Understanding the Effect of Biocidal Agents on Leather Disintegration

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Agenda Items

- Compostability of Leather & Sustainability
- Biocides in the leather making process
- Assessing Biocidal Migration
- Impact on disintegration
- Results

Compostability of Leather & Sustainability

Environmental & Consumer Benefits

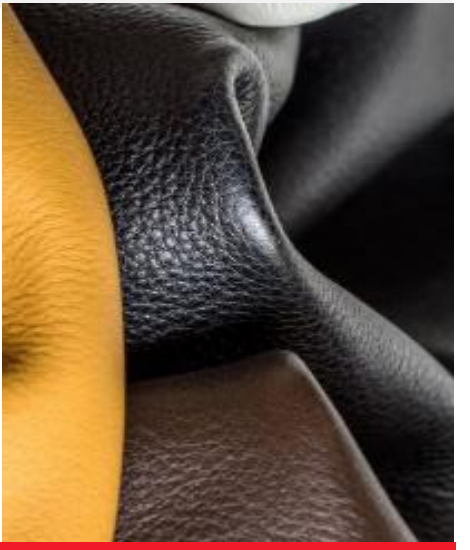
Environmental

- Enables **biological end-of-life** treatment
- **Reduces landfill** and incineration impact
- Aligns with **EU Circular Economy Action Plan**

Consumer

- **Safer, non-toxic materials** in contact with skin
- **Easier disposal** and lower environmental guilt
- Contributes to a **sustainable lifestyle**

Biocides used throughout the leather making process

Raw Hide Protection	Process Control	Preservation of Leather Intermediates	Crust Protection	In-can Preservation
☑ Prevents rapid rotting	☑ Ensures leather quality	☑ Prevents grain damage	☑ Prevents mould until dry	☑ Ensures best finishes
				

Biocides are an important investment to preserve your leather and protect you from potentials claims!

Assessing Biocidal Migration Across Different Leather types

Most common biocides used in worst case scenario (high level)

No migration

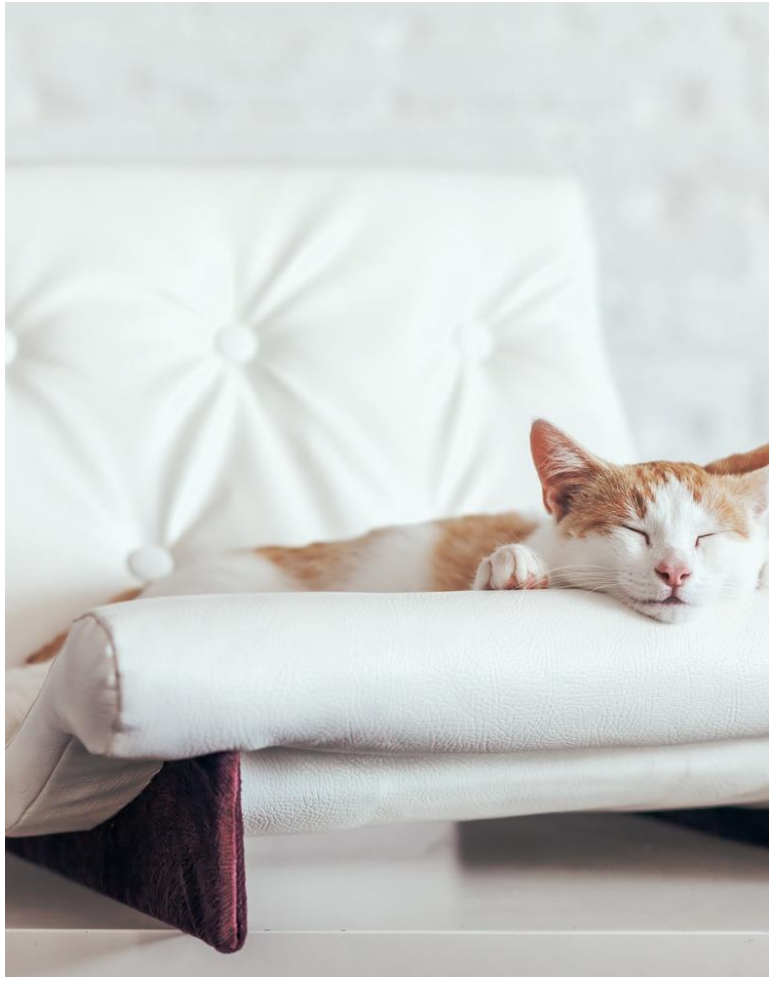
- No migration of biocides from leather detectable for all leather types
  (-> Migration Study 2024 LANXESS/FILK)
- Residues remain in leather
- No risk for consumers

Impact of Biocidal Agents on Leather Disintegration

Study Overview

Leather intermediates samples

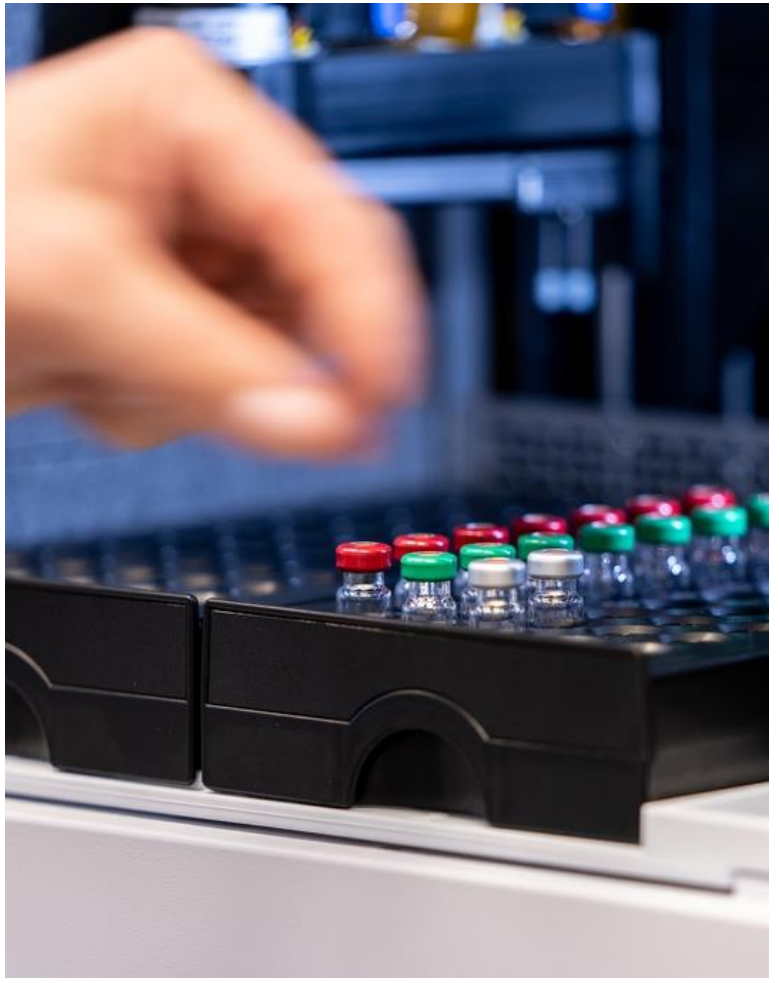
- The leather intermediates were produced using a standard process and tanning with glutaraldehyde (wet white).
- Three biocidal agents were added during the tanning stage at two different concentration levels.
  - Biphenyl-2-ol, OPP (CasNr.: 90-43-7)
  - 4-Chloro-3-methylphenol, PCMC (CasNr.: 59-50-7)
  - 2-n-Octyl-4-isothiazolin-3-one, OIT (CasNr.: 26530-20-1)
- A reference leather sample was produced without biocidal additives to assess its natural degradation under composting conditions.



Study Overview

Analytical Determination of Active Substances

- The procedure follows ISO 13365 principles for determining specific chemicals in leather, ensuring accuracy and reliability.
- Leather samples are cut and weighed before solvent extraction in an ultrasonic bath to isolate biocidal active ingredients.
- The analysis is conducted using HPLC with a C18 column and UV detection, allowing for the precise identification of chemical substances.

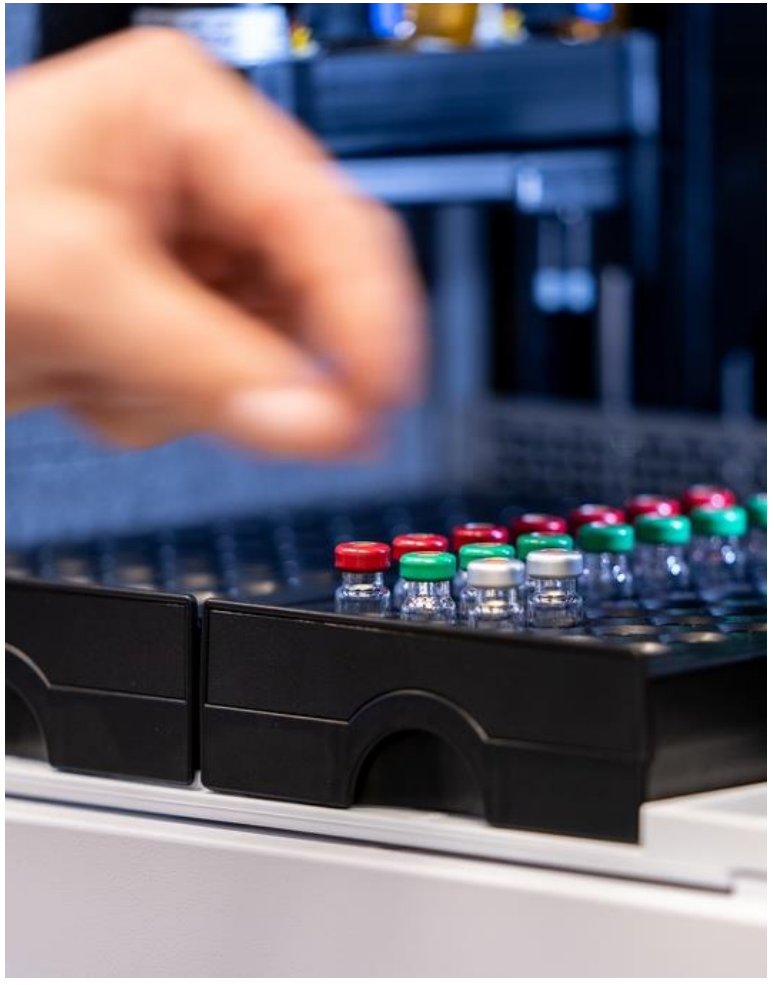


Study Overview

ISO 20200:2023 Disintegration Test

- The disintegration testing follows a laboratory-scale procedure outlined in ISO 20200:2023, designed for controlled aerobic composting.
- Samples were subjected to specific temperature, humidity, and aeration conditions to mimic a composting environment.
- Disintegration extent was monitored through visual inspection, mass loss, and photographic documentation at regular intervals.
- The tests were conducted for a total of 168 days, including 84 days thermophilic followed by 84 mesophilic composting phases.

Results



ISO 13365 Analytical determination of active substances

Active Substance	Biocide Content as is (mg/kg)	Biocide Content Corrected to 50% Water (mg/kg)
OPP (standard)	1490	2030
OPP (high)	14660	18510
PCMC (standard)	880	1100
PCMC (high)	11070	13780
OIT (standard)	580	730
OIT (high)	4060	5380
Control w/o biocide	Not detectable	Not detectable

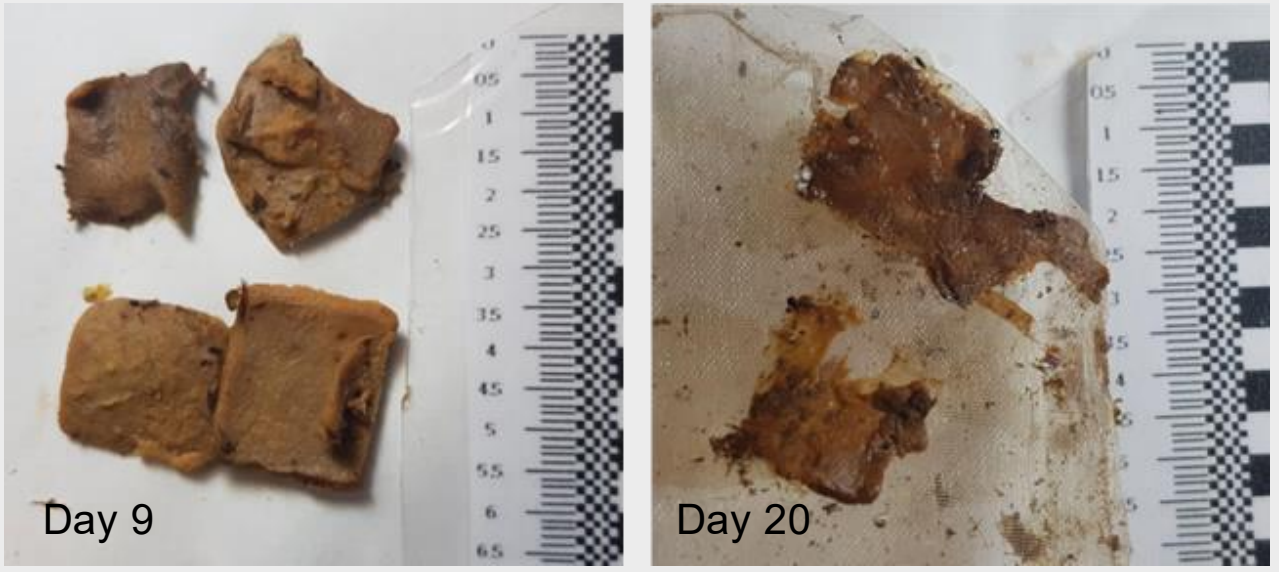
Results

Disintegration Results

- Leather samples were evaluated under thermophilic conditions over 84 days to determine disintegration percentages followed by mesophilic conditions for additional 84 days.
- The untreated control sample disintegrated rapidly, breaking down completely within 35 days, indicating high efficiency.
- All samples exhibited signs of microbial colonization already by day 20, indicating active degradation processes underway.

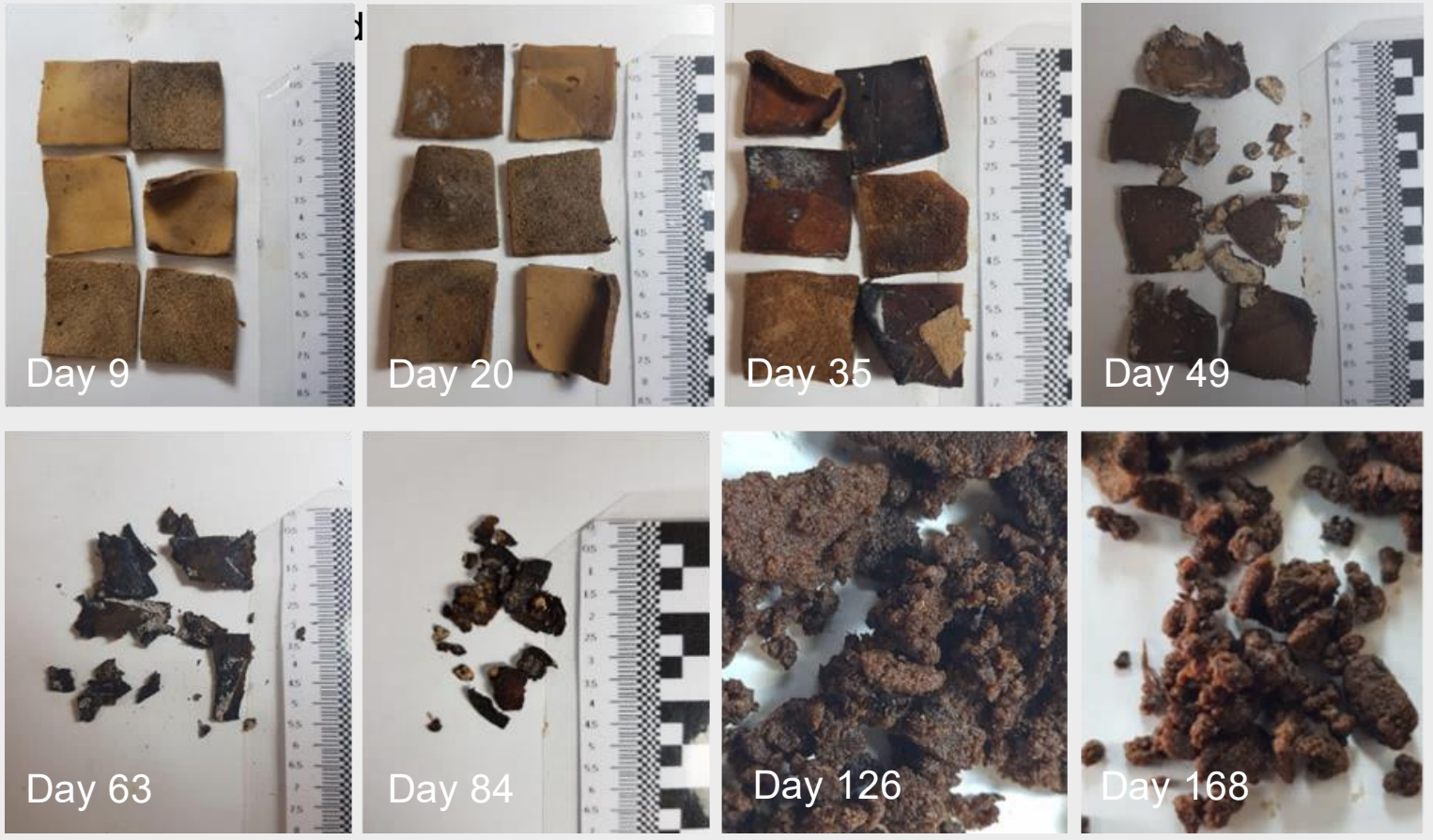
Treatment	Disintegration (%) Thermophilic (84 days)	Disintegration (%) Mesophilic (after additional 84 days)
Control (no treatment)	100.00	100.00
PCMC (Standard)	65.34 ± 12.80	70.02 ± 8.32
PCMC (High)	63.79 ± 12.01	67.80 ± 12.45
OIT (Standard)	100.00	100.00
OIT (High)	100.00	100.00
OPP (Standard)	75.17 ± 10.18	88.44 ± 0.60
OPP (High)	57.75 ± 14.41	59.57 ± 18.59

Results control sample



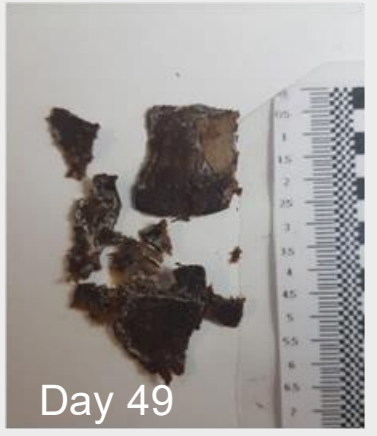
Control without biocide

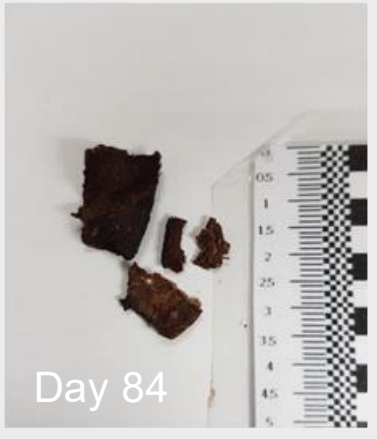
Results OPP samples



Standard biocide concentration

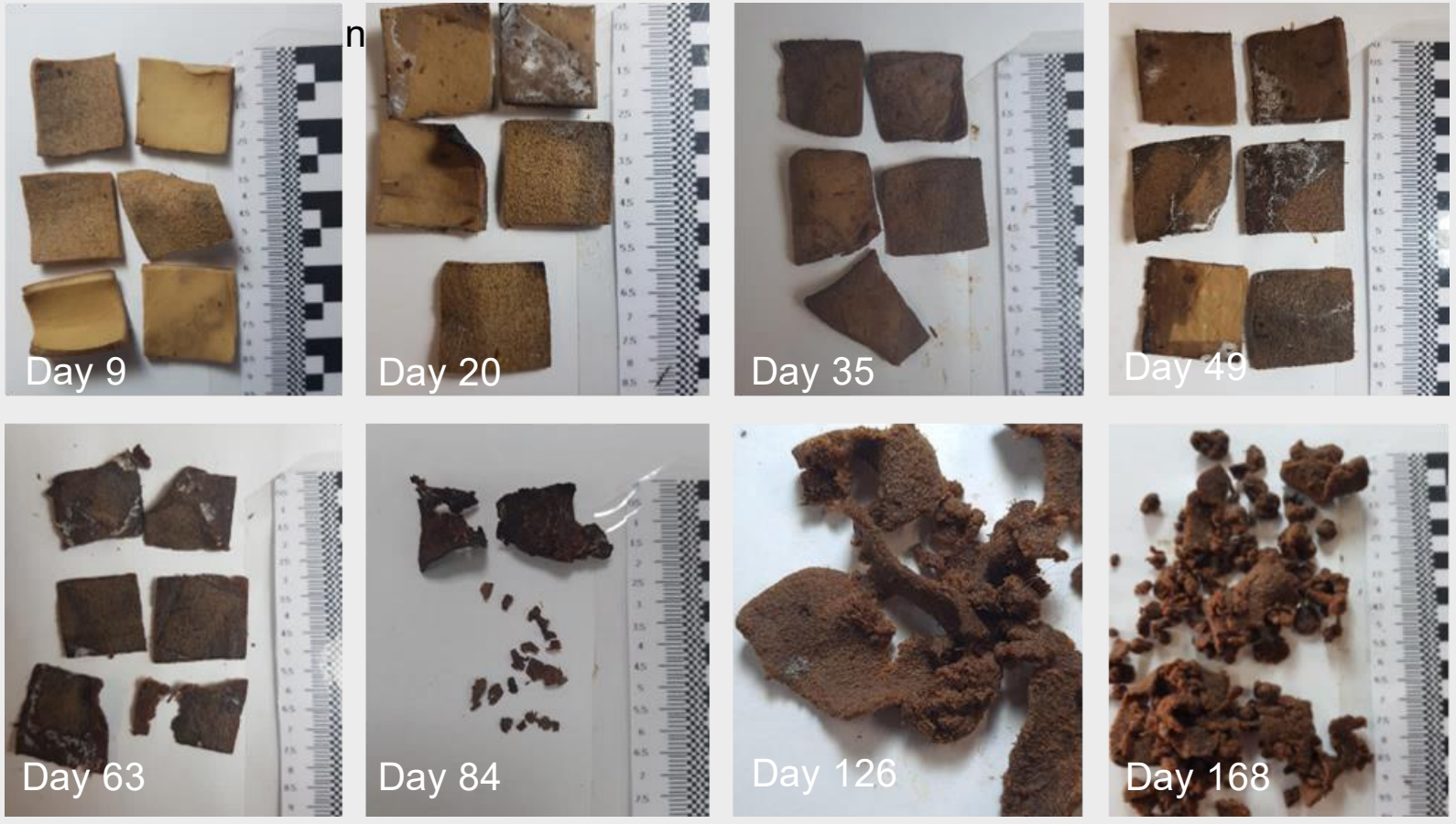
Results OPP samples





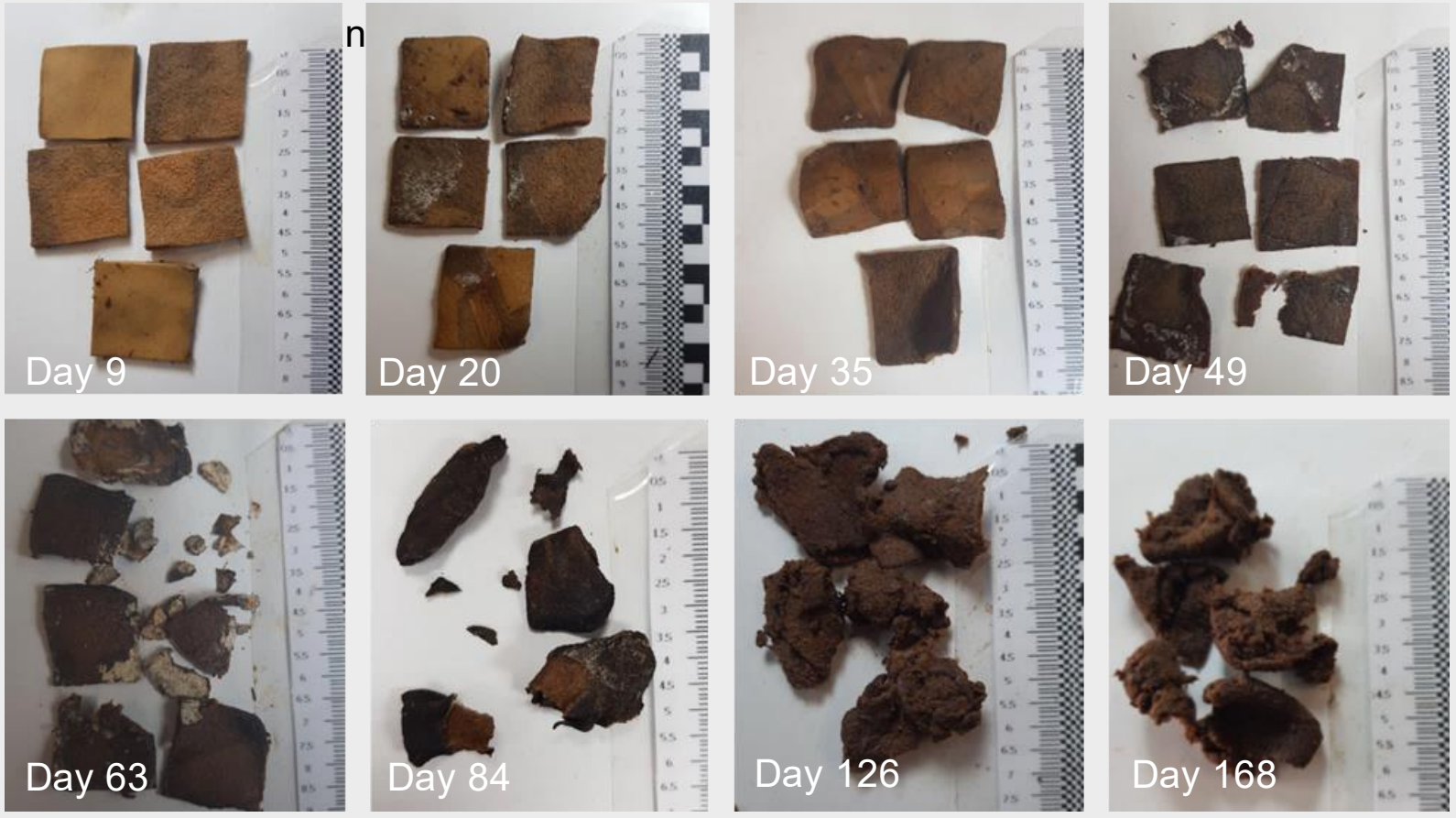
High (10 times higher)

Results PCMC samples



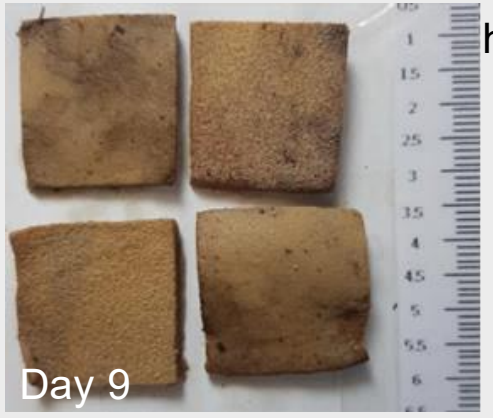
Standard biocide concentration

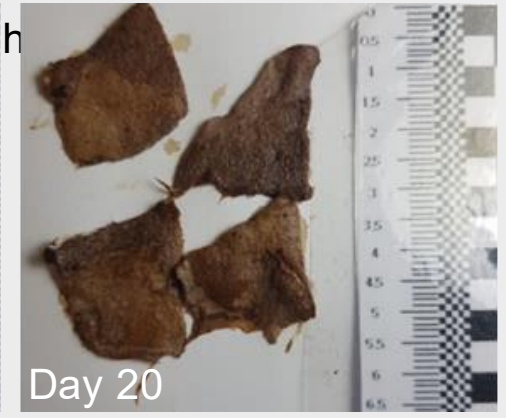
Results PCMC samples



High (10 times higher)

Results OIT samples





Standard biocide concentration

High (10 times higher)

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Conclusion

All tested leathers showed substantial disintegration

Even at 10× industrial biocide levels, compostability was not stopped

Biocides delay but do not prevent biodegradation

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Conclusion

Biocidal active substances are compatible with compostability, ensuring natural breakdown of leather materials.

Biocidal agents provide effective microbial protection during the leather's service life without hindering degradation.

Biocidal technologies enable the production high quality leather that aligns with circular economy principles.

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