



Degradation of Biodegradable Wet Wipes in Rivers

Thomas Allison¹, Benjamin D. Ward², Michael Harbottle³, Isabelle Durance^{1*}

¹School of Biosciences and Water Research Institute, Cardiff University, Cardiff, CF10 3AX, United Kingdom

²School of Chemistry, Cardiff University, Cardiff, CF10 3AT, United Kingdom

³School of Engineering, Cardiff University, Cardiff, CF24 3AA, United Kingdom

UKRI Engineering and Physical Sciences Research Council

CARDIFF UNIVERSITY

PRIFYSGOL CAERDYDD

Introduction

- Wet wipes contribute to aquatic pollution, even when labelled as 'biodegradable' and plant-based (e.g. cellulose).
- Lack of universal biodegradability standards = misleading product claims.
- Degradation behaviour in rivers remains unknown.
- Cellulose biodegradation in rivers is shaped by microbes and their environmental conditions - evidenced for leaf litter and cotton strip bioassays.
- Cellulose textile biodegradation can be measured using tensile strength loss (% per day).

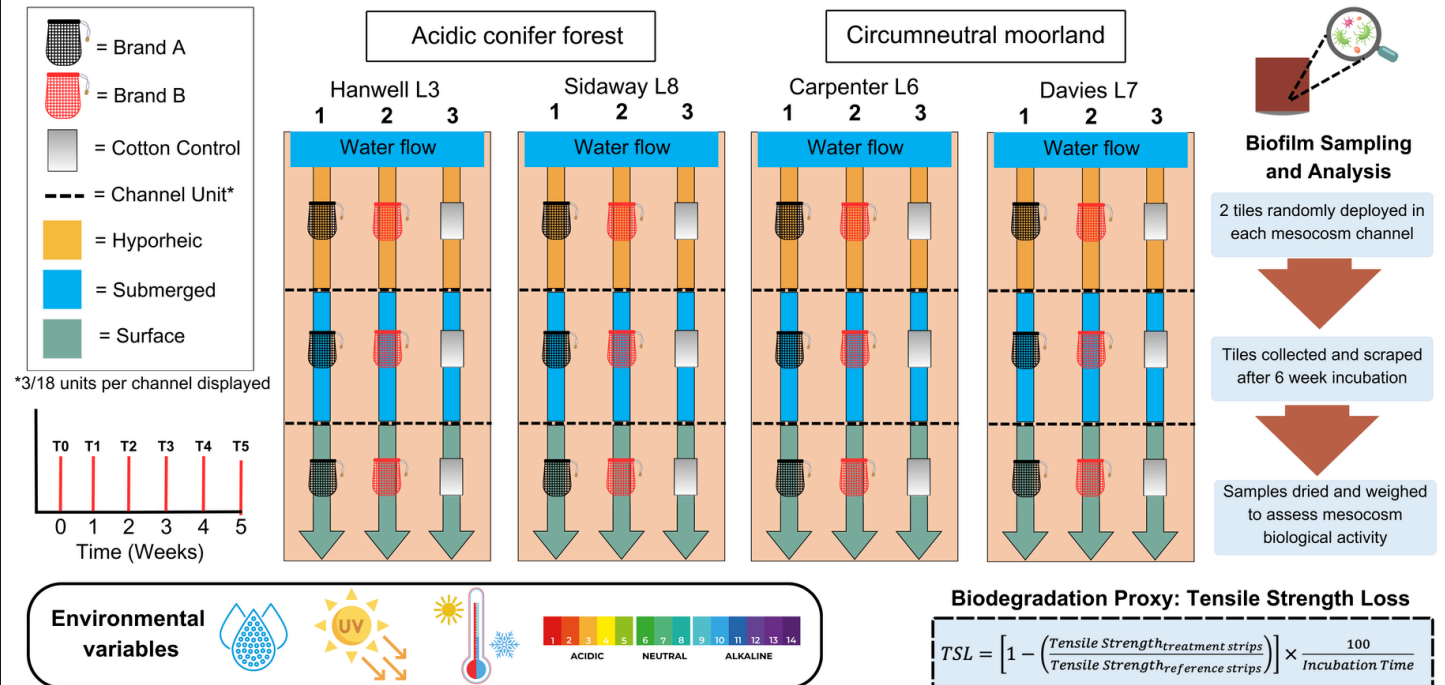


STUDY AIM:

- We investigate: 1) How biodegradable wet wipes degrade in rivers, and the role of 2) microbes and 3) environmental factors in this process.

Methods

Llyn Brianne Observatory, Llandovery, Wales



Results

1. How did wipes degrade in rivers?

a) Faster degradation followed pattern of Brand A > Brand B > Cotton ($p < 0.001$).

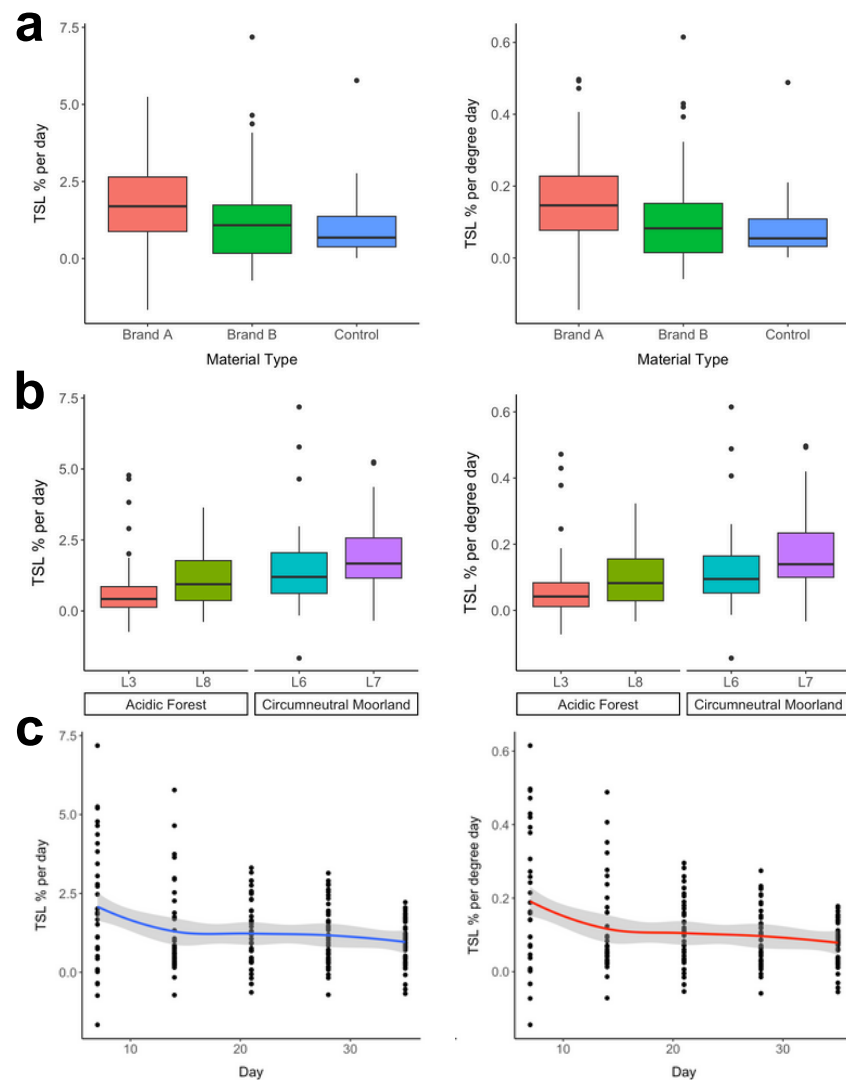
b) Degradation was faster in circumneutral than acidic streams ($p < 0.05$).

c) Degradation rates declined over time for wipes ($p < 0.001$).

No consistent treatment effect on degradation.

d) Structural degradation limited even after 5 weeks exposure.

Likely reasons: Different cellulose types, additives, microfibre release, and organic debris.



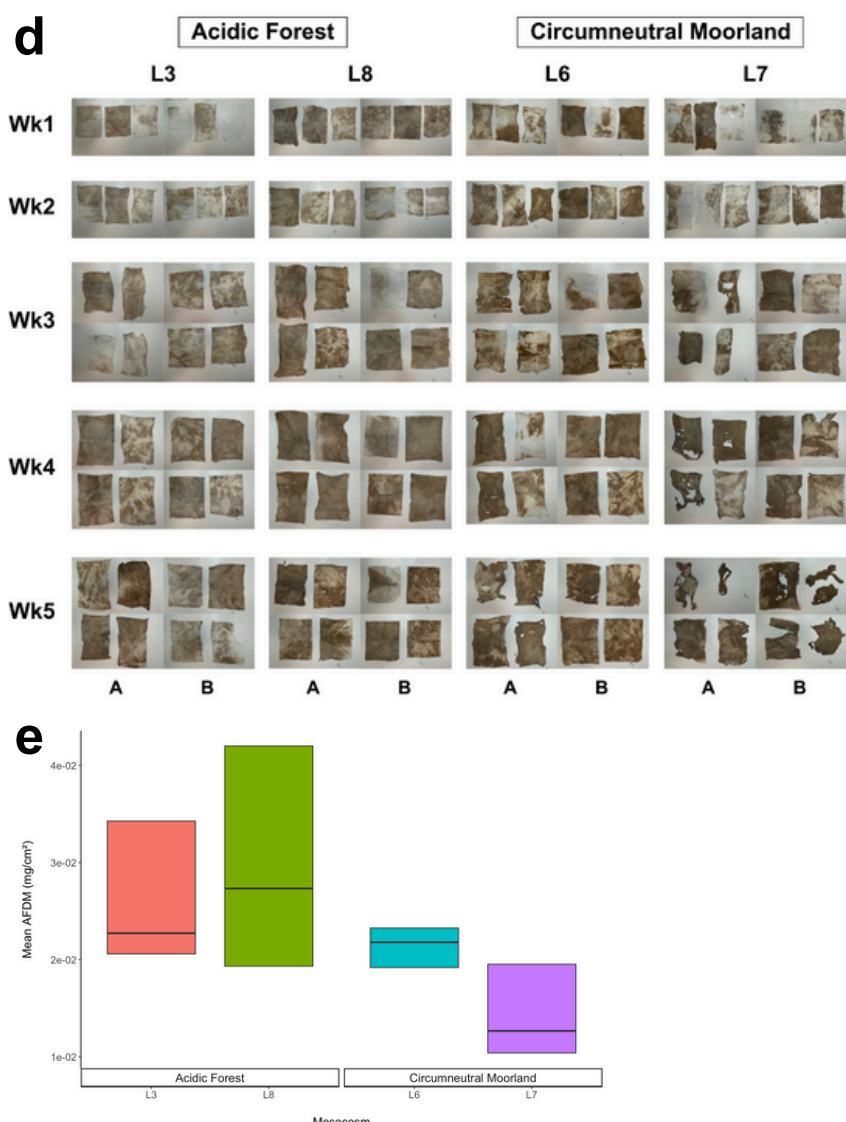
2. Did microbes affect degradation?

Microbes had a weak material-dependent degradation effect on Brand B wipes only ($p < 0.05$).

e) More biofilm biomass in acidic sites but lower biodegradation.

Likely reasons: more acid-tolerant algal biofilm and less insect grazers.

Microbial activity alone did not drive wipe degradation.



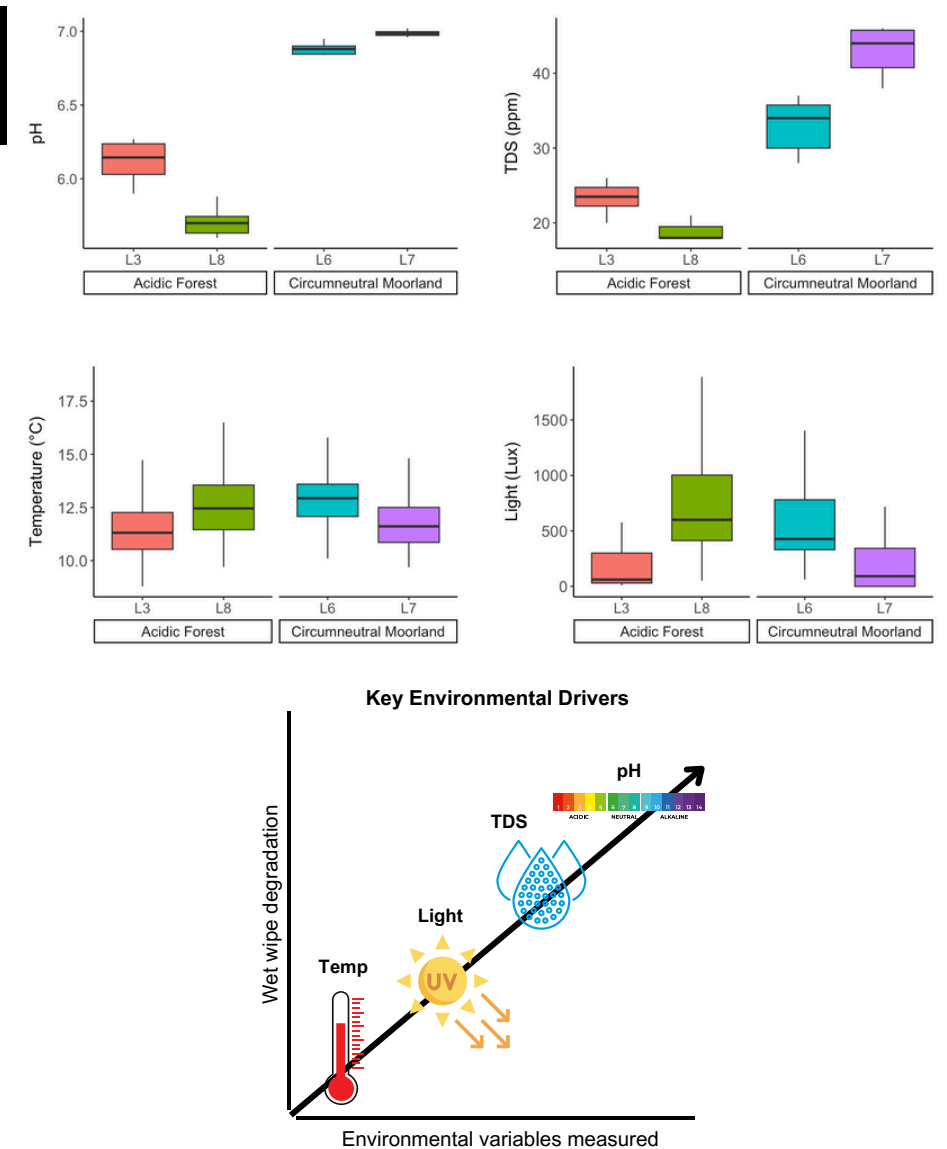
3. Did environmental factors affect degradation?

Increased pH and total dissolved solids increased degradation rates, especially when considered together ($p < 0.001$).

Reasons: Reflects greater microbial activity in circumneutral and moderate nutrient-rich conditions.

Temperature and light had negligible effects on degradation.

Likely reasons: Short time-frame of study and variable masking effects.



Conclusions & Implications

- First study to evaluate in-situ aquatic degradation behaviour of biodegradable wet wipes.
- Biodegradable wet wipes can persist in rivers for over a month.
- Given the high rate of flushed wipes, they pose a prominent short-term pollutant risk.
- Wet wipe biodegradation sensitive to stream pH and nutrient conditions - which likely reflects microbial availability.
- More attention required on environmental fate of biodegradable products.

Future Directions

Mesocosms allowed us to control environmental factors affecting breakdown...
...but focus is now needed on downstream urban rivers where most wipes end up!

Additionally, need to:

- Identify specific aquatic microbes degrading wet wipes.
- Test other environmental conditions on biodegradation.

References

Blackman, R.C. et al. 2024. *Ecological Indicators* 166, <https://doi.org/10.1016/j.ecolind.2024.112502>
Chauvet, E. et al. 2016. *Advances in Ecological Research* 55, <https://doi.org/10.1016/bs.aecr.2016.08.006>
Tiegs, S.D. et al. 2013. *Ecological Indicators* 32, <https://doi.org/10.1016/j.ecolind.2013.03.013>

Read about my other wet wipes research here:



SCAN ME