SOLVOLYSIS OF THERMOSET POLYMER MATRIX COMPOSITES

M. Pantazidou[1], M. Modestou[1], D. Semitekolos[1], C.A. Charitidis[1,*]

[1]R-NanoLab, School of Chemical Engineering, National Technical University of Athens, Athens, Greece

(*charitidis@chemeng.ntua.gr)

ABSTRACT

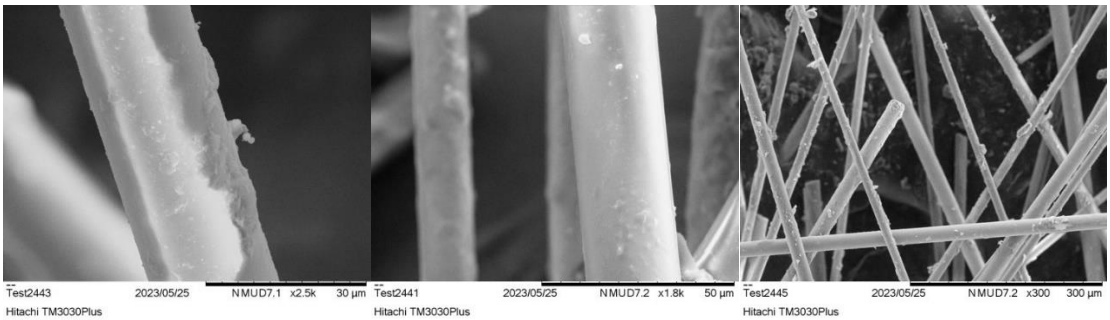
Recycling reinforced plastics is essential in order to establish a circular polymer economy. Mechanical recycling is the most common method of plastic waste management, but it cannot be applied in the case of thermoset plastics and thermoset polymer matrix composites (PMCs), due to their structure (i.e. covalent cross-links) and thus properties (i.e. non-meltable) [1]. In these cases, chemical recycling is a suitable option.

Chemical recycling can be categorized into solvolysis and thermal recycling (i.e. pyrolysis, gasification). There are different solvolysis techniques such as hydrolysis, methanolysis and glycolysis, depending on the reactant used for the depolymerization process (water, methanol and glycol respectively) and the operational conditions [2].

The present study focuses on the chemical recycling through solvolysis of Carbon fibre (CF) and Glass fibre (GF) reinforced composites (CFRPs/ GFRPs), such as End-Of-Life wind turbine blades (WTB), at both lab and pilot scale. The matrix of CFRPs used is epoxy resin and the matrix of the GFRPs is polyester according to literature and FT-IR analysis [3]. The developed solvolysis processes aim to recover the fibers.

Different solvolysis processes are examined, with an example being the glycolysis of WTB samples with Polyethylene glycol (PEG and specifically PEG200) as solvolysis agent, in the presence of NaOH, at 200°C and ambient pressure. Each process has been optimized at lab scale regarding temperature, catalyst and solvolysis agent quantity, time, etc. and then upscaled to pilot. The surface morphology of the recovered fibers is observed through SEM analysis. In the case of the PEG200/NaOH system the optimal conditions are 200 g PEG200, 12.5 g NaOH, 10 g WTB, for 6 h at 200°C, with a decomposition efficiency of 83%.

In conclusion, the present study proves that solvolysis is a promising method for recycling fiber-reinforced PMCs, with the aim of recovering the reinforcement.



SEM images of reclaimed GFs from WTB samples

KEYWORDS: Solvolysis, Reclaimed fibres, Chemical recycling, Composites, Plastic Waste

REFERENCES

[1] Ragaert K, Delva L, Geem KV. (2017). *Waste Management*, 69, 24–58.
[2] Mangold H, Vacano B. (2022). *Macromol. Chem. Phys.*, 223, 2100488.
[3] Mishnaevsky L, Branner K, Petersen HN, Beauson J, McGugan M, Sørensen BF. (2017). *Materials (Basel).*, 10, 1285.