A second life for composite waste: recycling thermosets by solvolysis

Sebastien Masson, April 2011

Recycling of thermosets has been an important point on the agenda for the composite industry for a long period. Due to the cross-linked state, composites are neither fusible nor soluble and cannot be treated by simple methods. The aim of the EURECOMP project is to develop the physico-chemical separation process called solvolysis.

The objectives in the EURECOMP are towards total material recovery. By achieving this goal, solvolysis could potentially support the industry to comply with recycling targets set by the European regulations and enhance the final value of recycled products. Effective setting of a recycling chain needs an integrated approach, beyond technical development. This is why economic and environmental aspects are covered in the study from the waste resource to the downstream markets (Fig.1).

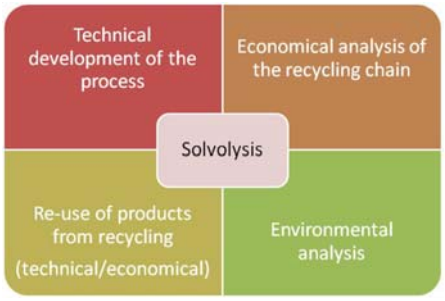


Fig. 1: Integrated approach of EURECOMP

From the beginning, EURECOMP identified the main composite waste resources for the surface transport sector in Europe. Most composites used for these applications are glass fibre reinforced plastics. Production waste amounts to 40-45 kt/year while the weight of composites in end-of-life vehicles can be estimated between 20 and 30 kt/year. Gathering material from production has the advantage of known localization and contents. However, dismantling systems that exist or are being developed for the transportation sector can also supply high volumes on a reliable basis. The volumes of waste produced (boats, car parts) show undoubtfully the need for recycling solutions.

The solvolysis technology

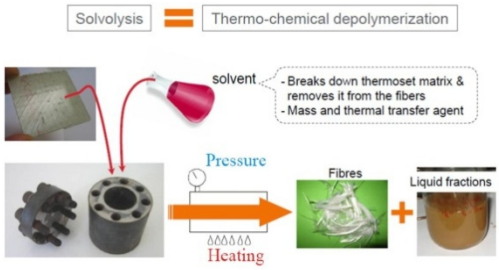


Fig. 2: The solvolysis process for recycling

(Fig.2 and Fig.3) This process breaks down the thermoset resin and removes it from the fibres.

A laboratory prototype reactor has been designed and built at the 'Institute Catholique d'Arts et de Metiers' (Nantes). Solvolysis trials have been performed to study the influence of several parameters such as temperature, treatment time and composite mass/water volume ratio.

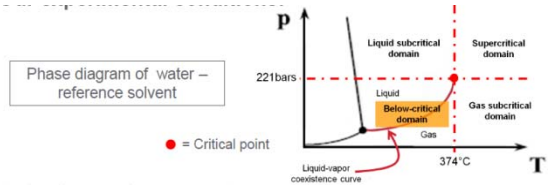
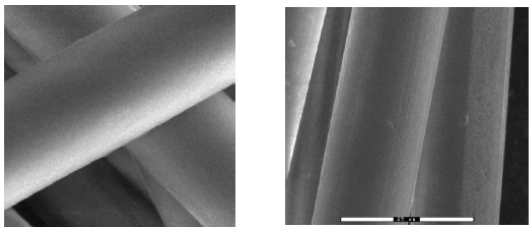


Fig. 3: Phase diagram of water

The first results show that up to 95% of resin is removed. Recovered fibres are clean with very few residues. This confirms the efficiency of the process and opens the path to their reuse. The coating of the virgin fibres is also removed and the fibres may need a new sizing step.



Virgin fibres *Fibres washed after solvolysis 350°C – 5min*

Fig. 4: Image of the fibres (*Source: University of Bristol*)

The mechanical properties of the fibres, such as the degradation is greater at high processing temperatures and longer reaction times.

Secondly, the liquid fraction which is retrieved from the depolymerisation of the resin contains chemicals of potential value : monomers of the resin, benzoic acid ...

Perspectives & next steps

The first trials exposed have shown high potential of the solvolysis technology for the recycling of glass fibre reinforced thermosets in a sustainable way.

During the upcoming period, composites containing recycled products will be manufactured to assess the properties of the final product and demonstrate the feasibility of the reuse. Further optimization of the parameters will also be performed as well as trials on other types of materials.

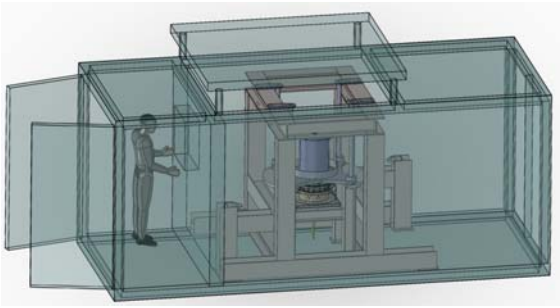


Fig. 5: preview of the pilot installation (Source: engineering office SACMO S.A., Coueron, France)

The Eurecomp project is foreseeing process upscaling to the pilot level (Fig 5).
The facility will then be able to treat several kilograms of composites per batch and open the way to real scale reuse of the final products.

The recycling possibilities offered by solvolysis may contribute to the reduction of the environmental impact of the transport sector. The opportunity to retain commercial value allows a competitive edge.

EURECOMP Project

• Objective: Recycling thermoset composites of surface transport trough solvolysis

• Duration : May 2009 - Duration 36 months

• Partners: Plastic Omnium Auto Exterieur Services, ICAM Nantes, University of Limerick, University of Exeter, University of Bristol, COMPOSITEC, GAIKER, Volvo Technology Corporation, Xietong Automobile Accessory, SACMO, URIARTE Safybox, Mixt Composites Recyclables, ECRC (European Composites Recycling Services Company), BPF (British Plastic Federation)

SEVENTH FRAMEWORK PROGRAMME

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