

Reducing our Plastic Imprint



Enhanced biodegradation of PET via microwave assisted green bio-based Deep eutectic solvent pre-treatment technique

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Introduction

Most plastics degradation methods are currently inefficient and are limited by processing difficulties, quality loss and diminished value. This research focuses on the development of novel mechano-chemical disintegration processes for the breakdown of waste plastics. The outputs will be biocatalysed and used as building blocks for new polymers or other bioproducts.

Aim

The aim of the project is to use innovative green pre-treatment processes to recover lower molecular weight compounds/oligomers which will generate high performance new polymers or bioproducts.

Objectives

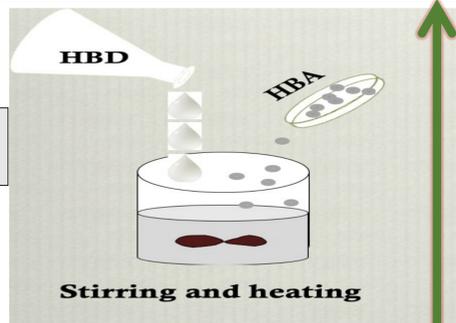


- Usage of Deep eutectic solvents (DESS) in degradation of plastics (PET).
- To demonstrate enhanced biotransformation of plastics waste into bioproducts by developing an optimized pre-treatment process.

Methods

1. Synthesis of suitable DESs (Via stirring and heating at desired ratios)

Urea	Choline Chloride	glycerol
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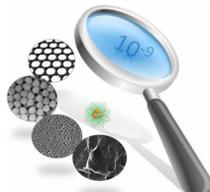


2. Microwave treatment of PET powder under at optimized conditions.

Exposure time: 90 seconds,
Power: 350 W,



3. Characterisations (FTIR, DSC, TGA)



Results

FTIR:

- Formation of new hydrogen bonds depicts successful synthesis of DES.
- Formation of OH group in oligomers which is not present in reference due to formation of chains containing OH,CH end groups.
- Reduction in peaks 1341 and 1241 depicts amorphous nature of materials as shown in Figure.1

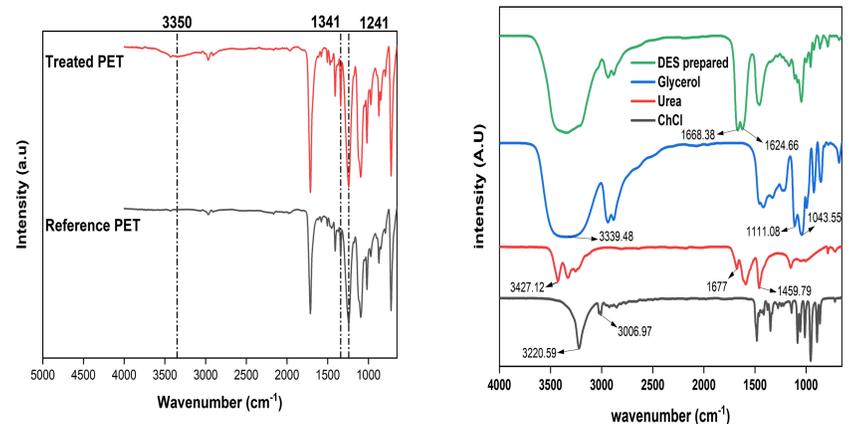


Figure 1: FTIR analysis of DES, Pure PET and Treated PET

TGA:

The reference PET has main weight loss at 395°C as a result of thermal decomposition but treated PET showed a lower weight loss temp around 130°C .it could be because of decrease in thermal stability depicting lower molecular weight product formation as shown in Figure.2

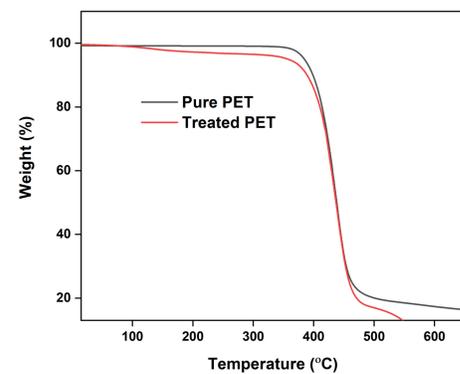
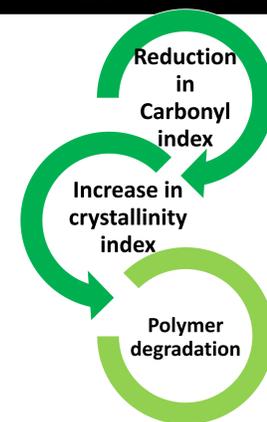


Figure 2: TGA analysis of Pure PET and Treated PET

Conclusion



Future Work

- Enzymatic degradation analysis will be carried out on treated plastics
- Effect of ultrasonication coupled with microwave will be evaluated.

References

1. Y. Li, J. Li, S. Guo, and H. Li, "Mechanochemical degradation kinetics of high-density polyethylene melt and its mechanism in the presence of ultrasonic irradiation," *Ultrason. Sonochem.*, vol. 12, no. 3, pp. 183–189, 2005, doi: 10.1016/j.ultrsonch.2003.10.011.
2. T. Aarthi, M. S. Shaama, and G. Madras, "Degradation of water soluble polymers under combined ultrasonic and ultraviolet radiation," *Ind. Eng. Chem. Res.*, vol. 46, no. 19, pp. 6204–6210, 2007, doi: 10.1021/ie070287+.