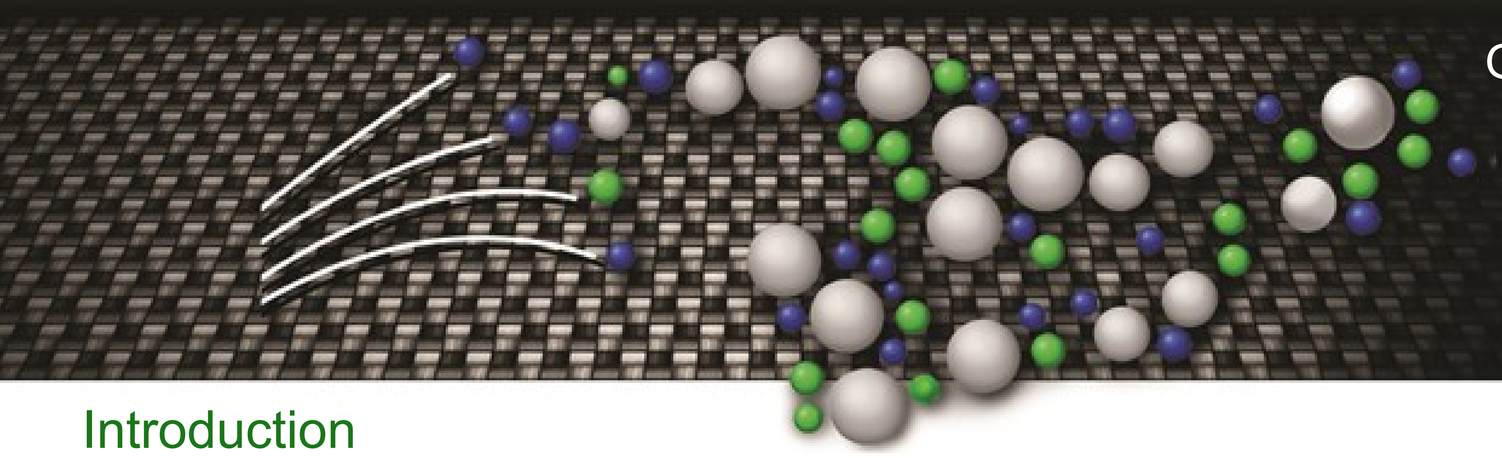
A STUDY ON THE FILTRATION OF NANO AND MICRO PARTICLES IN LIQUID COMPOSITE MOLDING PROCESSES



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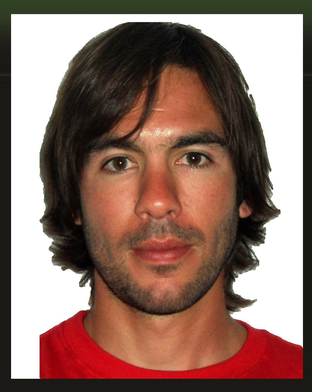
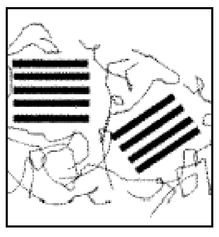
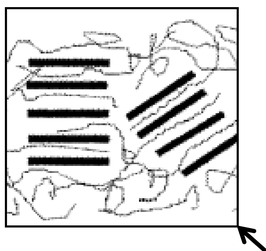
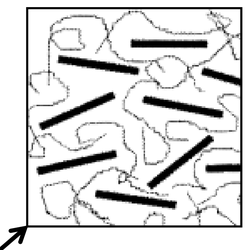
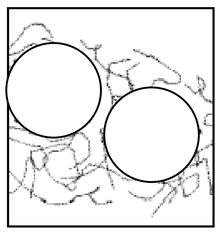


Introduction

When liquid composite molding techniques are employed using a filled resin, particles are transported by the resin and can be captured by the fibrous bed. The trapped particles can decrease preform porosity and therefore its permeability, increasing the resistance to flow. Moreover, a suspension concentration gradient can be developed along the flow path. This inhomogeneous particle distribution remains in the material microstructure after the resin cures, leading to uneven properties of the finished part.

Objective

Investigate the filtration of glass micro spheres (80μm) and nano clays and its effect on processing conditions and composite final microstructure.

Clay structure according to clay-polymer compatibility			Glass Spheres
Poor Compatibility (Micro-composite)	**Intermediate Compatibility (Intercalated Nano - composite)**	**Optimum Compatibility (Exfoliated Nano-composite)**	**Unique morphology**
			

Obtained clay morphologies

Methodology

- Suspension preparation (1, 2.5, 5% by weight of nano clays and 5,10, 20% by weight of glass spheres). Ultrasonic bath mixing for 30 min.
- Rheology tests.
- Permeability Measurements (glass fiber mat).
- Infiltration Tests (Figure 1) (glass fiber mat).

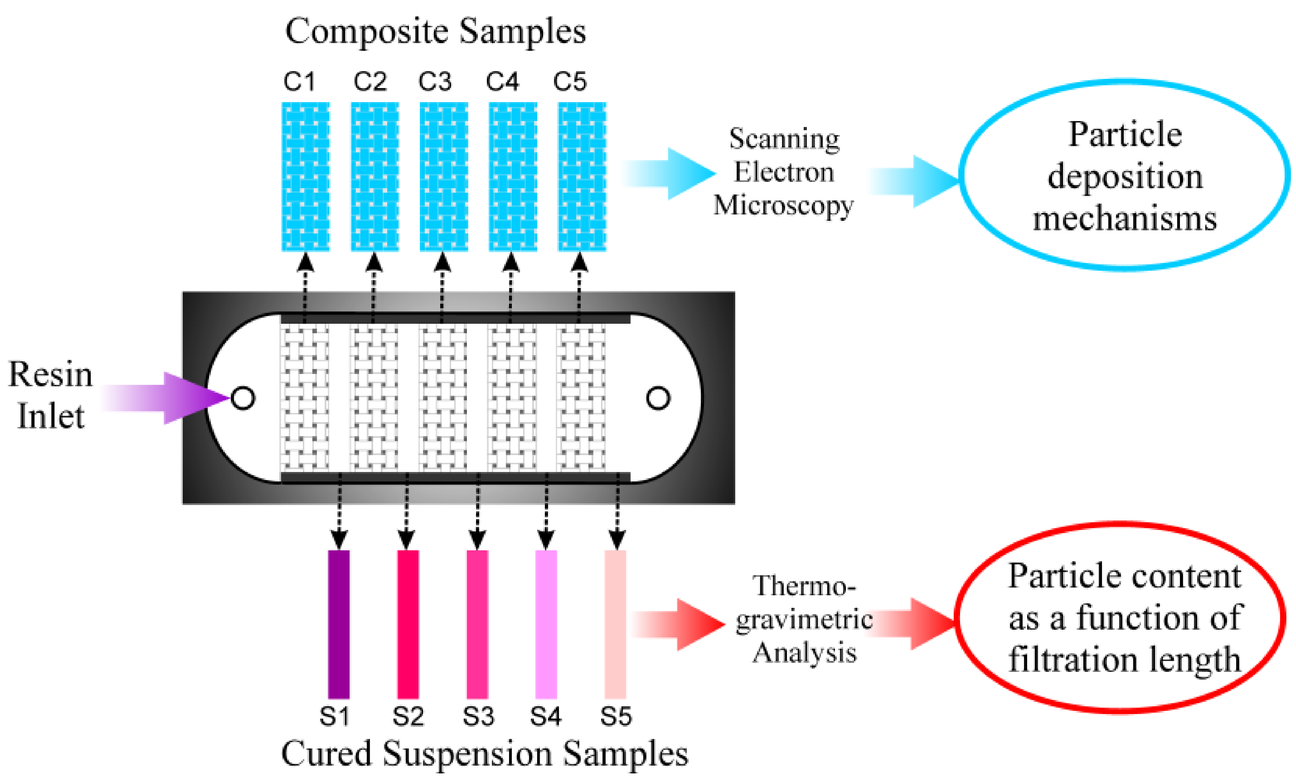


Figure 1: *Experimental set up for the infiltration tests*

Results

The effect of the fillers on resin viscosity is shown in Figure 2. Increasing clay concentration from 2.5% to 5% reduced the suspension viscosity due to the high tendency of the particles to agglomerate, leading to the formation of clusters which are more spherical than individual clay platelets.

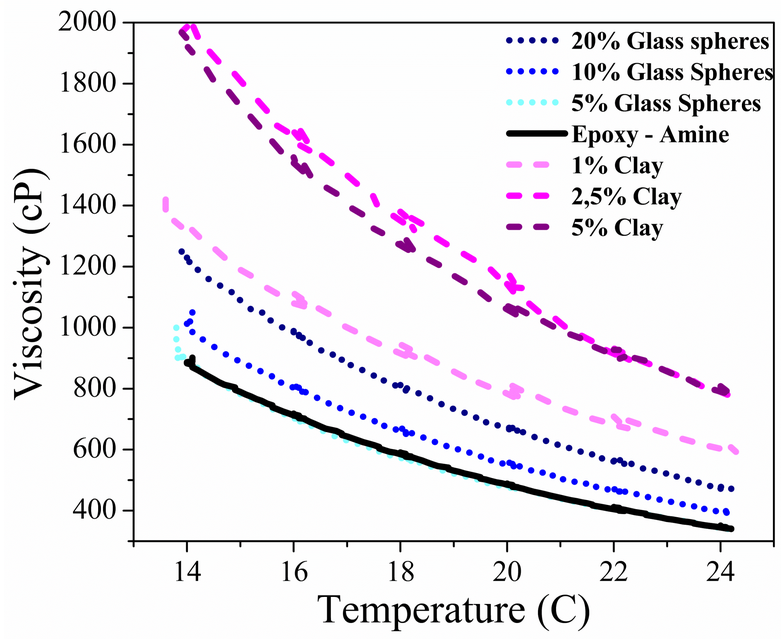


Figure 2: *Rheology results.*

The permeability of the reinforcement was measured using standard procedure. Both fillers decreased the measured value of this property (Figure 3). Glass micro spheres dramatically reduced this property, as a consequence of the cake formed at the beginning of the preform.

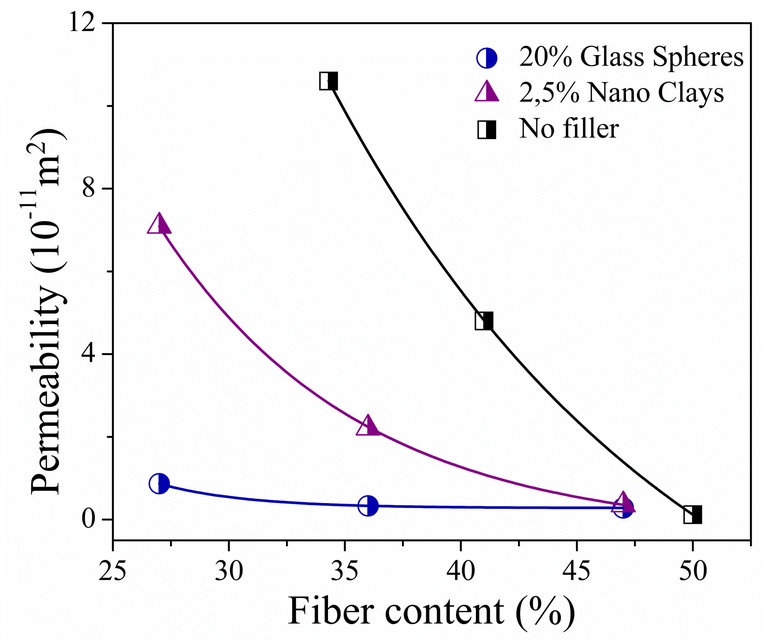
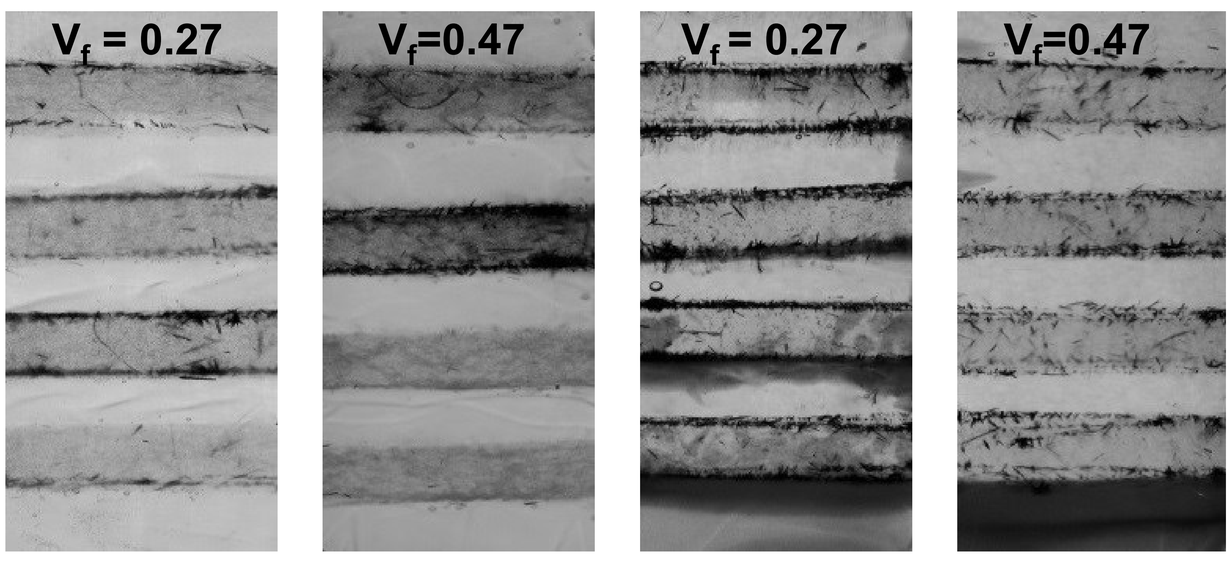


Figure 3: *Permeability results.*

No clay filtration could be observed by visual observation of the samples, at any fiber volume fraction. Glass microspheres were partially filtrated when 27% fiber volume content was set, leading to a deep filtration mechanism. When a fiber volume content of 47% was set, glass micro spheres could not enter into the microstructure of the fabrics, thus surface filtration occurred.



2.5% Nano Clays 20% Glass Spheres

Figure 4: *Visual observation of the cured composites. The inlet is located at the bottom of each picture.*

Further Research

Thermo-gravimetric experiments are currently being carried out in order to quantify the % of trapped particles as a function of the preform length. Furthermore, scanning electron microscopy will be performed to analyze the filtration mechanisms.