Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Source-like Solution for Radial Imbibition into a Homogeneous Semi-Infinite Porous Medium DANIEL ATTINGER, Department of Mechanical Engineering, Iowa State University, HOWARD STONE, Department of Mechanical and Aerospace Engineering, Princeton University, JUNFENG XIAO, Department of Mechanical Engineering, Columbia University — We describe the imbibition process from a point source into a homogeneous semi-infinite porous material. When body forces are negligible, the advance of the wetting front is driven by capillary pressure and resisted by viscous forces. Our analytical results show that the absorbed volume flow rate is approximately constant with respect to time, and that the wetting front assumes a hemispherical shape with radius evolving in time as $r \sim t^{1/3}$. This cube-root law is confirmed by experiments using a packed cell of glass microspheres with average diameter of 42 μm. This result complements the one-dimensional imbibition law known as the Lucas-Washburn law where the imbibition length l evolves as $t^{1/2}$, and studies in axisymmetric porous cone with small opening angle by Reyssat et al. [1] where $l \sim t^{1/4}$ at long times.

[1] Reyssat, M., L. Courbin, E. Reyssat, and H.A. Stone, *Imbibition in geometries with axial variations.* J. Fluid Mech., 2008. 615: p. 335-344.

Daniel Attinger
Department of Mechanical Engineering, Iowa State University

Date submitted: 01 Aug 2011 Electronic form version 1.4