

On Flow and Thickness Change

Project done by:

UBC (Pascal Hubert)

Project funded by:

NSERC

Summary:

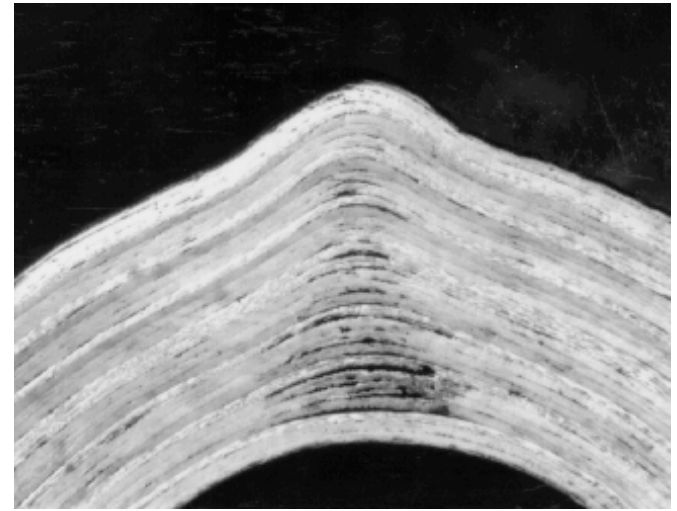
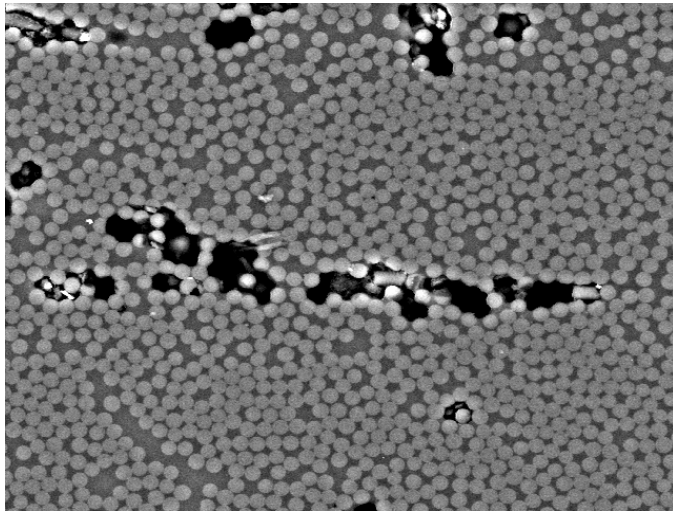
A brief discussion of resin flow and resin flow modelling, and the importance of resin flow is presented. Some experiments are compared with predictions.

References:

*Hubert P, Poursartip A. [A Method for the Direct Measurement of the Fibre Bed Compaction Curve of Composite Prepregs](#). Comp Part A 2001: 32; 179-187

*Hubert P, Vaziri R, Poursartip A. [A Two-Dimensional Flow Model for the Process Simulation of Complex Shape Composite Laminates](#). IJNME 1999: 44(1); 1-26

Flow Is Important



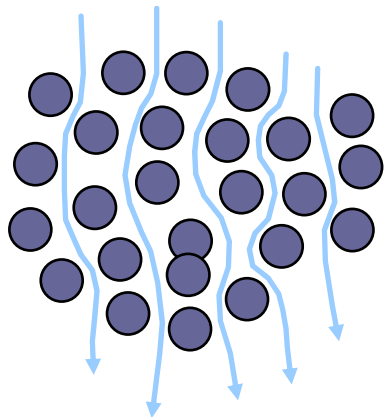
Void control

Dimensional stability

Fibre volume fraction

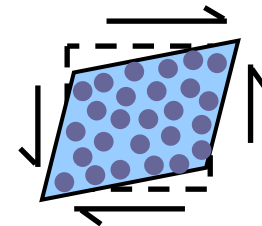
Flow Mechanisms

PERCOLATION

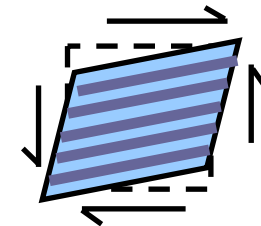


SHEAR

Intraply

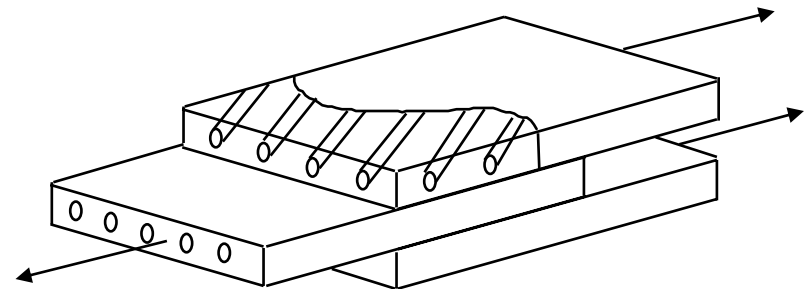


Transverse



Longitudinal

Interply



Flow Model Approaches

Thermoset World

($\mu = 0.1-10$ Pa.s)

**e.g. Autoclave, RTM,
filament winding**

Resin flows relative to fibres

Shear flow neglected

Darcy's Law coupled with fibre bed
consolidation

Thermoplastic World

($\mu > 100$ Pa.s)

**e.g. Sheet forming, ATP,
compression molding**

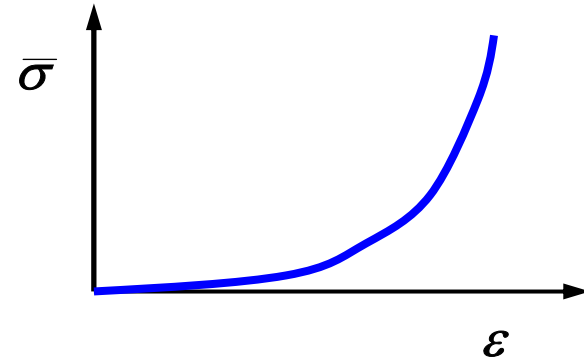
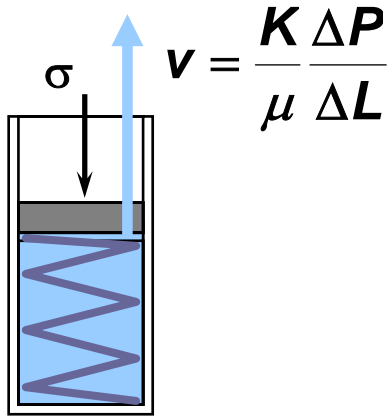
Resin + fibres flow together

Percolation often neglected

Flow of anisotropic viscous fluid

COMPRO Flow Module

PERCOLATION ONLY



Fibre bed compaction curve

K = fibre bed permeability

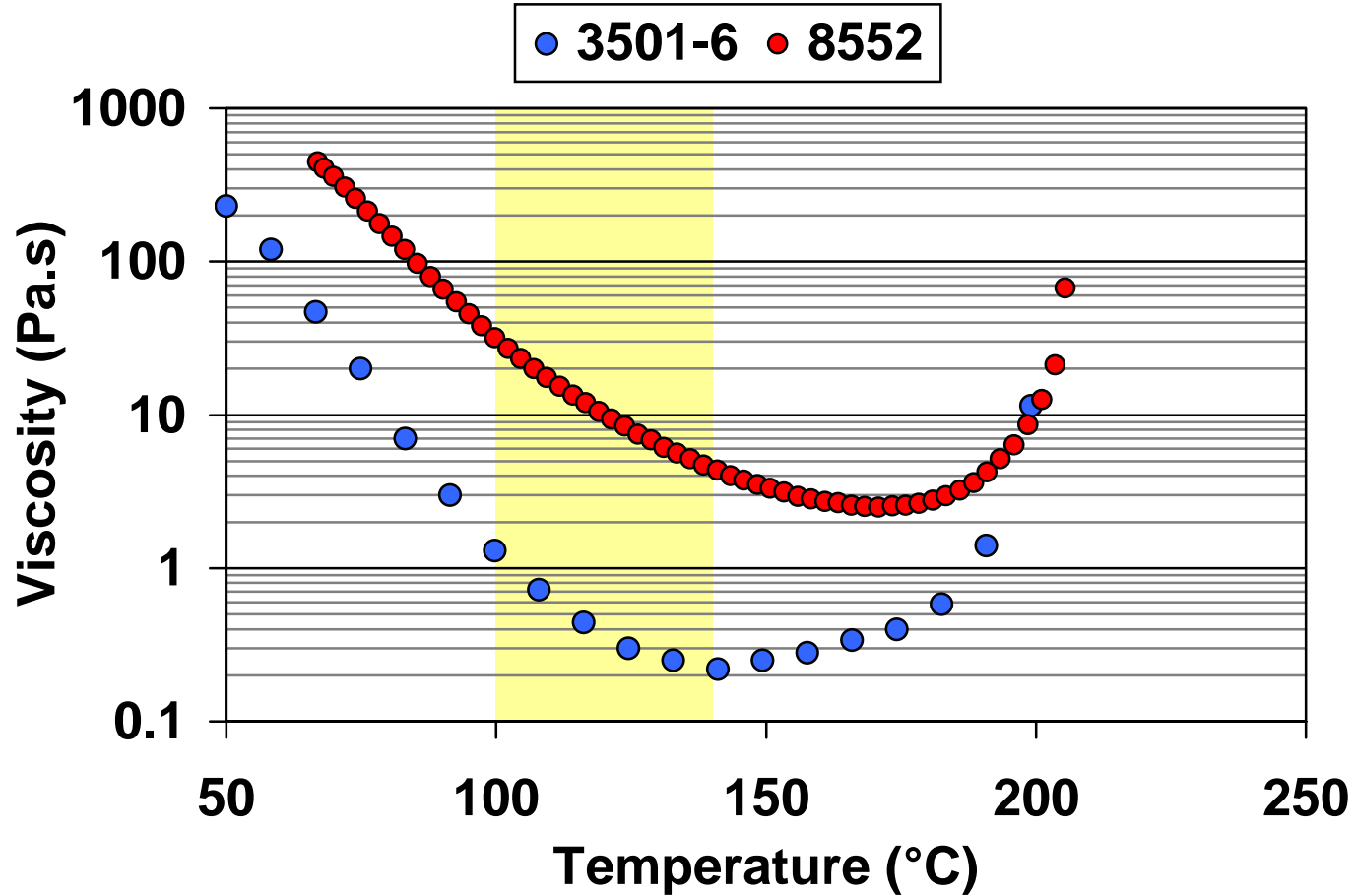
μ = resin viscosity

$$\sigma = \bar{\sigma} + P$$

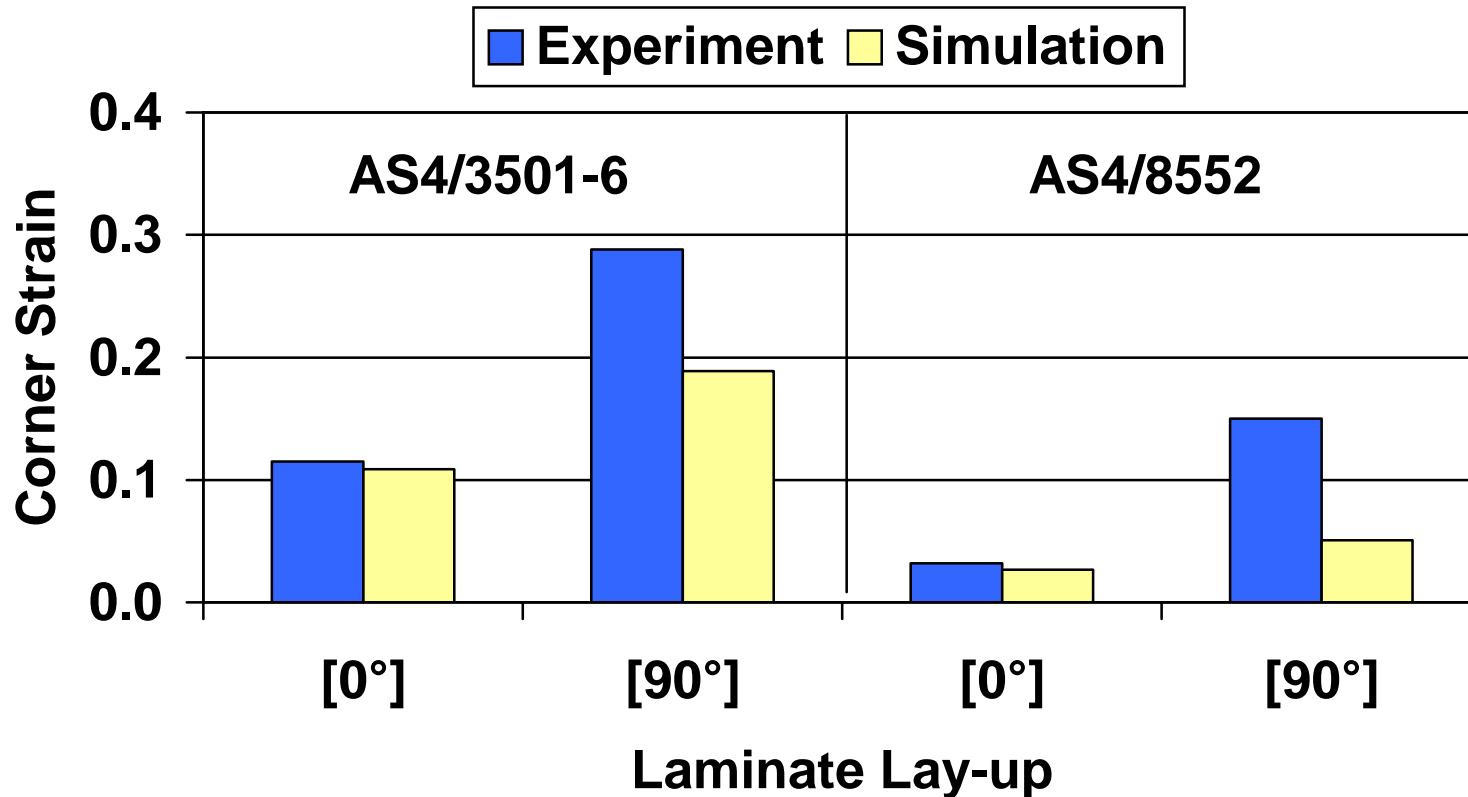
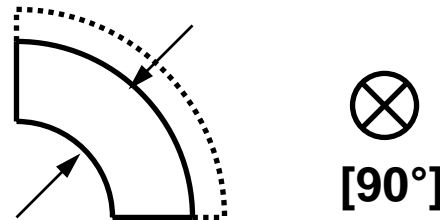
Fibre bed
stress

Resin
pressure

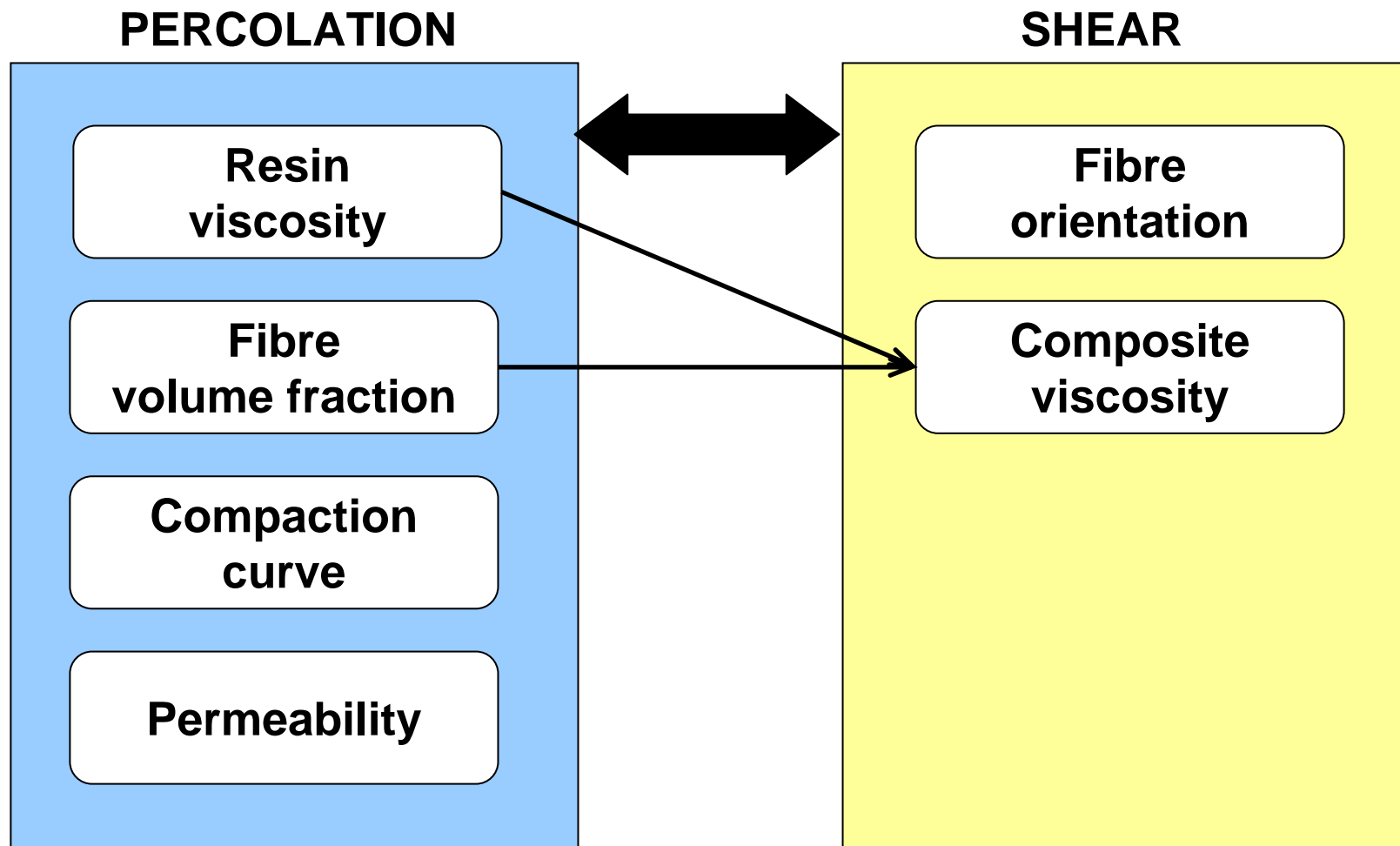
Input: Resin Viscosity



Corner Compaction



Mechanism Interactions



Comments on Flow

Shear flow can play an important role (in addition to percolation flow) during the processing of thermoset matrix composite structures.

Interaction between percolation and shear flow depends on the state of material

The state of the material is a function of:

- Resin and composite viscosities

- Fibre bed compaction curve

- Fibre bed permeability

- Fibre volume fraction

Percolation flow is mainly controlled by resin viscosity

Shear flow is mainly controlled by fibre orientation

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