Research Seminar by

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Computation of Permeability of Porous Media Using a Pipe Network Model

Abstract

Porosity, pore-size distribution and permeability are the most important factors that influence hydro-thermo-mechanical response of porous geomaterials like rocks, soils, concrete etc. In petroleum industry, these factors determine the viability oil recovery; in nuclear industry, they play a crucial role in the effectiveness of clay barriers for nuclear waste, oil, gas and CO_2 storage strategies whilst they control the durability of construction (perhaps all) materials like concrete, masonry etc. Their determination through physical experiments, however, is not an easy task except for homogenous sand type of particulate materials. Field tests are extremely expensive and unreliable. Moreover, the characteristics change when the porous media is subjected to a field of volumetric and/or deviatoric strain. To add further to complexity, permeability is a tensor and value of its all components is required for the solution of any problem. It is obvious that a computational model to determine permeability will be of great help.

A simple Pipe Network Model (PNM) is used to compute permeability of a number of rock specimens from various oil fields. The porosity and pore size distribution was determined in the laboratory by the well known technique of 'mercury porosimetry'. Class A predictions using PNM, were made and found to be in good agreement. Using some intuition and simple logic, the original model was modified to account for porous media being under a strain field and also in presence of periodic fractures.

Mercury porosimetry is an outdated method for determining porosity and pore size distribution. Although there are newer techniques of 'gas adsorption', they also have limitations. Current research efforts are being directed towards determining permeability of clays using X – ray CT scanning techniques incorporating computational intelligence.