IMBIBITION OF LIQUID INTO A POROUS MATERIAL

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The imbibition of liquid into a porous material is considered. The liquid is imbibed due to capillary suction in the initially dry substrate. Different combinations of dimension, deformation and gravity have been considered, e.g one dimensional with deformation and no gravity. General governing equations and associated boundary conditions are developed for all these cases. When the porous material does not deform and gravity is not present the height of the liquid follows square root in time behavior. When gravity is included in this case, the fluid rises to a finite, equilibrium height. In the case of deformable porous material, a pressure gradient in the liquid across the developing wet substrate region induces a stress gradient in the solid material. This leads to an evolving solid fraction and hence deformation. When the porous material deforms and the gravity is not present, the solution is based on similarity methods. For one dimensional imbibition and material deformation, material swells during imbibition. But for the case with gravity, an inconsistency is present in the model suggesting further modeling is needed.