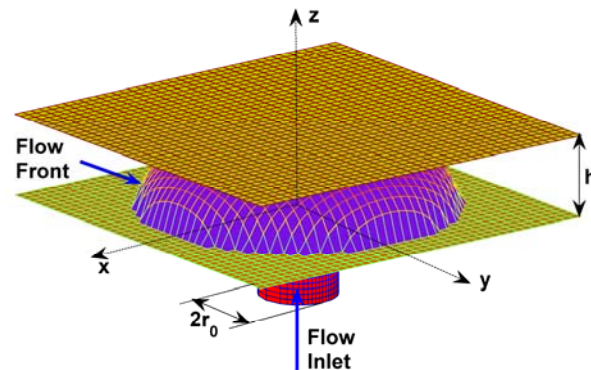


Permeability Tensor Measurements of Fiber Reinforcement in Composite Materials

(in collaboration with Prof. Chad Ulven)

Resin transfer molding (RTM) techniques are popular manufacturing methods of composite materials renowned for their simplicity, reduced time-to-market design, lower cost, and high quality in producing thermoset composite parts and structures. Optimization and numerical simulation of these techniques requires knowledge of physical properties such as the values for permeability tensor components. Of specific interest is the measurement of permeability in natural fiber preforms for the process modeling of newly developed biobased composite materials. These natural fiber preforms are finding use as reinforcement in polymers for the automotive, mass transit, and building products industries because of their renewability and low cost.



Physical Model for Transverse Permeability Measurements

The goal of this research is to develop theoretical and experimental methods for simultaneously determining the principal values of a permeability tensor for fibrous reinforcements which accounts for finite dimension of the inlet gate, when its diameter is comparable or larger than thickness of a fabric preform. Newly developed natural fiber preforms are tested under conditions similar to those during RTM (i.e. same pressure, temperature, viscosity of resin, etc.) and measured for permeability. To-date, the understanding of polymer resin flow through natural fiber preforms is limited.

Analytic solutions for the direct problem of liquid spreading in an anisotropic fabric preform are derived and analyzed. These solutions are compared with point source approximate solutions used by other authors. Algorithms for evaluating principal components of transverse and in-plane permeability are proposed. Experimental setup for monitoring of liquid spreading in an anisotropic fabric preform is built and tested.

- Mekic, S., Akhatov, I.S., Ulven, C.A. A radial infusion model for transverse permeability measurements of fiber reinforcement in composite materials, *Polymer Composites*, 2008. DOI 10.1002/pc.20632.
- Mekic, S., Akhatov, I.S., Ulven, C.A. Analysis of a radial infusion model for in-plane permeability measurements of fiber reinforcement in composite materials, *Polymer Composites*, 2008. DOI 10.1002/pc.20750.

Akhatov's research projects

- Mekic, S., Ulven, C.A., Akhatov, I.S. Nanoclay/epoxy solution flow through reinforcing fabric during liquid molding, International SAMPE Symposium and Exhibition (ISSI), Baltimore 2007.