POROMECHANICS RESPONSE OF INCLINED WELLBORE GEOMETRY IN CHEMICALLY ACTIVE FRACTURED POROUS MEDIA

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Naturally fractured rock formations involve a high degree of local heterogeneity due to the presence of abnormally high permeability but low porosity flow paths (fractures). The dominant characteristics of fractured rock formations, i.e., the coupling between various induced hydro-mechanical processes and interporosity flow can be well represented under the realm of dual-porosity poromechanics [1]. Additionally in chemically active formations, e.g., shaley geomeaterial, osmotic pressure arises due to the physico-chemical interactions among pore fluid components and the solid matrix. Thus, the chemical coupling in chemically active fractured porous media requires proper modeling.

In this paper, the chemical osmotic coupling effects in the overall response of naturally fractured formations are studied within the framework of the dual-porosity poromechanics. The conventional single-porosity Biot's poromechanics formulation [2] is extended to a consistent dual-porosity model that accounts for the coupled fluid flow and rock/fractures deformation. The chemical effect is incorporated using the concept of chemical potential of the pore fluid [3]. The analytical solution to the inclined wellbore geometry is derived for a wellbore drilled in an infinite fractured poroelastic medium, subjected to the three-dimensional in-situ state of stress.

Via the inclined wellbore solution, the importance of the chemical coupling on the stresses and pore pressure responses in and around the wellbore geometry are illustrated and analyzed. Finally, wellbore stability analyses have been carried out to demonstrate possible applications of the solutions.

References

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Keywords: Poromechanics, fractures, chemical effects, drilling