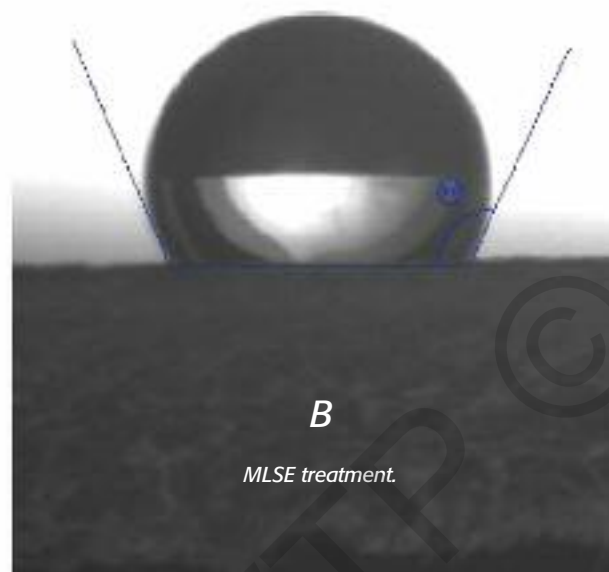
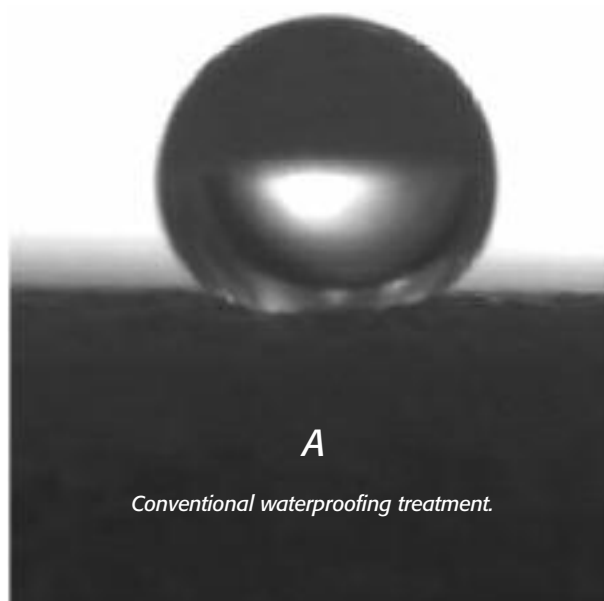




Contact angle measurement of a drop of water on bovine leather.

Laser plasma technology

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Due to its outstanding properties, leather is used for the production of a wide range of products, including clothing, footwear, leathersgoods, saddlery and upholstery for automobile, boat, aircraft and domestic furniture. Depending on the nature of the product and its intended use, a different type of leather with specific attributes is required for each final application.

In general, traditional finishing systems employed for producing leathers with specific functional properties such as water resistance, oleophobicity (oil repellency), flame retardancy, antimicrobial properties, abrasion resistance or antistatic properties, etc., require high energy and water consumption. In addition, many of these treatments require the use of certain chemicals, such as halogenated compounds, biocides or organophosphorous compounds. The use of these is restricted or under consideration by EU legislation including REACH Regulations and the Biocides Regulations, etc.

In this sense, sustainability is nowadays becoming an increasingly important issue for the leather industry. The health and safety of

consumers remains a priority for brands and retailers of leather products. There is indeed a growing demand for ensuring that no harmful substances are present in leather goods and that employees involved in the production of footwear and leather goods are protected from exposure to dangerous chemicals. Environmental campaigners are also pushing the industry towards a zero discharge of hazardous substances in the supply chain. To fulfil this demand, the leather industry is now looking for more sustainable solutions and processes that are more resource efficient and with lower environmental impact.

For these reasons, INESCOP is working on the development of innovative and sustainable technologies aimed at providing leather with functional properties such as flame retardancy, water repellency, stain resistance and/or antimicrobial that avoid the use of hazardous chemicals. This the aim in the case of multiple laser surface enhancement technology (MLSE).

MLSE

MLSE technology combines plasma and laser treatments and, in the

presence of non-toxic gases such as NO₂ (nitrogen dioxide) and O₂ (oxygen), allows the surface of materials to be modified. This treatment produces nanometric scale modifications which enable the required functionalisation of the material to be added without noticeably affecting its appearance. Furthermore, it also allows the addition of a thin but consistent precursor layer mainly on the surface, thus resulting in an improved material with functional properties.

What is more, MLSE technology consists of a dry, continuous process, so its application in finishing leather will lead to a significant reduction in the environmental impact of traditional leather finishing operations—especially in the case of flame retardant and water proofing treatments—in terms of greenhouse gas emissions and water and energy consumption.

Although the technology was first developed for the metallurgic and electronic industrial sectors, MLSE has since proved suitable for the cleaning of wool fabrics prior to dyeing. Nevertheless, the process needs to be adapted to the particularities of other

textile fibres and leather, as well as to the other functional properties to be acquired. The type of material being processed, together with other parameters, such as plasma intensity, laser energy and gas combination, determine to a large extent the modifications on the material surface and therefore, and, the imparted functional properties.

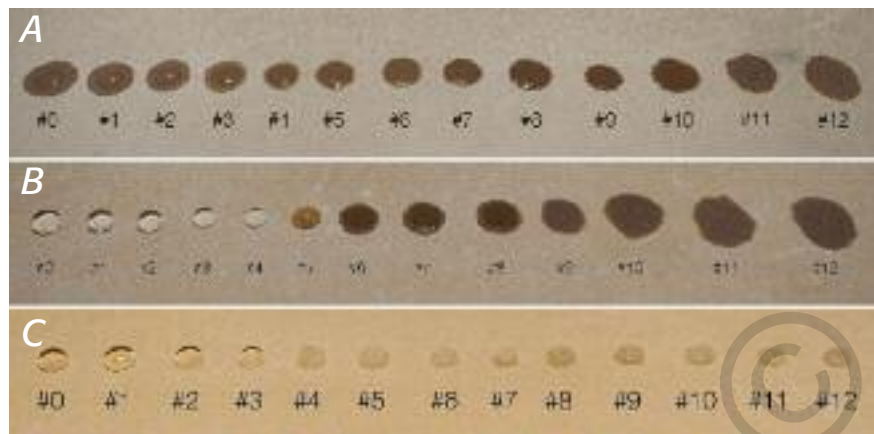
For this reason, a study aimed to demonstrate the technical and economic feasibility of MLSE in leather has been carried out in the framework of the European LIFE TextiLeather project in which promising results have been obtained.

RESULTS

With regard to hydrophobicity, it has been verified that the MLSE treatment could even yield water repellency properties in static conditions that were much higher than those obtained by conventional processes (ISO 23232). In addition, MLSE processed materials showed contact angles greater than 130° , which means high hydrophobicity of the treated surface when the contact angle is zero for untreated materials dyed to a total absorption of the liquid by the material.

In dynamic conditions, waterproofed leathers for professional footwear treated by MLSE were tested according to Standard EN ISO 5403-1, obtaining penetration times slightly greater than 60 minutes with water absorption less than 20%. Such results were achieved without detriment to water vapour permeability properties. Furthermore, MLSE treated leathers showed good stain resistance when tested according to Standard EN ISO 14419, up to Grade 7 (8 being the maximum). Furthermore, the MLSE surface treatment produced leathers with improved fire resistance and to an overall improvement in the antimicrobial properties of materials, avoiding the formation of bacterial biofilm on the surface of treated materials.

It should be noted that both the equipment employed in this study and the treatment conditions applied had been optimised for treating textile materials and had never been previously used for treating leathers. Promising results were still obtained however. Implementation of MLSE technology in the leather sector would nevertheless call for specific equipment



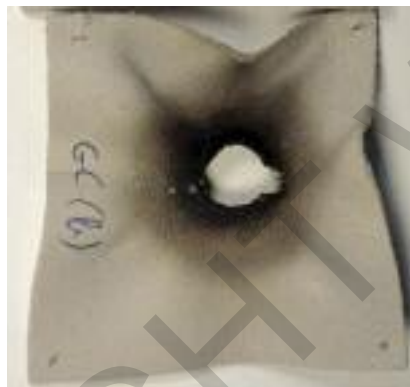
Effect of MLSE treatment on water repellency of bovine leather.

A – Without treatment.

B – With conventional waterproofing treatment.

C – With MLSE treatment.

A – Without treatment.



Grain side.



Flesh side.

B – With MLSE treatment.



Grain side.



Flesh side.

to be designed and produced.

MLSE treatment has been demonstrated to be an efficient and sustainable alternative to traditional finishing processes of functional leathers, which could help reduce the environmental impact of the leather industry, thus contributing towards meeting increasingly more demanding European legislation. It also endorses the resource-efficient Europe flagship initiative of the European Commission and supports the principles provided for in the Directive 2010/75/EU on

industrial emissions (integrated pollution prevention and control) and other EU environmental policies, such as the Waste Framework Directive (2008/98/EC) or the Water Framework Directive (2000/60/EC).^②

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