

CIRCULAR ECONOMY USING WASTE FROM DIFFERENT INDUSTRIES IN LEATHER RETANNING

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Paper ID: P246

Introduction

A circular economy is based on an economy that in principle, moves away from the accelerated model of consumption and disposal. Thus, the flow associated with the product, instead of being translated by a straight line, is now regarded as a circle or cycle.

The leather manufacturing applies several physical and chemical treatments in different stages to transform the skin into leather.

The pulp and paper industry generate several byproducts such as tannins and lignins. The sulfited lignins are a particular type of black liquor and could be used as dispersing, pre-tanning and retanning agents.

During the chestnut freezing process, as consequence of the quality control, a significant quantity of chestnut fruit is rejected and not accepted by the consumer. Due to its high starch content, the chestnut fruit reject is used to produce chestnut flour which can be used as a filler retanning agent for leather.

From the biodiesel process results a byproduct, which represents 10 % wt of the overall production, the crude glycerol. The hygroscopic effect of glycerol and its emulsifying and lubricant effect can be enhanced for the leather fatliquoring.

Methods

The industrial wastes were applied at a bench scale, in small drums as shown in Figure 1. A high number of trials were done with pieces, always cut from the same zone near the back-bone, with 100 g used in each trial.



PRETANNING

- ❖ Adjust the pH to 4,0
- ❖ Pretan with black liquor and synthetic tannin
- ❖ Shaving operation

VEGETABLE TANNING AND RETANNING

- ❖ 20% of the vegetable tannins were replaced by sulfited black liquor
- ❖ 10% of the fats were replaced by raw glycerol

WET-BLUE RETANNING

(wet-blue hides shaved at 1.3mm)

- ❖ 50% of the synthetic and natural tannins were replaced by sulfited black liquor
- ❖ 10% of the fats were replaced by raw glycerol

WET-WHITE RETANNING

(wet-white hides shaved at 1.4mm)

- ❖ Replacing the synthetic and natural tannins by black liquor (80%) and chestnut flour (20%)
- ❖ 10% of the fats were replaced by raw glycerol

✓ The hides resulted were squeezed, stretched, dried, softened, and evaluated.

Results

The evaluation of the leather obtained by the different trials done was carried out for grain cracking (ISO 3379:2015), tear strength (ISO 3377-2: 2016) and tensile strength (ISO 3376:2020). The results obtained are shown in Table 1 and Table 2 for DR and AV leather products respectively.

Table 1. Leather evaluation for Dias Ruivo company products.

Leather Product	Grain cracking		Tear Strength	Tensile strength	
	Distension	Load	Load	Tensile strength	Elongation
	mm	N	N	N/mm ²	%
Vegetable leather product DR	5.6	150	109	14.7	40
Wet-blue leather product DR	8.2	350	106	19.8	46
Minimum values required for footwear	7.0	200	50	15.0	45

- ❖ The “Vegetable leather product DR” has a very good tear strength performance, a tensile strength practically in the limit of acceptance and needs to be improved concerning the grain cracking resistance.
- ❖ The “Wet-blue leather product DR” is very good and satisfy for footwear.

Table 2. Leather evaluation for Curtumes Aveneda company products.

Leather Product	Grain cracking		Tear Strength	Tensile strength	
	Distension	Load	Load	Tensile strength	Elongation
	mm	N	N	N/mm ²	%
Wet-white leather product AV	7.3	160	109	13.5	55
Wet-white nubuck AV			57	13.6	57
Minimum values required for footwear	7,0	200	50	15	45

- ❖ The “Wet-white leather product AV” has a very good tear strength performance, and a tensile strength and a grain cracking practically in the limit of acceptance.
- ❖ The “Wet-white nubuck AV” is practically in the limit of acceptance. For this leather product the grain cracking is not so important, reason why it has not been determined.

Conclusions

The results obtained in this work allow us to say that wastes as sulfited black liquor from the pulp and paper industry, chestnut flour from the chestnut freezing industry, and raw glycerol from biodiesel production, can be used in the leather manufacturing mainly as retanning agents to improve the sustainability of leather manufacturing, reduce the carbon footprint of the process and also its costs.

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Acknowledgements

The authors would like to acknowledge to ANI for the support of the Project FAMEST 24529 by Portugal 2020 Programme.