, this negative impact can be compensated for, because the expansion process can result in an increase of the cutting yield due to a more uniform filling of the belly and flank areas as well as certain voids and defects. In addition the benefit of weight reduction which gives fuel savings over the lifetime of the component is expected to far outweigh the area issue, hence the massive interest we are experiencing from the industry.

Absolute values for tear strength of leather do not decrease with an increase in thickness. Several leather samples have been produced in the Lanxess leather facilities and submitted for evaluation at independent testing institutes. This shows a negative impact in tear strength compared to non-expanded leather with the same thickness, but still within specification as set down in *Panel 5*.

The physical strength can also be increased if necessary by, for example, the correct application of PCA Polymers⁽⁶⁾. In more serious cases, beamhouse processes can be manipulated to increase or maximise corium fibre density to compensate. 🌐

Acknowledgements

C. Henzel and A. Hippel for their contributions.

References

(1) <http://www.epa.gov> February 19th, 2009.

Panel 5 Tear strength: conventional leather and micro-sphere technology

	Standard	Light-weight	Spec.
Leather thickness, mm	1.5-1.59	1.45-1.5	
Specific gravity, g/m ²	800	630	
Tensile strength (N) 4%	6.6	7.0	5-15
DIN EN ISO 3376 8%	13.7	15.4	10-40
12%	24.5	27.5	18-75
16%	39.9	43.3	28-116
20%	59.5	61.9	40-165
Tear strength (N) ISO 3377	36	26	25
Stiffness AA -N 067	1.8	1.3	0.8-2.0

Test results to OEM specifications.

(2) *UN Environmental Statistics*.

(3) *CNN March 15th, 2009*.

(4) *The structural upgrading of leather: A new micro-sphere application*, Tegtmeier and Tysoe, *World Leather* Nov 2007 p.27-30).

(5) *Yield, quality and physical properties of leather*, R. Daniels, *World Leather*, February/March 2009.

(6) *Leather softening technology*, Reiners and Tysoe, *Leather International*, October 2008.