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Experimental study of permeability of oriented fiber arrays.[1]
QIANHONG WU, ZENGHAO ZHU, Villanova University — In this paper, a systematic study is performed to examine the permeability of a highly organized, oriented porous layer. Despite of extensive theoretical studies for the Darcy permeability of dilute or concentrated, oriented fiber array when the flow is either perpendicular or parallel to the fiber axis, there is a lack of research for the porosity between 0.3 and 0.8. Furthermore, no experimentally validated solutions have been reported to estimate the permeability of oriented fiber arrays where the angle between the fiber axis and the flow direction is in the range of 0 degree to 90 degree. We present in this paper an experimental study to examine the Darcy permeability of 3-D printed fiber arrays with different orientations. New correlations have been obtained when the porosity of the fiber array is in the range of 0.3 and 0.8. Furthermore, we have proved that, it is appropriate to use a linear combination method, based on the permeabilities of the fiber array at two distinct orientations, to predict the permeability of the fiber array at other orientations. The study presented herein has important applications in both biological systems and industrial applications, e.g. soft porous lubrication.

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Zenghao Zhu
Villanova University

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