Development of float separation as a pre-processing technique for wind blade recycling

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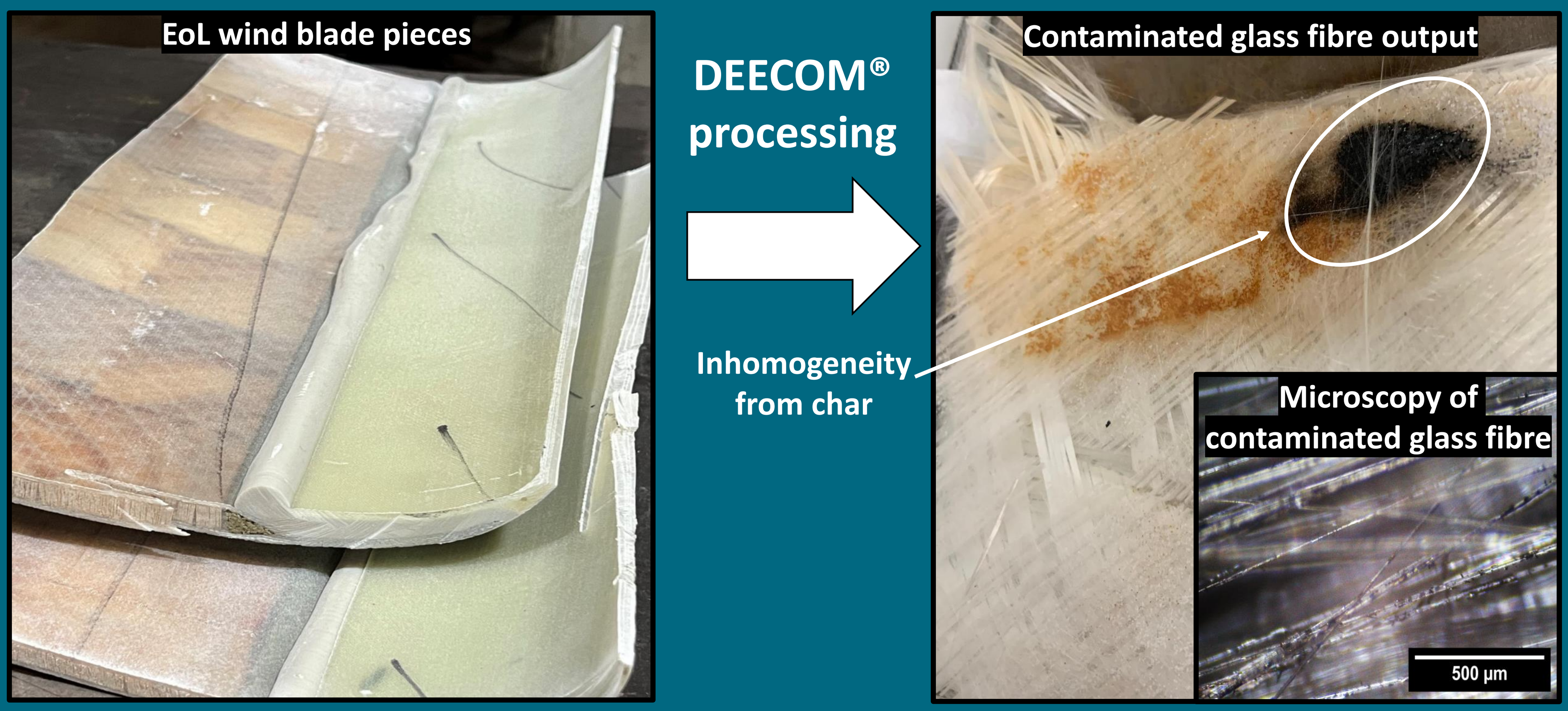
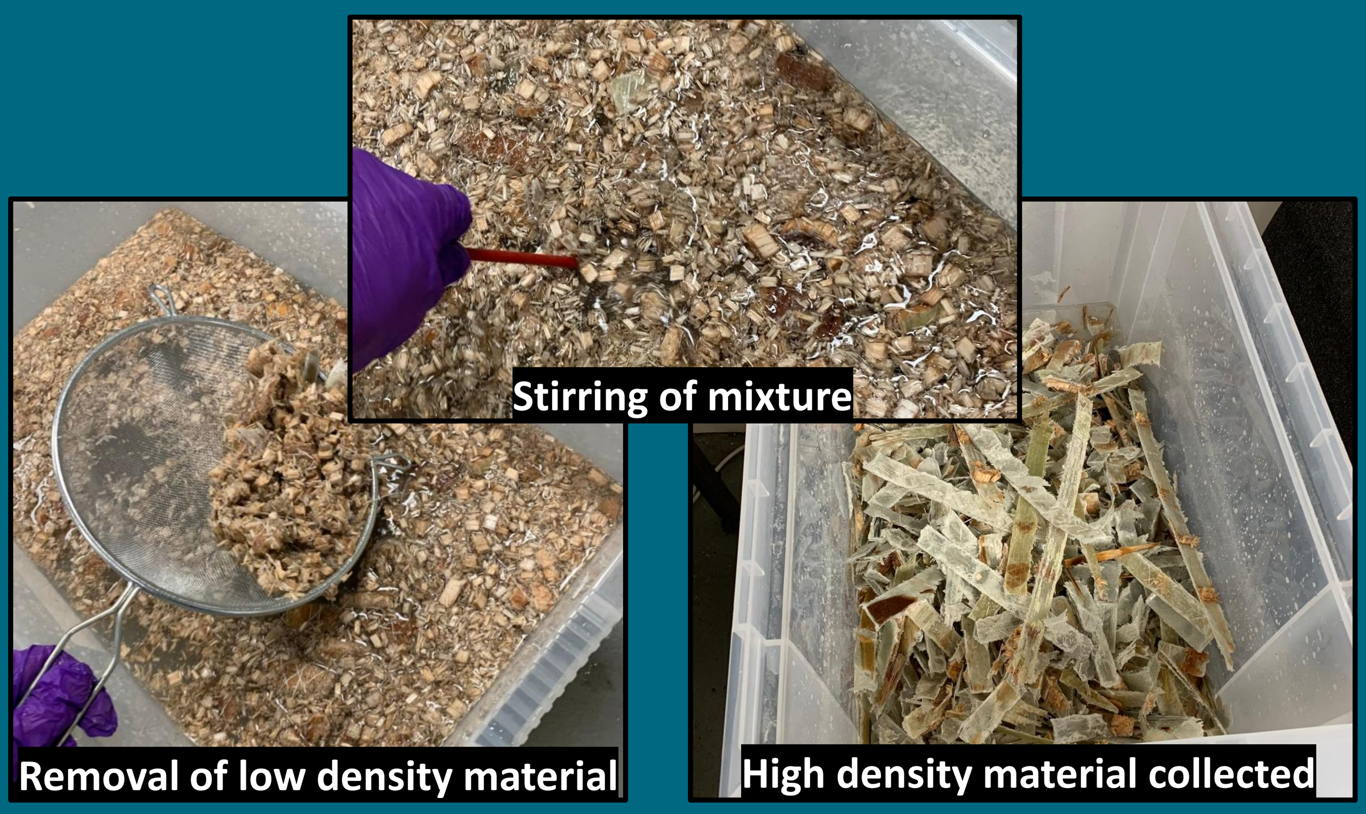
Priority Topic Area: **Responsible Production, Innovation and Industry**

1- Introduction + Aims

EMPHASIZING is an Innovate UK SMART project focused on upcycling Glass Fibre Reinforced Composites (GFRC), to reuse and resize glass fibre for use in car parts. Longworth uses the revolutionary patented DEECOM® process to recycle GFRC, typically wind blades from End of Life (EoL) turbines. Initially, output material was contaminated with charred wood, making fibres difficult to reuse.

This technique aims to enhance GFRC recycling by removing significant wood fractions before DEECOM® processing, thus increasing efficiency and purity. The project capitalizes on differing densities of wood, epoxy and glass fibre, respectively being <220 kgm^3[1], 1300 kgm^3[2], and 2540-2600 kgm^3[4].





2 – Methodology

Firstly, wind blade was processed through a Jenco (ITS340X390E) shredder and the shredded material weighed. This material was then inserted into a plastic container, and the container filled with water. Once filled, the mixture was stirred, allowing higher density material to sink. Lower density material was manually removed from the surface, and the water emptied to allow recovery of high density material. Both materials were then dried at 80 degrees for two hours and weighed prior to DEECOM® or disposal.

After DEECOM® processing, visual observations and optical microscopy confirmed adequate removal of resin and impurities from glass fibre.

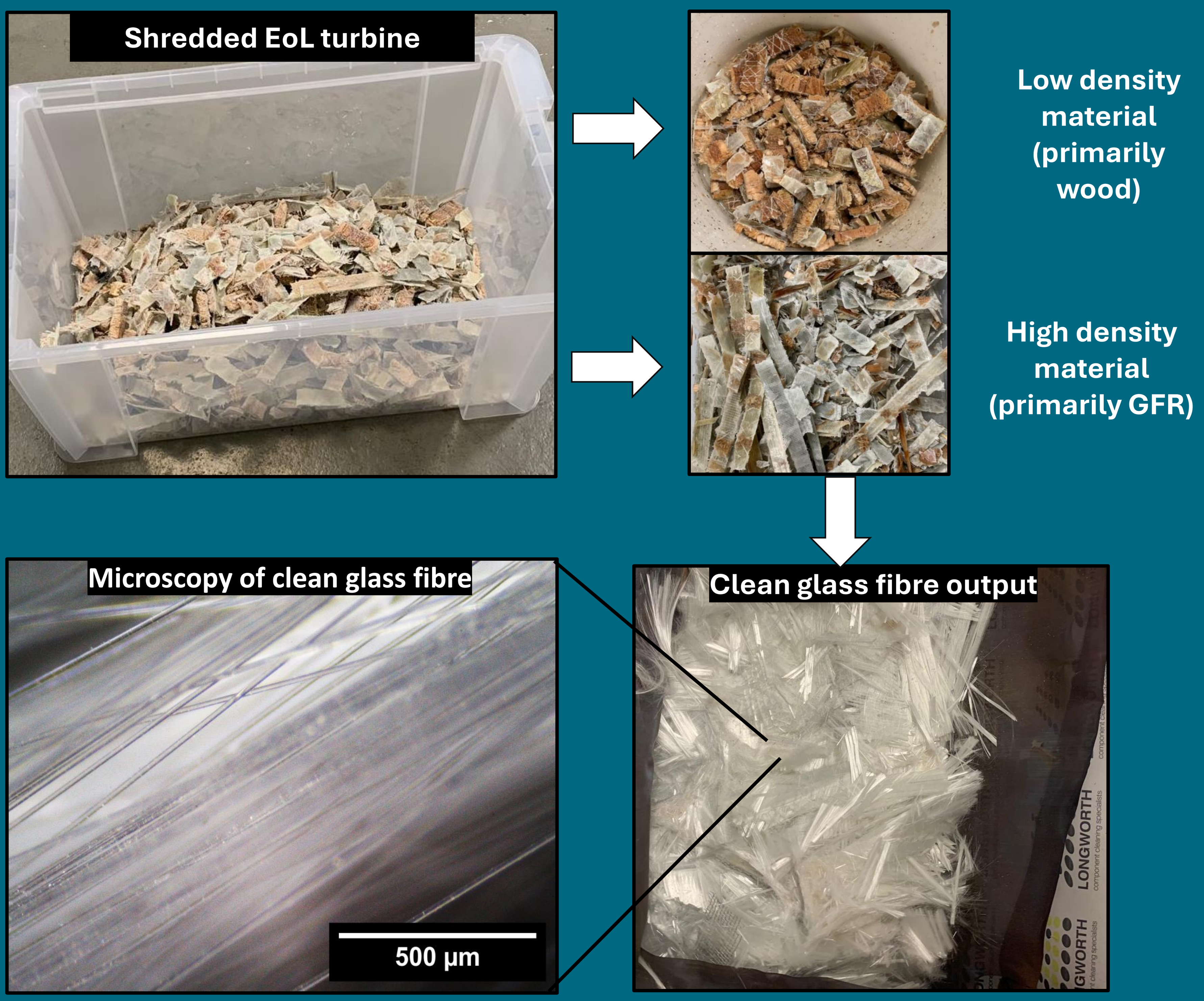
3 – Results and Discussion

After drying, it was visually apparent that the high density material consisted primarily of Glass Fibre and Resin (GFR), whereas the low density material was primarily wood. The mass loss observed showed that the float separation process had a GFR material recovery of 78%, thus showing that 22% of wood material can be easily removed for waste disposal.

Although use of DEECOM® for fibre reclamation is a new field, it often achieves better results than competitors. However, there are still limitations such as material throughput capacity. This project combats these limitations, allowing the vessel to now be filled with a higher percentage of GFR for each batch, increasing the operating throughput of material. Moreover, the process is more efficient, with less wood to process. This means greater amounts can be recycled each run for the same duration and utility usage, all while reducing inhomogeneity. Fibre cleanliness was confirmed through visual identification and optical microscopy.

Representative result: The yield of glass fibre was roughly 17% higher after pre-processing, as well as the output fibres being cleaner. Additionally, this does not take into account the increased throughput capacity of a run once the low density wood fraction has been removed.

Material	Mass in DEECOM® (g)	Mass out of DEECOM® (g)	Yield (%)
EoL wind turbine blade	397	163	41.1
Pre-processed blade	405	236	58.3



4 – Benefit to society

The float separation technique will reduce utility costs of DEECOM® GFRC recycling significantly. Hypothetically, 22% more GFR material can be processed each run, with the same utility usage. This results in lower emissions per kilogram of material recycled, improving the efficiency.

The DEECOM® process will now produce a more homogenous product, meaning less re-runs and thus less utility usage. Furthermore, the increased homogeneity of the product requires less sorting, reducing labor costs. This is currently being quantified.

These reasons both make the process attractive for commercial scale GFRC recycling, which is beneficial for the company and global sustainability.

5 – Next steps

The design and specification of a float-separator for high material throughput. This could involve the repurposing of density separators used for separation of plastics like PET and PP before recycling [3].

Opportunities in using DEECOM® to reclaim the cellulose from separated wood is another route that should be explored.

EMPHASIZING (Enhancing Material Properties of recycled glass fibres through SIZING) Recycle, refabricate, repurpose

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References/Acknowledgements

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[1] *Balsa | WoodSolutions* (no date). Available at: https://www.woodsolutions.com.au/wood-species/hardwood/balsa (Accessed: 25 April 2024).
[2] *Epoxy Material - an overview | ScienceDirect Topics* (no date). Available at: https://www.sciencedirect.com/topics/engineering/epoxy-material (Accessed: 25 April 2024).
[3] Wang, C. *et al.* (2015) 'Flotation separation of waste plastics for recycling—A review', *Waste Management*, 41, pp. 28–38. Available at: https://doi.org/10.1016/j.wasman.2015.03.027.
[4] *E-Glass Fiber, Generic* (no date). Available at: https://www.matweb.com/search/DataSheet.aspx?MatGUID=d9c18047c49147a2a7c0b0bb1743e812&ckck=1 (Accessed: 25 April 2024).

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