Eco-Efficient Dry Wool Scouring with total by-products recovery (LIFE11 ENV/ES/588)

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The greasy wool contains:

Wool fibre	40-80%
Suint	3 -12%
Wool wax (or wool grease)	6-20%
Dirt (or mineral matter)	5-20%
Vegetable matter	5-15%

Wool water scouring

Problems of wool scouring process:

Composition of Wool Scour Effluent*

Component	Amount (mg/L)
Wool Wax	3000-6000
Suint	3000-6000
Soil	4000-7000
Pesticide	<1
Biochemical Oxygen Demand (BOD)	2500-5000
Chemical Oxygen Demand (COD)	15000-30000
Suspended Solids (SS)	5000-10000
Total Nitrogen	200-500
Potassium	1000-1500
Ammonia N	40-120
Phosphorus	20-50
Total Surfactants	300-600
Sulphide	<1
Sulphate	30-100
Electrical Conductivity (EC)	1250-4000 µsiemens cm^{-1}
pH	7.5

*Data from Bateup, B O, Christoe, J R, and Russell, I M, CSIRO Division of Wool Technology, 1995. Refers to primary treated effluent. Assumptions: Australian wool, water consumption 10 L/kg greasy wool, primary recovery of 32% of the wax and 42% of the dirt.

large quantities of wastewater
highly pollutant wool scour effluents

⇩ Wastewater treatments

expensive
(high capital and operating costs)

non-efficient
(treated effluents are still a problem, sludge containing grease and dirt)

The European wool scourers closed progressively because they could not afford the waste water treatments costs required to accomplish with the discharge limits to rivers or public sewers.

WDS concept approach

Greasy wool solvent degreased and overdried liberates easily the non-fiber material as a fine dust

Wool Dry Scouring project focuses on demonstrating a new technology to scour wool with total by-products recovery using solvent in a closed-loop system to replace the conventional wool water scouring.

Solvent scouring - Historical approaches of solvent scouring

Common issues of past previous processes using solvent:

- Replicate water process using solvent
  (bowls, rolling press, convective drying…)

- Loss of whiteness and softness
- Non-soluble solids become a mud made of dirt and solvent.
  - Drop in lanoline yield; solvent content difficult to recover; generation of a new waste
- Solvent recovery Wool Imbibed is challenging

- <u>Fire and explosion risk</u>
  - Flammable solvents: it is required to avoid explosives atmospheres.
  - This was avoided by using chlorate solvents but then:
    - Health and Environment hazardous (ozone-depleting substance)
    - Lanoline had little value as was contaminated

WDS concept approach

Shorn Wool

WDS

Dedusted Wool

Water rinsing

Scoured Wool

Wool grease

Wool dust

WDS objectives

✓**Wool Dry Scouring (WDS)** project focuses on demonstrating a **new technology** to scour wool with total by-products recovery using solvent in a closed-loop system ⇨ replacement of the conventional wool water scouring

✓ High efficiency of **recovery of greasy wool components**: clean wool, wool grease (lanolin) and dirt (wool dust): by-products of wool with a market value.

✓Demonstration of **technical and economical feasibility** of the innovative technology to scour wool and recover by-products.

✓Reduction of **environmental impact**: reduction of water consumption, chemicals, energy, reduction of wastewater volume, wastewater with reduced waste load.

✓WDS targets fits with the priority areas for **LIFE+ Environmental Police and Governance** (waste prevention, recovery and recycling products)

WDS Consortium

- Coordinator:
  - **LEITAT** Technological Centre

- Associated Beneficiaries:
  - Recuperación de Materiales Textiles S.A. (RMT SA)
  - Textil Manuel Rodrigues Tavares SA (TAVARES SA)
  - Consejo Superior de Investigaciones Científicas – Instituto de Química Avanzada de Catalunya (CSIC-IQAC)

- 01/09/2012 - 28/02/2016

WDS process optimisation at lab scale

SOLVENTS ⇨ different polarity

PREVIOUS LAB WORK: erlenmeyer flask

(hexane, methanol, acetone and isopropanol)

Define the WDS protocol at lab scale

DESIGN 1: tea pot + polypropylene bag

(hexane, methanol and acetone) *dust retention*

Next: without bag

DESIGN 2: tea pot

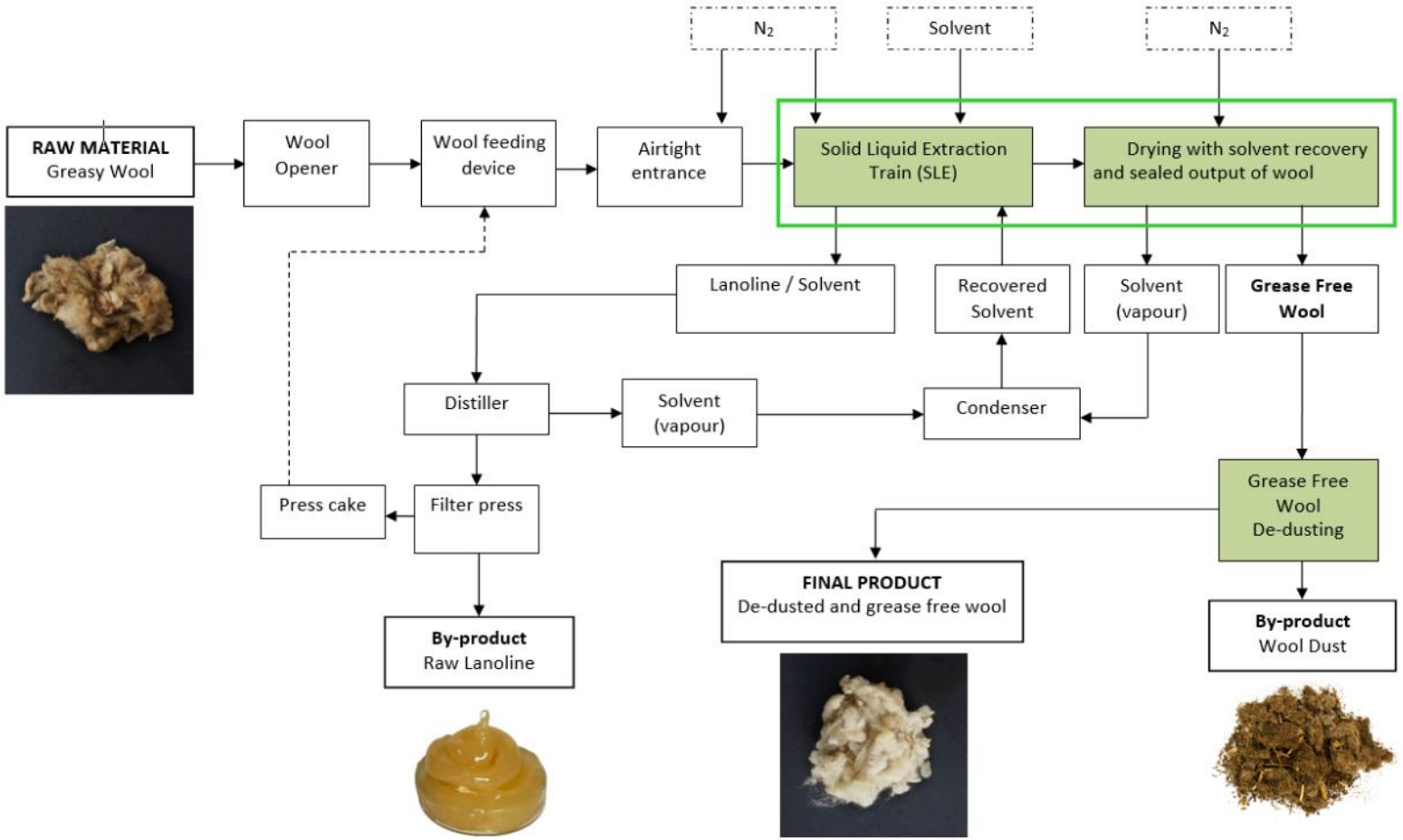
(methanol + H_2O +sulfuric acid)⇨ *acid influence on suitine and water influence in solvent*

DESIGN 3: tea pot

(hexane, pentane and mixture 50/50)

Next: apolar solvent

WDS process layout



Issues considered in the prototype

- Entrance/exit confinement
- Solid-Liquid Extraction (counter current system)
- Embedded solvent: recovery/drying
  - Avoid explosive atmosphere
  - Avoid wool colour fixing and toasting
  - Avoid solvent losses
  - To separate the lanolin and solvent from the fines

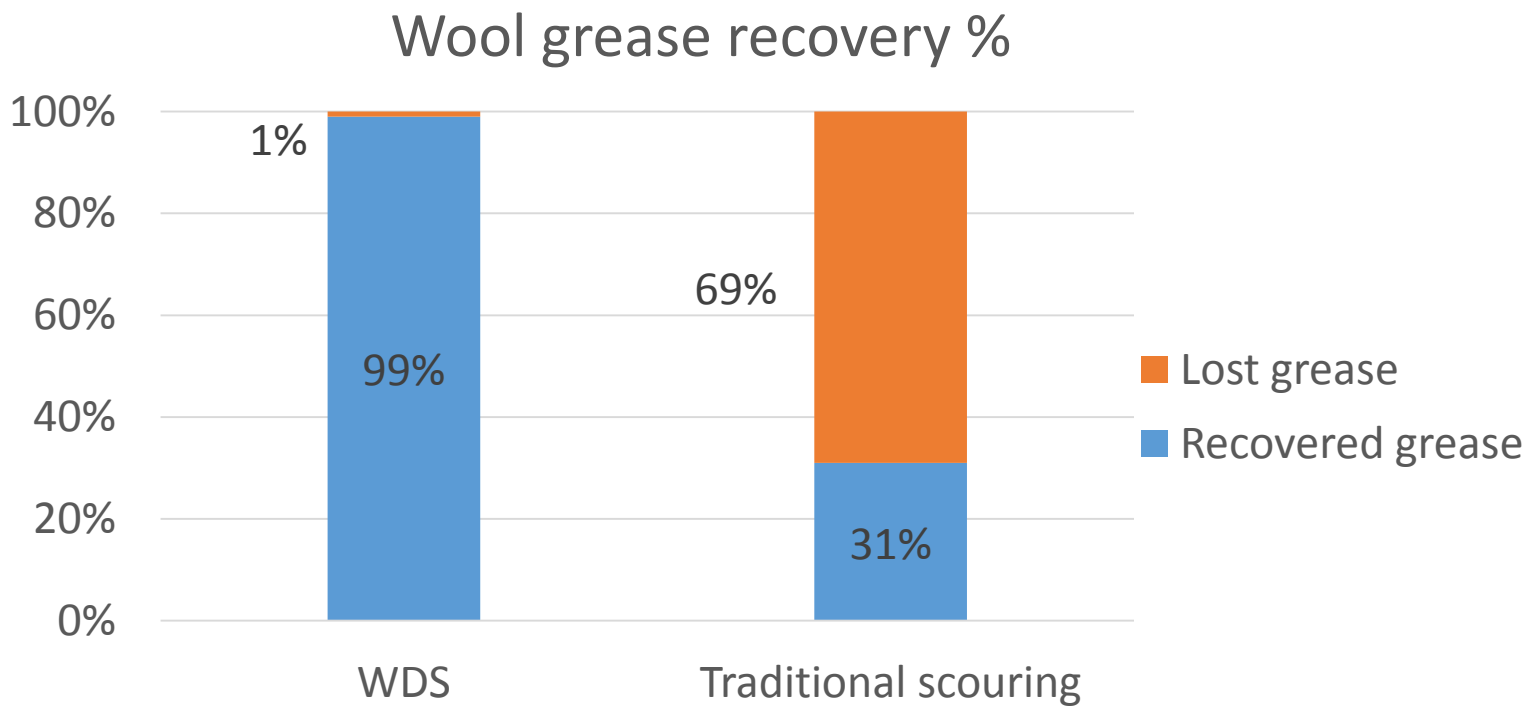
⇨
  - The continuous process was assessed. Finally, the batch system was implemented.

WDS Prototype

Comparative Industrial trial Shorn Wool: Spanish Merino Type II		
	Traditional Water scouring	WDS + rinsing
% Initial wool grease	14,4%	
% Recovered grease	-	11,9%
Post-treatment	-	Drying at 60 ºC & de-dusting
% COD Reduction vs water scouring		**76,4%**
% Residual grease in scoured wool	1,15%	**0,64%**
% Total Wool dust	1,81%	**23,6%**
Scoured wool Whiteness	48,6	**52,6**

% over initial wool weight

Wool grease: Yield comparison



Conclusions

The Wool Drying Technology (WDS) has demonstrated :

✓WDS enhances **Wool Quality:**

Whiter, cleaner, smoother, fibre entanglement free,
higher combing yield and lower grease content

✓WDS **recovers**:

95% **Wool Grease** content (vs 40% in conventional wool scouring)

~ 100% **Wool Dust** (100% when implementing rising water evaporators)

Conclusions

✓**Technical viability**: Demonstrated

✓**Economic viability**: Assured vs Water scouring

✓**Minimum environmental impact**:

The carbon footprint is reduced 96 kg of CO_2 eq. per functional unit by WDS technology

Reduction:

- ✓>75% COD in rinsing water
- ✓75-100% Detergent and chemicals consumption
- ✓75% Water consumption / Wastewater
  - ⇨ 100% reduction when implementing rising water evaporators

⇩

Zero waste generation !!!

Conclusions

-Wool Dry Scouring friendly process focuses on a wide range of **potential target markets**

-Associations for sheep farming
-Wool scouring companies
-Wool manufacturers and designers
-Wool textile federations
-Fertilizers manufacturers
-Lanolin manufacturers
-European engineering companies
-Wool research centres and the European scientific community
-Waste managers consultants
-Public bodies

-WDS can **enhance the competitiveness of the wool sector** thanks to

- ✓selling byproducts (wool wax and wool dust)
- ✓decreasing of manufacture costs (reduction of water, energy, chemicals consumption, wastewater treatments and land disposal)

Eco-Efficient Dry Wool Scouring with total by-products recovery

http://life-wds.eu/en/dissemination

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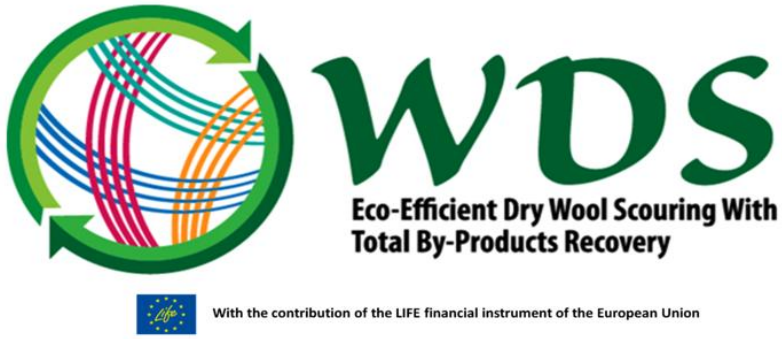
https://leitat.typeform.com/to/NwEgwW



THANKS FOR YOUR ATTENTION

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