# NON SATURATED FLOW IN COMPRESSIBLE PREFORMS

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## ABSTRACT

In many cases of composite processing by liquid matrix infiltration, the fiber reinforcement is compressed when it comes in contact with the liquid and then relaxes as the matrix flows within its pores. In parallel, as the reinforcement is generally made of fiber tows, and thus exhibits a dual-scale, infiltration occurs gradually in the preform. Modeling of the process hence requires solving the coupled equations of multi-phase flow in a compressible medium. If infiltration is isothermal, the physics of the process are similar to imbibition/drainage phenomena encountered in soil mechanics. Using this similarity, a finite-element software is developed to simulate the infiltration of polymer in a compressible porous preform by adaptation of a code originally developed for soil mechanics. The dual scale of the porous medium is taken into account by introducing an additional sink term. The chosen case study is polypropylene transversally infiltrating glass fiber mats as used industrially in the production of Glass Mat Thermoplastic (GMT) blanks. The compressive behavior of the fiber preform, as well as the variation of permeability with volume fraction fibers are experimentally measured, and the curves introduced into the model. The sink term evolution is based on the solution of radial flow into an elliptical glass fiber tow, as experimentally observed. Solutions are given for the unidirectional infiltration of polypropylene under an increasing or constant applied pressure. The progression of the flow front, the evolution of the fiber volume fraction and local preform stress profile, as well as the saturation and local matrix pressure profiles are obtained. The influence of the processing and materials parameters is discussed in light of the experimentally observed phenomena, pointing out the advantages and limitations of the approach. veronique.michaud@epfl.ch