Ending Plastic Waste Symposium 2023

How biodegradable are bioplastics in the sea?

An 18-month aquatic field trial testing 3 biodegradable plastics, made using 3 processing methods of varying morphology including 2 types of additives.

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Aim: To understand degradation behaviour of multiple biodegradable plastics and to extrapolate lifetime rates of plastic with different thickness, produced by different methods, including commonly used additives, exposed to a variety of aquatic conditions.

Overview of the aquatic field trial

One of the issues with conventional plastic is its longevity in the environment. Part of the solution to this global problem is to switch from non-degradable to biodegradable plastics for particular applications. But, we don't fully understand how long biodegradable plastics will last, how they'll behave, what the effects of additives are or how different manufacturing methods and varied morphologies affect biodegradation rates when they also end up unfortunately, in the sea.

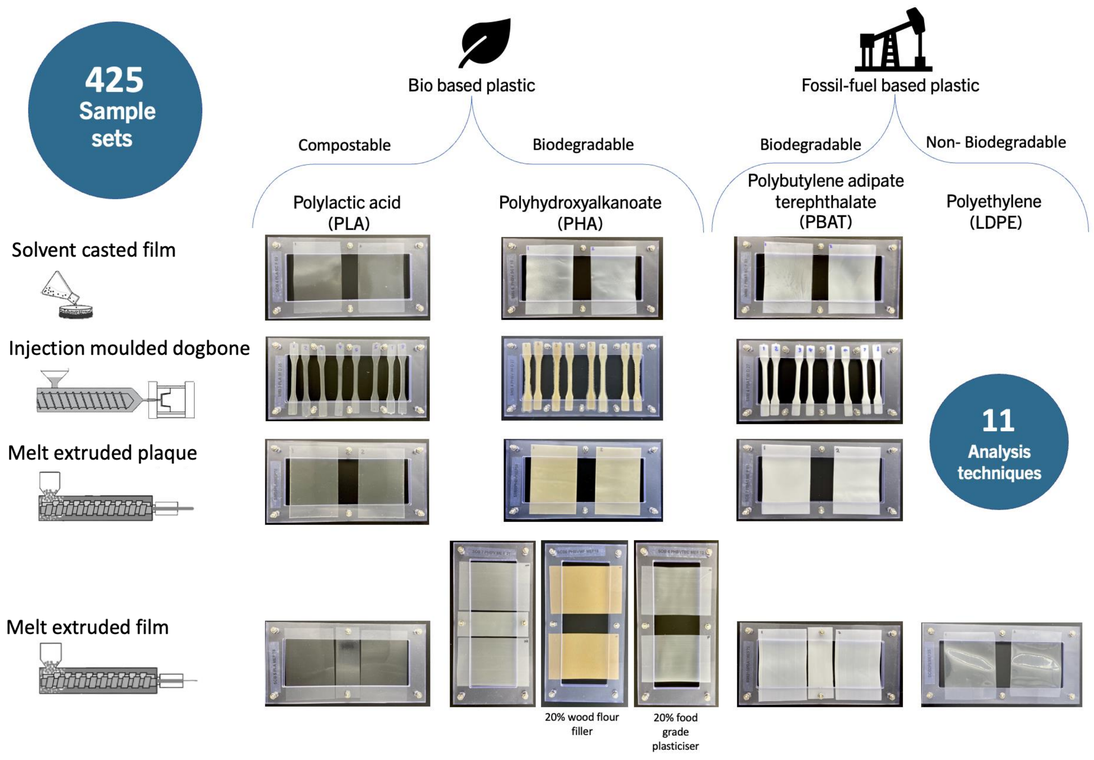


Figure 1: Overview of field trial showing sample frames with sample sets of different material/forms/thickness/additives and manufacturing methods.

The five sites for the field trial include seabed rigs installed in estuarine, open sea, enclosed sea marina and a mesocosm environment. A surface rig is also installed in the sea marina.

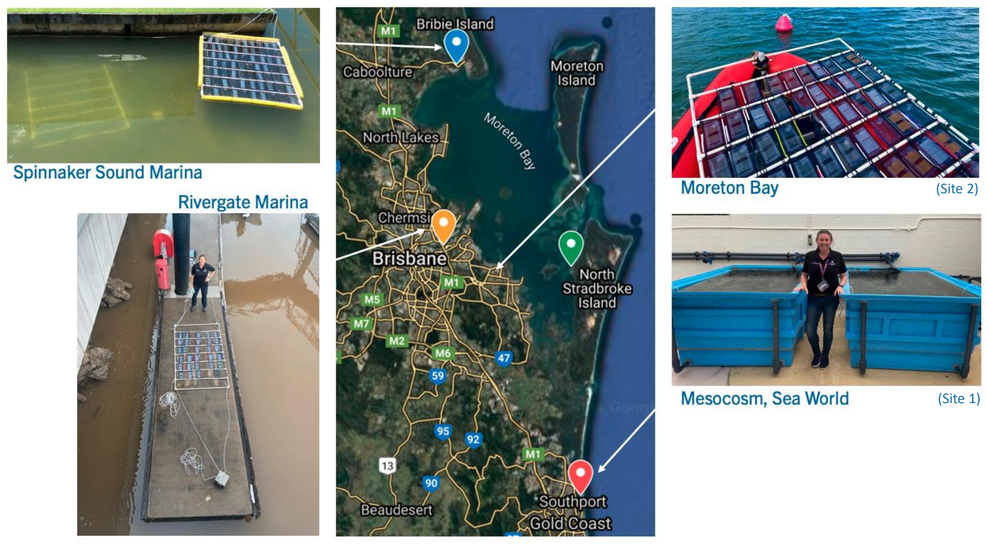


Figure 2: Field trial locations, chosen for their propensity for plastic waste to accumulate, varied environmental conditions and safety.

Initial results

Additives: Did not affect the rate or lifetimes of melt extruded PHA film in marine environments but there were differences in the mechanism of biodegradation.

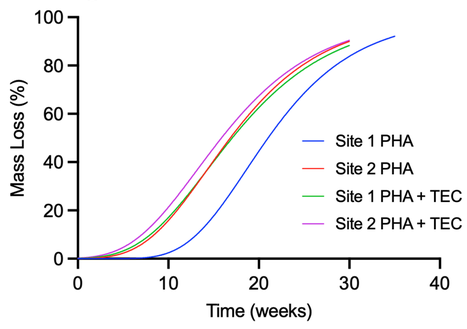


Figure 3: Mass loss with Gompertz modelling to determine biodegradation rates comparison.

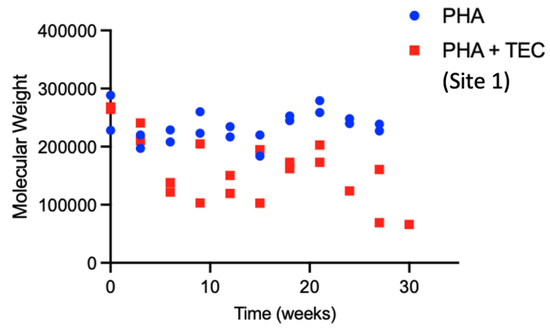
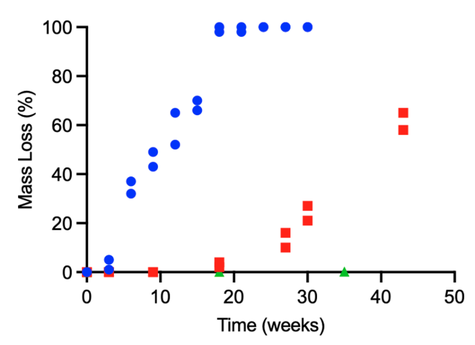


Figure 4: Molecular weight of PHA + TEC decreased whilst molecular weight of PHA was consistent as expected with surface erosion.

Materials: Rates and lifetimes of PHA, PBAT and PLA melt extruded films vary significantly in the same aquatic conditions.



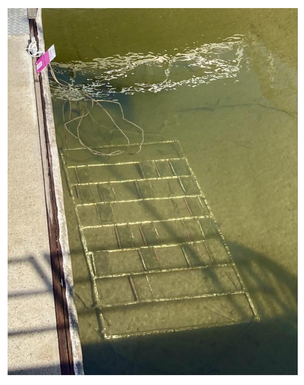


Figure 5: Mass loss comparison of different melt extruded biodegradable plastic films (150-micron thick) in estuarine conditions in the Brisbane River (pictured)

Processing: Initial results suggest that processing methods can have an effect on biodegradation.

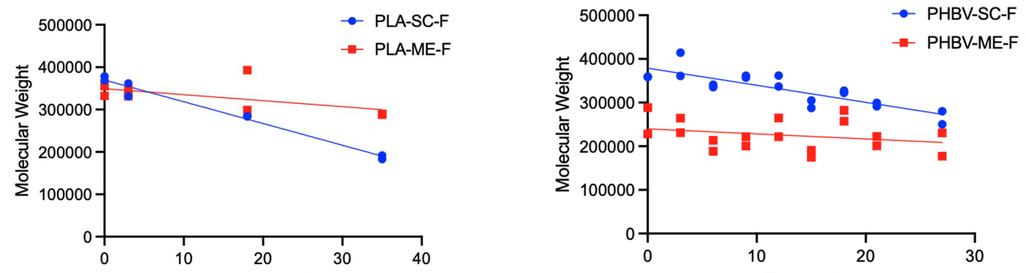


Figure 6: Molecular weight comparison of solvent casted and melt extruded films of PLA and PHA

Thickness and environment: Microbial interactions in a silty seabed accelerate biodegradation rates of PHA plaques.

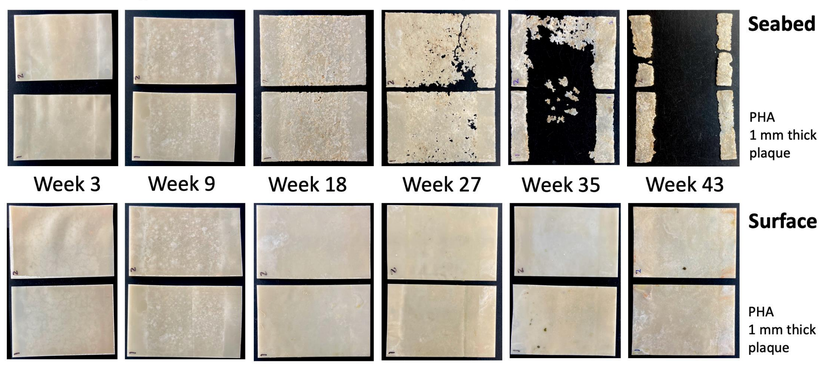


Figure 7: Visual interpretation of degradation of PHA plaques (1 mm thick) in different environments (seabed/surface) at the sea marina site.

FOR FURTHER INFORMATION

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EPICFIELDTRIAL

ACKNOWLEDGEMENTS

I acknowledge the Turrbal and Jagera and Quandamooka people as the Traditional Owners and their custodianship of the lands and sea on which my research project is located and pay my respects to their Ancestors and their descendants.

Research Permit: Department of Environment & Science (Authority No. P-MPP-100121707)

With thanks to the Moreton Bay Research Station and Sea World Foundation for project support.

ARC Training Centre for Bioplastics and Biocomposites

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