



Improving the biodegradability of vegetable tanned leather

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Waste from cutting components for new products.



New articles - potential waste at the end of useful life.

Tanning stabilises protein, thus making leathers more difficult to biodegrade than raw hides and skins. A significant percentage of the worldwide leather production is vegetable-tanned⁽¹⁾, and although the biodegradability is considered low, composting offers a solution to waste disposal problems associated with these leather products. In this event this offers a strong alternative to land-fill disposal or incineration of waste.

The detanning of leather is well known technology. The recovery of chromium from wet blue leather waste is established in practice⁽²⁾, and the stripping of vegetable tannins from leather takes place^(1,3) before dyeing to help even out the shade⁽¹⁾. However, a stripping concept has never been applied to treat vegetable-tanned leather waste where the biodegradability might be improved.

The investigation

Pickled goat skins were tanned over a period of 48 hours (using a standard University recipe), with 1%, 5%, 10% and 30% offers of Mimosa ME⁽⁴⁾, quantities based on the pickled weight. The investigation was carried out in two stages:

Detanning: Borax buffer at a pH of 9.22 (0.01M di-sodium tetraborate at 3.81g/l) was applied for a period of seven days at 20°C with occasional agitation, then washed thoroughly with water.

The shrinkage temperature was then determined using a differential scanning calorimetry (DSC) (Mettler-Toledo, Leicester, UK). Here, fully hydrated samples, 5mg to 10mg, were hermetically sealed in a 40µl aluminium pan and heated at 25°C to 100°C at a heating rate of 5°C per minute. The onset temperature of the denaturation peak was considered as shrinkage temperature.

Composting: This was carried out following a modified BS EN ISO 20200:2005 method. Control (tanned with Mimosa ME

only) and detanned samples (tanned and subsequently treated with a borax solution) were placed in a composting container containing synthetic compost. Incubation was for 24 days at 58±2°C, and the percentage of disintegration was measured based on differences between sample weight before and after composting. The composting tests were carried out in duplicate.

Findings from the study

It was found that the detanning method reduced the shrinkage temperature of vegetable tanned leathers. These findings are set down in *Panel 1*.

Panel 1: Shrinkage temperature of vegetable-tanned samples at various percentages offers, and subsequent reduction of shrinkage temperature due to detanning.

Mimosa ME offer %	Shrinkage temperature °C ^(a)	
	Tanned (Control)	Detanned
1 (b)	71	-
5 (c)	79	72
10	80	72
30	81	78

^(a) Values to unit percentage.

^(b) Incomplete penetration was observed with the offer of 1% Mimosa ME, but an offer of 5% achieved full penetration.

^(c) Indicates that a low vegetable-tannin offer is capable of providing stabilisation to the hide protein).

These effects were partial, as the shrinkage temperatures of the treated samples were still above 70°C. However, the composting trial showed a considerable increase in the degree of deterioration due to these effects. This comparative deterioration is expressed as a percentage and shown in *Panel 2*.

Complete degradation was observed with the leathers that were tanned with 5% and 10% Mimosa ME. Moreover, complete degradation occurred seven and five days respectively



Panel 2: Percentage of Mimosa ME offer and the corresponding level of deterioration following detanning treatment.

Mimosa ME offer %	Percentage of degradation % ^(a)	
	Tanned (Control)	Detanned
5	60 - 63	100
10	12 - 14	100
30	17 - 22	92 - 94

^(a)Values to unit percentage

before termination.

Useful comparisons can be made between the samples of leather tanned with 10% mimosa after 24 days composting with the comparative partially-detanned samples after 14 days composting. These findings are shown in *Panel 3*.

Panel 3: Comparison: Biodegradation under controlled conditions^(a): Leathers fully tanned with 10% mimosa ME and in partially-detanned state.

Composting fully tanned sample for 24 days



Composting partially-detanned sample for 14 days



^(a)Modified BS EN ISO 20200:2005 method: Incubation 24 days at 58±2°C).

Furthermore, 93% degradation was observed within 24 days for the samples that were tanned with 30% Mimosa ME then partially-detanned. It may be speculated that complete deterioration would have been possible if composting was carried out for 90 days as specified in BS EN ISO 20200:2005.

Conclusions

The findings clearly demonstrate that:

- The concept of detanning – although partial in this event – has the potential to increase the biodegradability of vegetable tanned leather.
- Further investigations are required to identify more effective detanning agents and to optimise their application.

References

1. Buljan, J. & Kral (2015) *The Framework for sustainable leather manufacture*. United Nations Industrial Development Organizations.
2. Daniels, R. (2011) *Innovation part 2: Co-products and solids management*. World Leather, Vol 24(6), pp. 24-25.
3. Covington, A.D. and Shi, B. (1998) *High stability organic tanning agent using plant polyphenols. Part 1: The interactions between vegetable tannins and aldehydic crosslinkers*. Journal of the Society of Leather Technologists and Chemists, 82(2), pp. 64-71.
4. Forestal Mimosa Ltd.



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