Sheep wool contains high levels of impurities, as much as 60% by weight. The major impurity is grease (lanolin), a waxy substance secreted by the animals to repel water from their coats. Wool also contains varying amounts of dirt, dead skin, sweat residue, pesticides and vegetable matter, often in the form of wool dust. Before wool can be used commercially, it must be cleaned by hot aqueous scouring. Depending on the properties required for the final product, this can involve a complicated process using detergents and alkali, which generates large quantities of wastewater with a high organic content.

For every kg of clean wool produced by aqueous cleaning, some 17 litres of effluent, with a high Chemical Oxygen Demand (COD) value (0.3-2.4 kg) is generated. Consequently, aqueous wool scouring has a high environmental impact, since it consumes large amounts of water and energy, and generates large quantities of highly polluted effluents. Moreover, the wastewater requires several treatment stages before disposal, consuming additional resources.

Objectives

The objective of the Wooldryscouring (WDS) project was to demonstrate an innovative process of “wool dry scouring”, based on closed-loop processing and total waste recovery. The aim was to determine whether it is possible to achieve quality improvements in the clean wool, to reduce wastewater consumption and
to increase the recovery and valorisation of by-products.

The project aimed to recover lanolin and wool dust by means of solvent extraction and purification technologies in a prototype dry process. After this process, it was expected to obtain cleaner wool which would require just a simple rinsing process with low water and energy consumption to produce clean showing better quality than the one produced by water scouring. The WDS process was designed to optimise the overall wool scouring through: 1. Reducing the volume of effluents generated and chemicals in the scouring process (detergents). 2. Minimising the contaminants in water effluents through the recovery of wool grease, which can find application in the cosmetic industry, and wool dust, which can find application as fertiliser.

Results

The Wooldryscouring (WDS) project demonstrated an innovative wool scouring cleaning process to remove impurities in the early stages of wool manufacturing, which resulted in a cleaner product and reduced environmental impacts in terms of water and energy consumption and polluted wastewater generated. The consortium created with LEITAT and CSIC as research centres, RMT as an industrial partner and Tavares as a scouring plant, designed, built, tested and demonstrated at pilot scale the new technology, which uses organic solvents instead of the hot water with alkalis and detergents used in conventional wool scouring. In this way, grease (mainly lanolin) can be extracted at an earlier stage, for example, for use in the cosmetic industry. To achieve this, the WDS approach uses a batch production process rather than the conventional continuous production process in water. This new approach is highly innovative in the sector.

As a result of the pilot demonstration, the project team produced wool that was whiter, cleaner, smoother and with larger fibres, than conventionally scoured wool. The project’s wool was practically free of grease content, with 95% of wool grease (lanolin) being recovered for use as a valuable by-product. In addition, nearly 100% of the wool dust was recovered, which can be used as an agricultural fertiliser.

The new dry scouring process resulted in several environmental benefits:

- **Water:** o Reduction of 70% in water consumption; o Reduction of wastewater effluents in the rinsing water process by 70%; o Wastewater produced of better quality as it had 75% lower Chemical Oxygen Demand (COD); and o The need for detergents and chemicals was reduced by 70%.
- **Energy and climate:** o Reduction of 30% in energy consumption mainly from the wastewater management system (reduction of amount of wastewater and improved quality of the effluent); and o Carbon footprint reduced by 96 kg of CO2 eq. per functional unit with the WDS technology compared to traditional processes.
- **Waste:** Recovery of water-polluting greasy wool waste (95% recovery of lanolin) components and other by-products avoiding expensive water treatment and waste disposal.

WDS technology has lower environmental impact (Life Cycle Assessment, LCA) than the traditional wool scouring process. The low fugitive emissions of solvent measured at the pilot plant due to the solvent manipulation and vacuum suction
pump could be reduced significantly at industrial scale when implementing mechanization and automation.

The technology developed also produces economic benefits. Reductions in waste generation and water, energy and chemical consumption using the WDS technology resulted in important cost savings, compared to the costs of conventional wool scouring. The Economic Assessment conducted by the project team showed that the WDS process should be economically viable in Europe and holds a high replicability potential. The project’s technology represents a significant step towards achieving a closed loop concept where all the current wastes streams are recovered as by-products, in line with EU circular economy policy and the Europe 2020 Strategy for smart, sustainable and inclusive growth.

Policy-wise, due to the valorisation of the dust and grease recovered using the WDS process, the project is in line with the Waste Framework Directive (2008/98/EC), which prioritises valorisation rather than waste disposal. Furthermore, reductions in water consumption together with the improvements in the quality of the process’s final effluent contribute to the implementation of the Water Framework Directive (2000/60/EC), aiming to achieve a good status of all EU water bodies.

The project proved the environmental and economic viability of the new technology. The project beneficiaries are therefore looking for partners who wish to implement WDS at semi-industrial scale in order to boost confidence in the sector since the implementation of the WDS process would mean to change the process substantially, replacing the traditional continuous scouring process using water with a batch scouring process using solvent.

The process has the potential to increase the competitiveness of the European wool industry. Many European wool scouring companies cannot afford wastewater treatment costs (accounting for nearly 28% of total production costs). Wool scourers cannot find other viable alternatives to scour wool and they close progressively. In fact, in Europe there are only 18 wool scouring manufactures left. So, wool traders sell greasy wool to other countries to be scoured where the scouring costs are lower. The WDS process could reverse this trend, to help maintain and recover the wool industry in Europe, as a result of being 25% cheaper (with further benefits possible through lanolin valorisation). New jobs could be created after industrial implementation, with worker health benefits due to reductions of odour and dust. Around 18 industries requested to receive updated information after the project end date.

Further information on the project can be found in the project's layman report and After-LIFE Communication Plan (see "Read more" section).

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Environmental issues addressed:

Themes

Industry-Production - Textiles - Clothing
Environmental management - Cleaner technologies

Keywords

water quality, waste water reduction, natural fibre, water pollution, by-product, clean technology, water quality improvement, waste recycling

Target EU Legislation

- Waste
- Water

Natura 2000 sites

Not applicable

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Beneficiaries:

Coordinator  LEITAT
Type of organisation  Research institution
Description  LEITAT is a non-profit research centre founded in 1906, with a history of more than 100 years. LEITAT develops R&D activities in the areas of materials sciences, environment, surface treatments, biotechnologies and renewable energies with deep knowledge and experience in technological transfer to several industrial sectors. LEITAT is a Technological Center, member of TECNIO and recognized by the Spanish Ministry of Economy and Competitiveness, that aims to collaborate with companies and institutions by adding technological value both to products and processes, and focuses its activity on research, development and industrial innovation (R+D+2i). The expertise of LEITAT covers a wide range of thematics such as
Biotechnologies, Construction, Energy, Environment, Food Security, Maritime, Health, ICT, Nanotechnologies, Security, Transports and Aeronautics. LEITAT takes part and works as a technology partner in several initiatives that demonstrate its reliability as a dynamic agent in technology transfer and innovation planning in companies, entities and institutions, through different national and international organisations. LEITAT is totally involved in the development of different R&D projects at national and international level.

Partners
Recuperación de Materiales Textiles, S.A., Spain
Téxtil Manuel Rodríguez - Tavares S.A., Spain
Agencia Estatal Consejo Superior de Investigaciones Científicas – Instituto de Química Avanzada de Cataluña, Spain

Administrative data:

Project reference  LIFE11 ENV/ES/000588
Duration 01-SEP-2012 to 28-FEB -2016
Total budget 3,007,866.00 €
EU contribution 1,477,182.00 €
Project location Cataluña(España)

Read more:

Leaflet Title: Leaflet of the project (Spanish version) No of pages: 2
Leaflet Title: Final conference leaflet (Barcelona, February 2016) Year: 2016 No of pages: 2
Newsletter Title: Newsletter 5 - February 2016 Year: 2016 Editor: WDS Consortium No of pages: 1
Newsletter Title: Newsletter 5 - September 2015 Year: 2015 Editor: WDS Consortium No of pages: 1
Newsletter Title: Newsletter 4 - March 2015 Year: 2015 Editor: WDS Consortium No of pages: 1
Newsletter Title: Newsletter 3 - September 2014 Year: 2014 Editor: WDS Consortium No of pages: 1