

Advanced process monitoring of the in-mould polymerization of a thermoplastic composite

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Summary

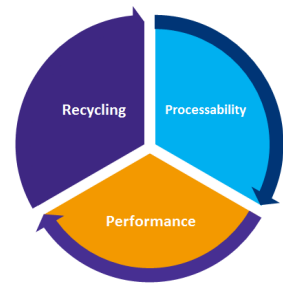
Reactive thermoplastics has been always the way to replace the thermoset matrices in liquid composite moulding. However only with the introduction of the **Elium[®] acrylic resin from Arkema**, the in-situ polymerized thermoplastic composites have really found a sustainable path to mass production. In order to support the development and the use of this resin in composites manufacturing the incorporation of an **advanced process monitoring system** which has been used extensively in the intelligent process monitoring of thermoset composites has been employed. The **Optimold cure monitoring** system measures the resistivity and temperature of the resin which are directly correlated online to viscosity, degree of conversion and the glass transition temperature. The first lab-scale trials show the high potential of the sensor system for automating a significant part of the production mainly in the **automotive and wind energy industries**.

The Elium[®] resin

Renewable energy Elium [®] for Wind : Elium [®] 188 XO Elium [®] 190 M Hand layup : Elium [®] 351 SO Pultrusion : Elium [®] C595	Transportation Room temp. process : Elium [®] 150 / 180 Elium [®] 182 S / 151 S Fast RTM : Elium [®] C195 Elium [®] C24 SMC : Elium [®] MC590	Building & construction Pultrusion : Elium [®] 591 Elium [®] C595 Casting Elium [®] C445	Sport & leisure and marine Room temp. process : Elium [®] 182 S / 151 S Elium [®] 188 O / 188 XO Fast RTM : Elium [®] C195
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- Fluid liquid resin (2K components) suitable for Infusion (VARI) , RTM, pultrusion, SMC and filament winding
- High performance material reinforced with continuous glass or carbon fibers
- Two different recycling strategies
 - Mechanical recycling
 - Chemical recycling by depolymerization



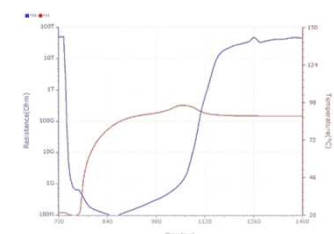
* Grades under development

Monitoring the reaction of the Elium[®] resin

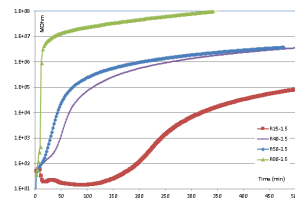
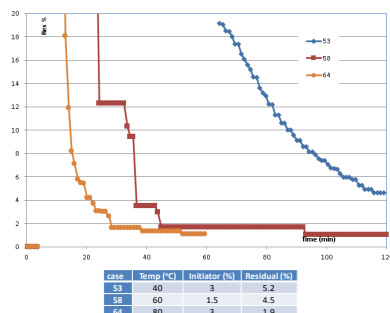
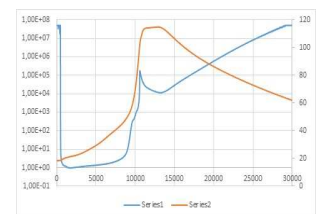
- Employing the Synthesites Optimold DC monitoring system which measures the electrical resistance and temperature.
- The resin's electrical resistance is directly related to the resin's viscosity and Glass transition temperature.
- It is possible to have online estimation of the residual monomer (graph below)



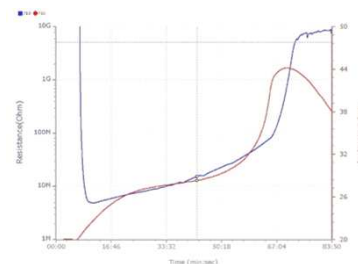
Automotive Application



Windblade Application



Resistance evolution for several processing temperatures. The sooner resistance increases the faster is the reaction.



Vacuum infusion of a thick CFRP part without external heating.

Conclusions and next steps

The **Elium[®] resin** is a very promising resin for the production of **recyclable advanced thermoplastic composites** that can be used in a wide range of applications. An **advanced cure monitoring system** has been used successfully for the intelligent process monitoring in the manufacturing of composites with a liquid reactive thermoplastic resin. The DC-based cure monitoring system which measures the electrical resistance and temperature of the resin can provide in real-time the evolution of the Tg/degree of reaction and as a result it allows its use for real-time quality and process control purposes during manufacturing. The challenge in Recotrans project is to combine this technology with microwave curing for the manufacture of an automotive RTM component as well as a composite profile made by pultrusion with the Elium[®] resin.



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