

Clean Technologies and Environmental Policy

From leather wastes to leather: enhancement of low quality leather using collagen recovered from leather tanned wastes

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Costs/Benefits analysis of traditional and innovative re-tanning processes

	Costs related to the re-tanning of 1 piece of ovine leather					
	Traditional re-tanning (CONTROL)		Collagen-based re-tanning (TEST C)		Collagen-based re-tanning (TEST E)	
	Input		Input		Input	
	Amount	Cost	Amount	Cost	Amount	Cost
Leather ^a	0.2 kg	€ 7.50	0.2 kg	€ 7.50	0.2 kg	€ 7.50
Process water ^b	0.0007 m ³	€ 0.0006	0.0007 m ³	€ 0.0006	0.0007 m ³	€ 0.0006
Fatliquoring step						
- Lipoderm ^c	0.006 kg	€ 0.024	0.006 kg	€ 0.024	0.006 kg	€ 0.024
- Coripol ^d	0.006 kg	€ 0.015	0.006 kg	€ 0.015	0.006 kg	€ 0.015
- Temperature ^e	45°C	€ 0.34	45°C	€ 0.34	45°C	€ 0.34
- Stirring ^f	100 rpm	€ 0.0135	100 rpm	€ 0.0135	100 rpm	€ 0.0135
- Process time	1 h	-	1 h	-	1 h	-
Process water ^b	0.0007 m ³	€ 0.0006	0.0007 m ³	€ 0.0006	0.0007 m ³	€ 0.0006
Resins-based filling step						
- Sellasol ^g	0.012 kg	€ 0.034	0.012 kg	€ 0.034		
- Melamina ^h	0.012 kg	€ 0.019	0.012 kg	€ 0.019		
- Tara ⁱ	0.012 kg	€ 0.028	0.012 kg	€ 0.028		
- Basytan ^j	0.012 kg	€ 0.022	0.012 kg	€ 0.022		
- Temperature ^e	45°C	€ 0.51	45°C	€ 0.51		
- Stirring ^f	100 rpm	€ 0.02	100 rpm	€ 0.02		
- Process time	1.5 h	-	1.5 h	-		
Collagen-based filling step						
- Collagen ^k			0.010 kg	€ 0.789	0.010 kg	€ 0.789
- Enzyme ^l			0.010 kg	€ 1.00	0.010 kg	€ 1.00
- Casein ^m			0.001 kg	€ 0.12	0.001 kg	€ 0.12
- Temperature ^e			45°C	€ 1.54	45°C	€ 1.54
- Stirring ^f			150 rpm	€ 0.06	150 rpm	€ 0.06
- Process time			4.5 h	-	4.5 h	-
Total costs		€ 8.52		€ 12.03		€ 11.40
Leather added value ⁿ		€ 12.50		€ 17.50		€ 17.50
Gain		€ 3.98		€ 5.47		€ 6.10

a) Low quality leather costs 15.00 €·m⁻², 1 piece of ovine leather is 0.5 m² and 0.4 kg·m⁻²

b) Water costs: 0.88 €·m⁻³ (Resolution ARERA n.665/2017/R/Idr)

c) Lipoderm costs: 4.030 €·kg⁻¹

d) Coripol costs: 2.551 €·kg⁻¹

e) Estimated as 1.27 kW per 0.27 €·kW⁻¹·h⁻¹ per process time

Where 1.27 kW is the power required by the used oven (Heraus Function Line UT 6); 0.27 €·kW⁻¹·h⁻¹ is the current cost of the electricity (Resolution ARERA n.621/2021/R/eel)

f) Estimated as 0.05 kW per 0.27 €·kW⁻¹·h⁻¹ per process time

Where 0.05 kW is the power required by the orbital shaker (Stuart Scientific SSL1); 0.27 €·kW⁻¹·h⁻¹ is the cost of electricity (Resolution ARERA n.621/2021/R/eel)

g) Sellasol costs: 2.863 €·kg⁻¹

- h) Melamina costs: $1.660 \text{ €}\cdot\text{kg}^{-1}$
- i) Tara costs: $2.35 \text{ €}\cdot\text{kg}^{-1}$
- j) Basytan costs: $1.85 \text{ €}\cdot\text{kg}^{-1}$
- k) Collagen costs: $78.90 \text{ €}\cdot\text{kg}^{-1}$. The extraction costs were estimated in “Leather industry towards circular economy: enzymatic extraction of potential high added-value products from tanned wastes”
- l) Transglutaminase costs: $100.00 \text{ €}\cdot\text{kg}^{-1}$ (the cheapest price present on the market related to the product with analogue characteristics)
- m) Casein costs: $120.00 \text{ €}\cdot\text{kg}^{-1}$ (the cheapest price present on the market related to the product with analogue characteristics)
- n) In the same category, filled leather costs $25.00 \text{ €}\cdot\text{m}^{-2}$ and well filled leather $35.00 \text{ €}\cdot\text{m}^{-2}$