XXXVIII IULTCS Congress | Lyon, France
8th - 11th Sept' 2025

Hair saving and ecological tanning processes as a source of a great reduction in pollutant load

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Introduction

Leather is widely used in clothing, footwear, furniture and leathergoods. As a natural material, skin is vulnerable to the temperature, microbial attack and mechanical stress. These features can be improved with the tanning industry by several physical and chemical treatments. Leather industry is known to be a very pollutant activity that needs large amounts of water and, at the same time, produces a highly pollutant wastewater. Particularly, beamhouse and tanning are the most pollutant phases of the tanning industry. The environment is a concerning factor in our lives that forces society to search for and implement technologies that enable cleaner processes in industry. So, prevention of highly polluted wastewater emission must be achieved.
This study aimed to compare a traditional soaking and liming hair burning process with a soaking and liming hair saving process, and a traditional chrome tanning process with an ecological chrome tanning process.

Methods

Beamhouse

Traditional soaking and liming **hair burning process**

compare to

Soaking and liming **hair saving process**

Reduction in pollutant load

Tanning

Traditional chrome tanning process

compare to

Ecological chrome tanning process

Hair saving process

Washing

Soaking

(run at low speed approx. 20 hours)

Liming

Imunisation: 1.2% slaked lime (45 min)

Unhairing: + 1.5% sodium sulphide (60 min)

Filtration of hair

Liming: + 90% water
1.3% slaked lime
0.25% sodium sulphide
0.05% surfactant agent (15 min)

(run at low speed approx. 20 hours)

Washing

Ecological chrome tanning process

Washing
Deliming: 50% water
1% deliming agent
0.5% sodium bisulfite
0.01% lipase (enzyme) (15 min)

+ 0.05% acetic acid (15 min)

Bating
Washing
Pickling: 30% water
0.1% acetid acid
1% synthetic fatliquor (15 min)

+ 20% water
4% granofin F90 (90 min)

+ 50% water (30 min)

+ 0.6% non swelling acid (15 min)

+ 0.6% non swelling acid (75 min)

Cut control (bromocresol green)

+ 0.2% non swelling acid (5 min)

+ 4.5% chromium salt (30 min)
(25% Cr_2O_3 ; 33% basicity)

(run until total chrome penetration)

Basiication
Washing

Results

Hair burning process (I) *versus* Hair saving process (II)

- In both processes, hair removal was effective, without residual hair on the surface.
- The processes produced pelts with moderate wrinkling; although fewer wrinkles were observed in the hair burning process, slightly more pronounced.

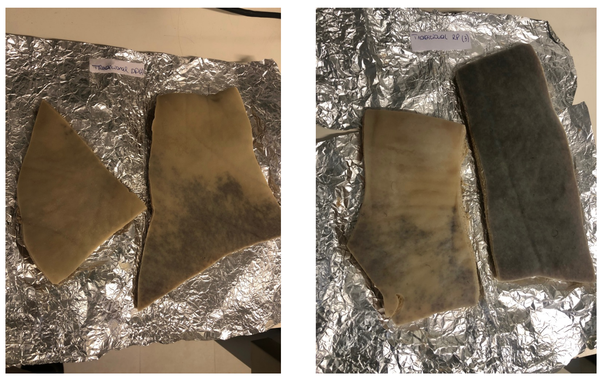

Figure 1 - *Pelts produced by hair burning (left) and hair saving process (right)*

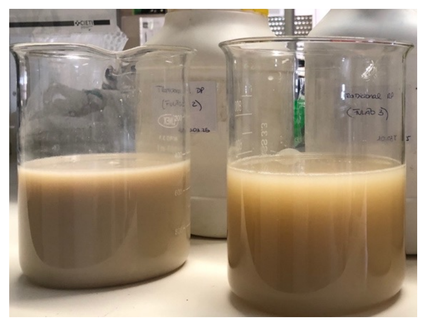

Figure 2 – *Effluent of hair burning (left) and hair saving process (right)*

Tradicional chrome tanning process (III) *versus* Ecological chrome tanning process (IV)

- The wet-blue leather produced by the ecological chrome tanning process showed a slightly lower shrinkage temperature (95 °C) compared with the traditional chrome tanning process (104 °C).

Figure 3 – *Effluent of ecological chrome tanning (left) and traditional chrome tanning process (right)*

Table 1- *Results of the process effluent charactrization*

Parameter	I	II	III	IV
pH	12.19	12.42	6.56	4.55
TS (%)	3.67	2.53	1.96	0.77
TSS (mg/L)	6.53	2.35	2.05	1.17
COD (g/L O_2)	27	8	5.2	5.3
BOD_5 (g/L O_2)	18	1.9	1.4	2.4
Sulphides (mg/L)	1.3	0.38	---	---
Total nitrogen (mg/L)	---	---	16.52	10.24
Total Chrome (g/L)	---	---	0.42	0.23
Electrical conductivity (mS/cm)	31.5	29.3	20.60	10.86

Table 2- *Results of mechanical resistances of the crust leather*

Crust leather	Ball burst method (ISO 3379)		Single edge tear strength (ISO 3377-1)
	First grain damage (mm)	Force at first grain damage (N)	
Traditional chrome tanning	13.29	284.2	54.4
Ecological chrome tanning	13.85	367.2	38.1

Conclusions

- ✓ The **hair saving process** and **ecological chrome tanning process** resulted in a significant reduction of pollutant load in effluents, which was was also evident from their visual appearance.
- ✓ Crust leather obtained from both tanning processes showed similar values of mechanical resistances, meeting the minimum values required for footwear (7 mm and 200 N in the ball burst method and 50 N in tear strength).
- ✓ Both alternative processes contribute to **more sustainable leather production by reducing the environmental impact**. These findings, obtained at a bench scale, provide a basis for further research and for pilot and semi-industrial scale work.

Acknowledgements

The authors would like to acknowledge Fundo Ambiental for the support of the Project BioShoes4All by Portugal PRR Programme.

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