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Chemical Recycling of Amine-crosslinked Polyesters

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Why chemical recycling?

Chemical recycling is an alternative to mechanical recycling, allowing the recovery of monomers

Material quality

TRL

Emissions (CO₂ kg/kg)

Water use (L/kg)

| Virgin | | 100% | Virgin | | 9 | Virgin | | 3.4 | Virgin | 1.5 | | |
|--------------|----|------|--------------|---|---|--------------|------|-----|--------------|------|-----|----|
| Mechanical | 7. | 5% | Mechanical | | 9 | Mechanical | 0.53 | | Mechanical | 0.14 | | |
| Dissolution | | 94% | Dissolution | 3 | | Dissolution | | 4.5 | Dissolution | | 7.9 | |
| Methanolysis | | 100% | Methanolysis | | 7 | Methanolysis | | 4.2 | Methanolysis | | 9.2 | |
| Hydrolysis | | 93% | Hydrolysis | 4 | | Hydrolysis | | 4.0 | Hydrolysis | | | 14 |

For the example of PET (above), superior properties compared to mechanical recycling can be gained by extraction or chemical recycling by hydrolysis or Data from DOI: 10.1021/acssuschemeng.2c05497 methanolysis. However, the environmental impacts are greater.

Recovery of CHAMPION project materials





Outlook

Methanolysis successful in was bio-based Michael returning the acceptor. Zinc acetate was applied as a catalyst. Excess methanol was used as a solvent.

Recovery of amines was challenging, with incomplete retro-aza-Michael addition observed in the presence of



Polylactic acid (PLA) and PET are not reactive under the methanolysis conditions

preferred Methanolysis is to hydrolysis because the methyl esters the reactive in more are repolymerisation stage.

catalysts.

was able to Thermal treatment CHAMPION depolymerise the polymers but some of the amine cross-linkers prone to were decomposition.

for selective chemical recycling.

CHAMPION materials are a small component of the final products. Delamination of coatings and debonding of adhesives could be used to reclaim materials. The value that can be gained from recycling the coating or adhesive is limited unless expensive amines can be recovered.



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