Permeability of Aerogels at Supercritical CO_2 conditions

Haotian Jia, Georgios Karamanis, Hy Dinh and Marc Hodes
Department of Mechanical Engineering, Tufts University, Medford, MA 02155
Presenter: Haotian Jia, haotian.jia@tufts.edu

Permeability of aerogels is a necessary parameter in modeling the transport of supercritical carbon dioxide ($SCCO_2$) during drying. It quantifies the ability for fluids (gas or liquid) to flow through a material given a prescribed pressure gradient as described by Darcy's law. Data available in the literature consists of permeability of aerogels (primarily silica aerogels) at atmospheric conditions which is not applicable at supercritical conditions because of different Knudsen number regimes related to molecular slip. The Knudsen number characterizes the likeliness and frequency of fluid molecules colliding with another fluid molecules versus with the pore surface and thus determines if the usual assumptions of continuum and no-slip condition hold at $SCCO_2$ conditions. We developed an apparatus to measure permeability of aerogel via a direct and an inverse method. In the direct method, we apply a constant pressure difference on two sides of an aerogel cylinder and calculate its permeability by the measured flow rate of $SCCO_2$. In the inverse method, we place an aerogel sample inside a closed vessel and introduce a step change in pressure. We obtain the permeability by matching the theoretical and experimental pressure relaxation time.