BUILDING-UP NANO-MAGNETIC RESINS FOR LIQUID COMPOSITE MOULDING – GEL-TIME AND MECHANICAL PROPERTIES

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INTRODUCTION

Liquid Composite moulding (LCM) processes are commonly used to manufacture polymer-textile composites because of their low equipment and tooling costs, low pressure requirements, short cycle times and ability to yield net-shape parts. One key issue in LCM process simulation is the resin infiltration in the fibrous preform which is usually described by Darcy’s law. Permeability is strongly dependent on resin viscosity and fibre volume fraction [1-2].

The manufacturing and characterization of nano-magnetic resins is the initial task needed to create a novel technique for resin flow control, which is based on magneto-rheological control over a nano-magnetic resin composed by a thermosetting polymeric matrix combined with nano-magnetic particles. By dispersing nano-magnetic particles on RTM resin systems it is expected to enable a local control of the flow velocity with the application of magnetic fields to the resin flow during manufacturing. This process control is intended to reduce LCM’s classical properties dispersion and to enhance the production of composites by Resin Transfer Moulding (RTM) [3-4].

DISCUSSION

In this work, several samples of a nano-magnetic thermoset resin were manufactured combining a vinylester resin used in RTM with a Nano-Magnetic Fluid (NMF). Several percentages (from 0.5% to 3% weight) of NMF were mixed with the thermoset resin. The polymerization process of the nano-magnetic resin was studied and took place with and without magnetic field. The influence of the magnetic field on cure behaviour and on dispersion and orientation of the nano-magnetic particles in the resin was assessed through electron microscopy. The gel-time and the gel-time temperature of the different thermoset/NMF combinations as well as the influence of the magnetic field on it were determined (Fig.1).
The bending (Fig 2) and flexural properties of the several manufactured nano-magnetic resins took place by performing three point bending and tensile tests on the materials. These tasks were performed on an universal INSTRON machine. The Tg of the studied thermoset resin was determined through a Dynamic Mechanical Thermal Analyser (DMTA) and the influence of the NMF on Tg was assessed.

**REFERENCES**


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**Fig. 1 – Influence of magnetic field and %NMF on gel time.**

**Fig. 2 – Influence of %NMF on flexural modulus.**