

# EU project aims to set up new tanning process

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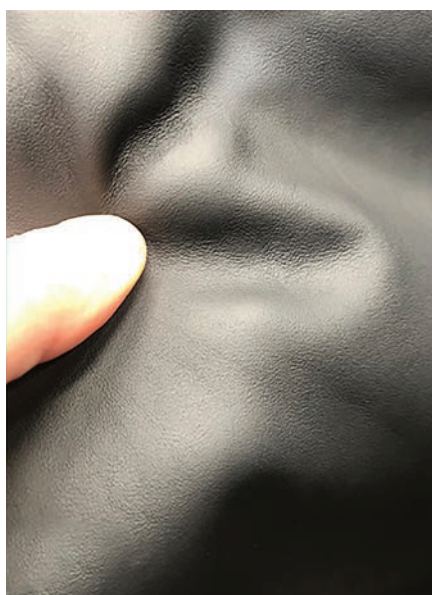
(Pasubio, Arzignano, Vicenza)

*Academics from Ca' Foscari University in Venice and tanning industry partners in nearby Vicenza have been working together and making progress on GOAST, a project that is part of the European Union's wider LIFE programme and aims to encourage the use of greener tanning agents to make leather manufacture more sustainable.*

**G**reen Organic Agents for Sustainable Tanneries (GOAST) is part of the LIFE programme, a funding instrument for environment and climate action that the European Union set up in 1992. GOAST's classification is: LIFE16 ENV/IT/000416. The project began in July 2017 with the aim of demonstrating the efficiency and benefits, on an industrial scale, of a new tanning technology that the project partners believe can replace the traditional chrome-tanning process (TCTP) in the production of leather for automotive, furniture and footwear.

## The tanning process

The tanning process is the treatment raw hides undergo to transform them into the stable, workable conservable material that we know as leather. During this process, tanning salts, such as basic chromium or aluminium salts, vegetable tannins or aldehydes and so on bring about the crosslinking of the collagen fibres that make up the hide. This leads to improvements in the properties of the material in terms of resistance to enzyme attack, to water, and to thermo-mechanical stress. Tanning hides is one of the most ancient human-discovered technologies we have. Around 160,000 years ago, it was the use of animal



*Leather produced using GOAST technology.*

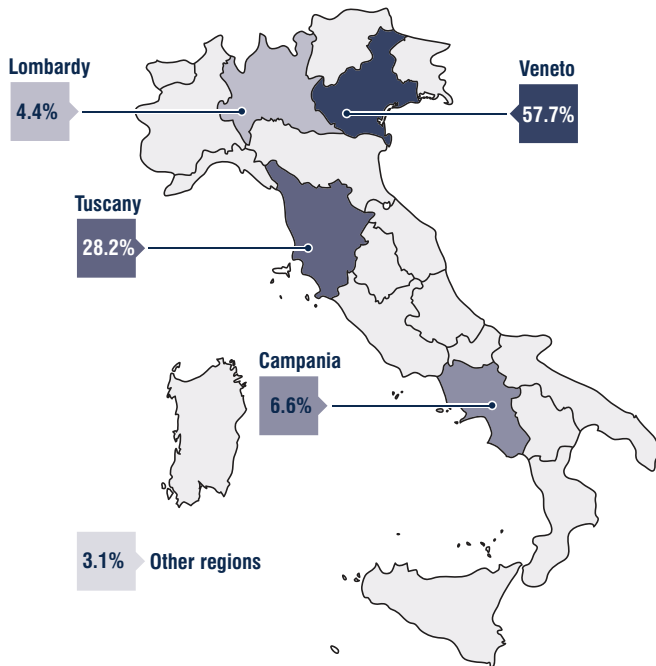
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skins and fur that allowed Neanderthals to survive adverse weather conditions<sup>1</sup>. Later, around 3,000 years BC, the Egyptians were using aluminium salts to tan skins, as artefacts that have come to light testify<sup>2</sup>.

However, it took until 1858 for a really radical transformation of tanning production to come about when

Friedrich Knapp discovered the tanning properties of chromium. This method, that became widespread across the industry within 30 years of its discovery, has revolutionised the tanning industry because of the quality and versatility of the leather it produces<sup>3</sup>.

Nowadays, leather production at a global level is in excess of 6.5 million tonnes a year, with industry turnover around \$220 billion<sup>4,5</sup>. At a global level, Europe is the biggest supplier of leather. Among the member states of the European Union, Italy leads in leather, producing 65% of the total European volume and 22% of global volume<sup>6</sup>. Italy's tanning sector combines innovative technology with the artisanal production its companies specialise in. It is this that has made it possible to bring the excellence of Made In Italy to the world. Around 1,200 companies are active in the Italian tanning sector, most of them small- and medium-sized enterprises, concentrated in a number of specialist tanning districts. The district with the largest production and biggest workforce is the one in and around Arzignano in the province of Vicenza, followed by the Tuscan tanning district that covers Santa Croce sull'Arno and Ponte a Egola. There are also districts in Campania and in Lombardy.



The raw hides used in Italy's leather production come from the meat industry. The tanning sector is, therefore, using another industry's by-product as its raw material and can consider itself part of the circular economy. Every year across the globe, the tanning industry takes and puts to good use around 1.7 million square-metres of raw hide and transforms

this into a product with a high added value<sup>7</sup>.

While the tanning sector uses a by-product as its raw material, it uses large quantities of chemical products and other resources to convert that raw material into finished leather. Chemical processes aside, it takes a high volume of water to produce leather. *Table 1<sup>8</sup>* sums up the volumes of water and chemicals required to produce 1,000 square-metres of chrome-tanned leather. Unless they are handled correctly, these resources, plus the wastewater they generate, can cause harm to the environment and to workers' health and safety.

For these reasons, leather manufacturing is classified as water-, energy- and waste- intensive. Today, around 85% of all leather production around the world uses chrome tanning, with only a minor proportion, therefore, using alternative processes. The use of chrome has the potential to cause environmental and health concerns because of the possibility, under some circumstances, of chrome VI forming in finished products. Chrome VI has been recognised as potentially carcinogenic, mutagenic and allergenic, which is why current legislation sets a limit of 3mg/kg of chrome VI in finished products<sup>9</sup>.

Moreover, there is another problem linked to the presence of chrome in the wastewater from tanning processes because only between 50% and 70% of the chrome binds covalently to the collagen<sup>10</sup>. This has led to increasingly stringent environmental regulations for the total chromium discharge into surface waters, the value of which must be below 2.0 mg/l<sup>11</sup>.

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**Table 1: Water and chemical volumes required to make 1,000 square-metres of finished leather**

| Substance                                             | Quantity (kg) |
|-------------------------------------------------------|---------------|
| Water                                                 | 215,000       |
| Inorganic salts (NaCl)                                | 570           |
| Organic and inorganic acids                           | 30            |
| Sodium sulfide                                        | 175           |
| Sodium hydroxide                                      | 285           |
| Enzymes                                               | 20            |
| Bactericides                                          | 20            |
| Surfactants                                           | 20            |
| Chrome                                                | 700           |
| Chromium(III) oxide (Cr <sub>2</sub> O <sub>3</sub> ) | 175           |
| Vegetable tannins                                     | 50            |
| Synthetic tannins                                     | 50            |
| Polymers                                              | 50            |
| Resins                                                | 10            |
| Fatliquors                                            | 150           |
| Colourants                                            | 35            |
| Polymeric binders                                     | 30            |

From this, it has become clear that the whole leather value chain is obliged to explore new tanning strategies that have sustainability as their common denominator and the objective of reducing the impact of the whole process on health and on the environment. It was as a result of this obligation that the GOAST project came into being; the project partners wanted to implement on an industrial scale a new tanning technology that would be more environmentally friendly than TCTP.

GOAST has these specific project goals:

- Produce high-quality, chrome-free leather articles for the automotive, furniture and footwear sectors on a pilot scale
- Improve the condition of wastewater by means of reducing the presence of chrome salts, acids, alkalis and sodium chloride in the tanning and retanning phases
- Show that the new GOAST technology has a lower environmental impact, in terms of reducing dangerous substances, risks to the environment or to human health and the consumption of water
- Eliminate or reduce chrome sludge.

The end objective is to show that the new process brings about a reduction in the environmental impact and can deliver leather that is equal or better in quality compared to the leather obtained through the TCTP while presenting fewer challenges when it comes to waste disposal.

GOAST has involved tanning sector experts from leather chemical company GSC, leather manufacturer Pasubio and wastewater services provider Mediochiampo all working together, with the scientific, technical and environmental support of academics from Ca' Foscari University in Venice.

The partners have used lifecycle assessment (LCA) and lifecycle costing (LCC) to measure the impact of the technology and to assess the feasibility of bringing it to market. They have set out to establish a sustainable value chain from using the new technology to transform raw hides in crust. In addition, they have set out to try to find a way of obtaining value from one of the solid waste products, shaving dust, resulting from the process.

### Production of the new tanning agents

The technology the GOAST partners have come up with is based on a combination of acrylic polymers and synthetic tannins. The acrylic polymers are plasma-treated to facilitate interaction between the polymers and the collagen in the hides through covalent bonds. This, in turn, leads to leather articles with good physical and chemical properties.

Producing the polymers required has worked well in the laboratory but scaling this up is still in progress and the technology for producing the plasma-treated polymers that the system requires is patent-pending.

### Conclusions

GOAST technology has shown itself to be, potentially, a valid alternative to the TCTP process. Its use can certainly lead to a tanning process with a lower environmental impact. Tanners can substitute chrome salts and apply the new GOAST process. It uses the same fatliquors and retanning agents as TCTP, which means the new technology is versatile.

Leathers produced so far using GOAST have shown characteristics that are suitable for meeting the needs of the automotive industry, an industry that demands a very high performance standard compared to other markets for finished leather, including furniture and apparel. What this means is that GOAST leather will be suitable for use in furniture and apparel, too. Ongoing aims of the project partners include producing materials for a vast range of leather products.

GOAST clearly has the potential to have a lower impact on the environment through avoiding the use of chrome and other metals in the tanning process, especially with regard to the treatment of wastewater and disposal of solid waste. The system includes the use of pyrolysis on the shaving dust, which yields a biochar, a type of charcoal, free from any dangerous metal, that can be used to improve the quality of soil. 🌱

### Notes

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