Influence of Retanning Agents on the Compostability of Leather

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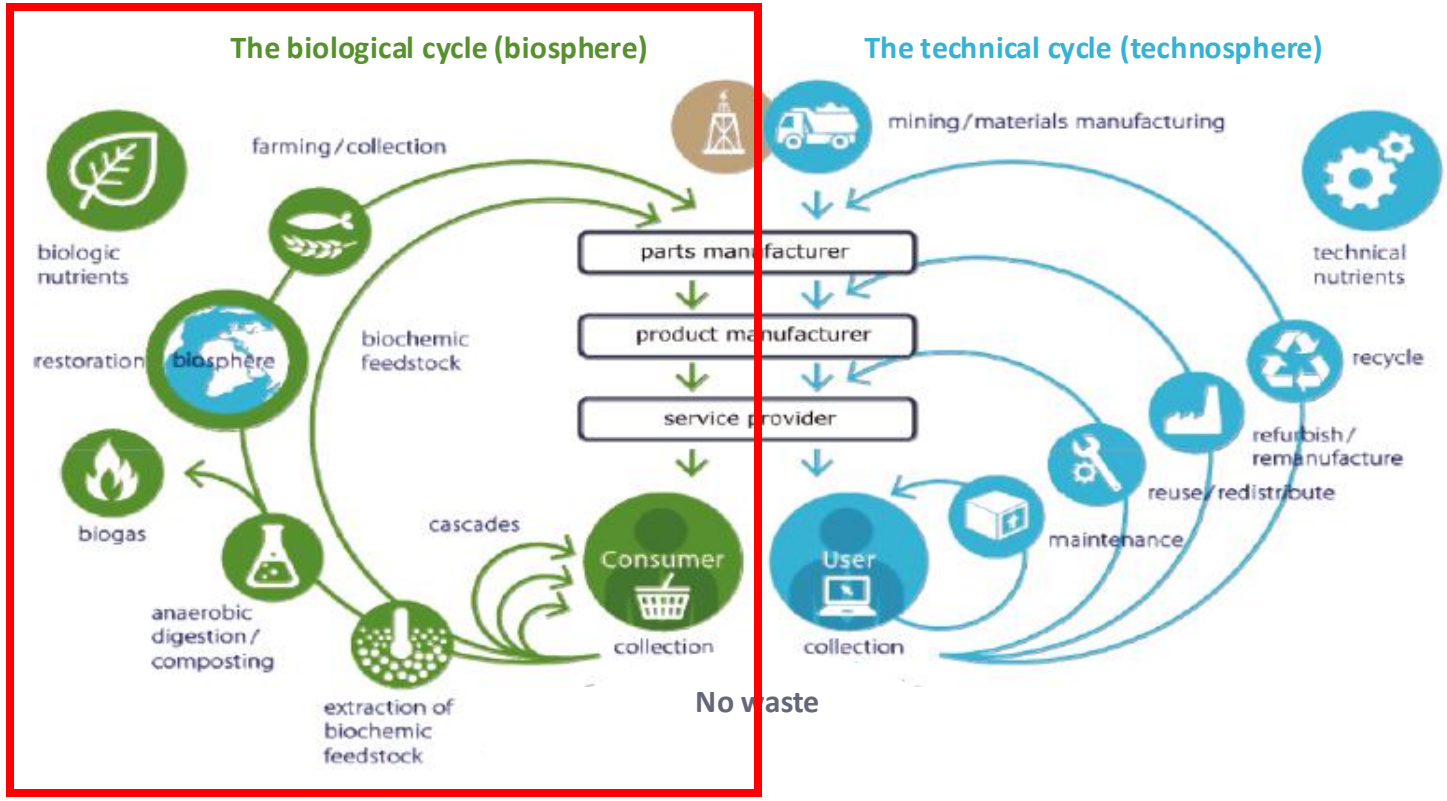
Visualizing Material Circularity with an Illustrative Model

The Butterfly model for circular production and consumption *

For biobased and **biodegradable** products which can safely return to nature



For synthetical and not biodegradable products which can be recycled.

* Soldal, O., Master Thesis, (2019). doi:10.13140/RG.2.2.18343.70569

Leather End-of-Life Phases: Disintegration and Bioassimilation

End-of-life cascade for leather

Leather *

Biological disintegration

Biological breakdown into small fragments

Test method
ISO 20200: 2023
Simulate industrial composting

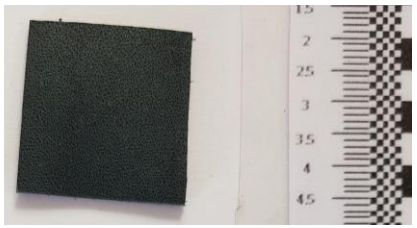
Bioassimilation

Aerobic biodegradability of small fragments

Test method
ISO 20136:2020
Simulate Microbial degradation

Test setup ISO 20200: 2023
Simulate industrial composting

1.Placing sample into defined compost
2.Thermophilic phase: 84 days at 58 °C
3.Mesophilic phase: 84 days at 25 °C

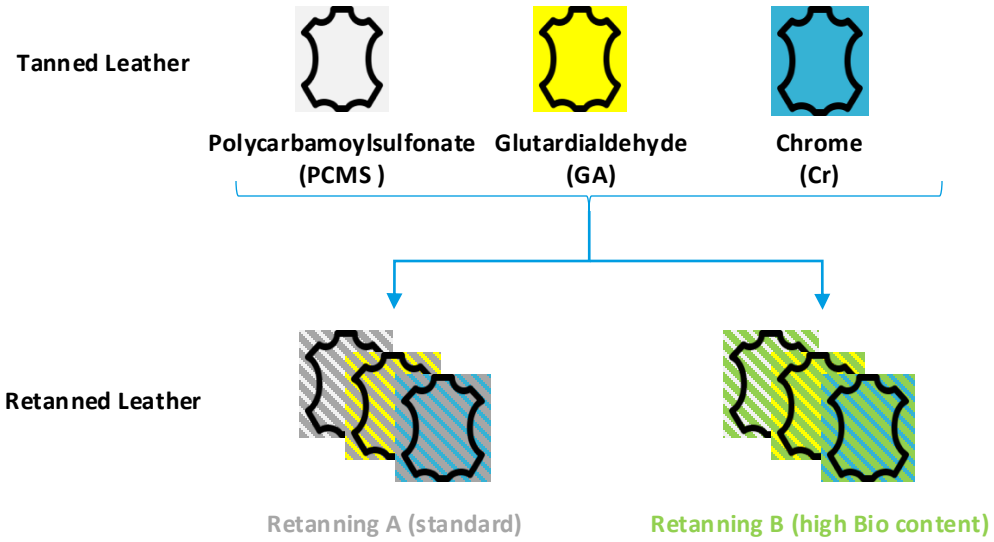


Sample is disintegrated if no more than 10% of the starting material is retained by a 2 mm sieve.

* Symbols from www.flaticon.com

Experimental Design and Results to Assess the Impact of Retanning on compostability

Experimental design



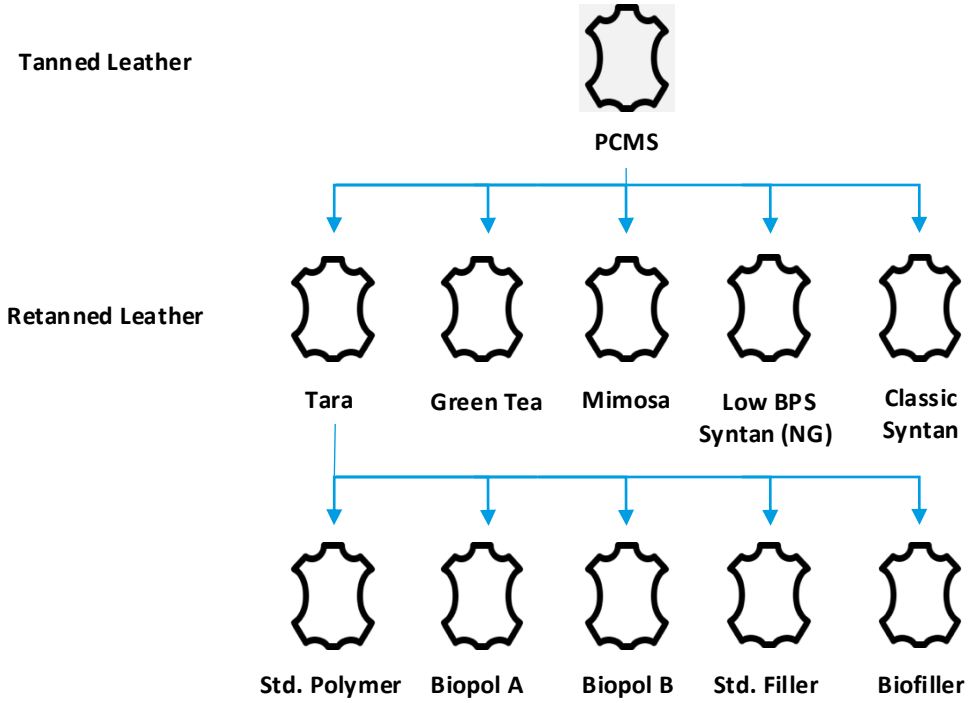
Results of Biodegradation test of different leathers according ISO 20200

Tested materials	Retanning	Thermophilic Stage (84 days) Disintegration rate in %	Mesophilic Stage (84 days) Disintegration rate in %	> 90% Disintegrated
PCMS	A	100	Test terminated	yes
PCMS	B	100	Test terminated	yes
GA	A	83,53	85,24	no
GA	B	90,73	93,21	yes
Cr	A	19,08	21,68	no
Cr	B	42,61	43,98	no

Retanning has a measurable influence although plays only a secondary role compared to primary tanning

Impact of Individual Retanning Agents on Leather Biodegradability

Experimental design

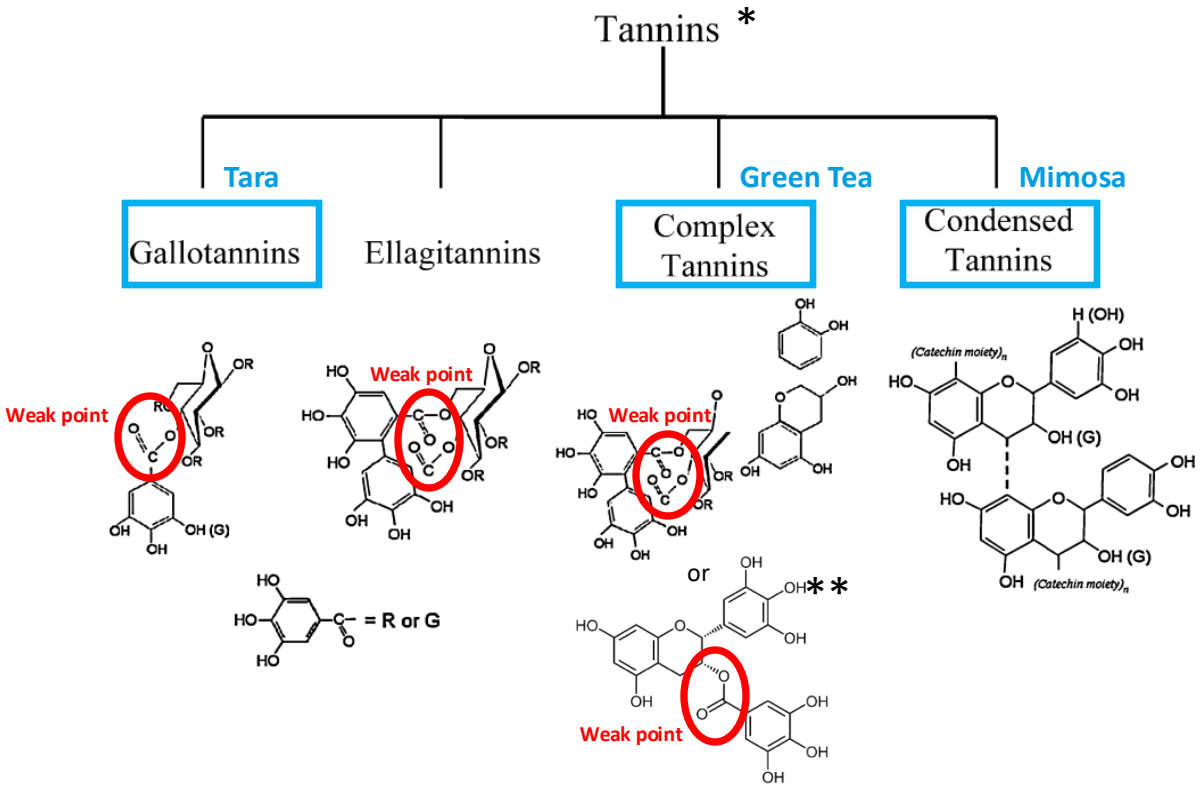


Results of Biodegradation test of different leathers according ISO 20200 after 20 days

Amount	sample	Type	Disintegrated after 20 d	Disintegrated by Day
6%	PCMS Std.	Organic	100%	16
A		**Retanning**		
30%	Tara	Hydrolysable	100%	18
30%	Green Tea	Complex	100%	16
30%	Mimosa	Condensed	10%	-
30%	Syntan	NG	90%	-
30%	Syntan	Classic	10%	-

Results indicating that only collagen crosslinking additives mostly affecting degradation behavior of leather

Possible Explanations for the different Degradation Behavior



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Hydrolysable and complex tannins are susceptible to microbial degradation due to cleavable ester groups, whereas condensed tannins lack this vulnerability.

Source: * Sardroudi et al., Sustainability 2024, 16, 2324
** Stephane Quideau et. al. Angew. Chem. Int. Ed. 2011, 50, 586

Summary

- Leather has circular potential; compostability assessed by ISO 20200
- Primary tanning dominates, but retanning agents also influence disintegration
- Additives with little collagen interaction → only minor effect on degradation
- Hydrolysable/complex tannins → limited influence; condensed tannins → strong inhibition
- Differences can be explained by molecular structure
- Systems without an intrinsic weak point inhibit microbial breakdown

Choosing the right retanning system is important to improve leather's end-of-life performance