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Experimental Method to Determine Anisotropic Permeability of Hollow Fiber Membrane Bundles

Abbr. title: Anisotropic Permeability of HFM bundles

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Abstract

The hydrodynamic flow resistance at low Reynolds numbers through hollow fiber membrane bundles is modeled, e.g. for computational fluid dynamics (CFD), as Darcy permeability K following the porous media approach. Experimental determination of the permeability of a particular hollow fiber bundle arrangement (fiber angle, diameter, and distance) is limited to one-directional flow measurements due to problems preparing representative elementary volume (REV) and following permeability is usually assumed to be isotropic. This ignores the fact that hollow fibers are usually arranged in an organized manner, or fiber bundle, and that resistance to flow is assumedly anisotropic. In this study, we developed a method of creating scaled-up REVs of almost any kind of geometry (by rapid prototyping) that can be measured in multi-dimensional directions within a permeameter. By means of a dimensional analysis the measured anisotropic flow resistances can be expressed in dimensionless friction factors, which can then be transformed into directional permeabilities on an arbitrary scale. The method was developed on two different fiber angle configurations (24° and 90°)

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