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Editorial corner – a personal view
Recycling of thermoset structural composites: Would textile technology bring a high added-value solution?

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Substantial amounts of composite end-of-life and manufacturing waste are still being landfilled or incinerated. Most of them are made of long or endless glass or carbon fibres and cross-linked thermosetting resin matrices, which are not easily recycled and remoulded. Recent changes to waste management legislation are however powerful drivers to identify more environmental friendly and economically viable recycling routes for such thermoset composites.

Many attempts have been made over the past twenty years to develop recycling processes (mechanical grinding, different variants of pyrolysis, cement kiln route, solvolysis …) and seek ways of cost-effectively using recycled material (glass or carbon fibres, resin chemicals) in various applications (moulding compounds for automotive and sanitary ware, concrete and rubber compounds for the construction industry, ceramic composites for friction applications).

In spite of the huge research efforts, the industrial achievements are globally disappointing up to now as far as closed-loop recycling of structural composites (i.e. high performance unidirectional or textile composites) is concerned. Indeed, one should keep in mind that the glass or carbon fiber reinforcement has potentially the most recoverable value in a structural composite, and that fiber length and fiber alignment are key features in composites design. That means that mechanical grinding, which dramatically reduces the fiber aspect ratio and cannot preserve continuous fibers, and further re-use as random compounds are obviously inappropriate in the case of structural composites.

Textile technology may bring a solution to overcome this problem. Patented textile technologies already allow manufacturing from dry fibre waste (selvedges, offcuts …) high added-value aligned fibre products such as veils, tapes or continuous yarns which could be re-used to form fabrics. However, glass or carbon fibres recovered by pyrolysis or solvolysis are more challenging to process that way because contrary to dry fibres (i) they do not retain the sizing applied to the virgin fibres at manufacture and would require further surface treatment; (ii) they are not fully 'clean', polluting residues or small resin pieces being possibly still attached to their surface; (iii) their mechanical properties (strength, modulus) may be significantly reduced in some cases (e.g. if recovered by pyrolysis). Current research programmes address these issues. If successful, then a closed-loop recycling route for such high-performance composites will emerge.

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