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On the Examination of Darcy Permeability a Thin Fibrous Porous Layer¹ ZENGHAO ZHU, QIUYUN WANG, QIANHONG WU, Villanova University, VUCBMSS TEAM — In this paper, we report a novel experimental approach to investigate the Darcy permeability of a soft and thin fibrous porous layer. The project is inspired by recent studies involved compression of very thin porous films and the resultant pore fluid flow inside the confined porous structure. The Darcy permeability plays a critical role during the process, which however, is tricky to measure due to the very thin nature of the porous media. In the current study, a special micro-fluidic device is developed that consists of a rectangular flow channel with adjustable gap height ranging from 20 μm to 0.5 μm . Air is forced through the thin gap filled with testing fibrous materials. By measuring the flow rate and the pressure drop, we have successfully obtained the Darcy permeability of different thin porous sheets at different compression ratios. Furthermore, the surface area of the fibers are evaluated using a Micromeritics®ASAP 2020 (Accelerated Surface Area and Porosimetry) system. We found that, although the functions relating the permeability and porosities are different for different fibrous materials, these functions collapse to a single relationship if one express the permeability as a function of the solid phase surface area per unit volume. This finding provides a useful approach to evaluate the permeability of very thin fibrous porous sheet, which otherwise is difficult to measure directly.

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