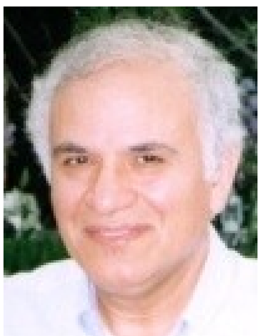
Numerical Simulation of Hydraulic Fracturing in Isothermal and Non-isothermal Conditions by Water and by CO_2 and Fluid-Rock Surface Energy

Prof. Abbas Firoozabadi (NAE),
Rice University

Thursday, April 4, 2024, 9 a.m. Central Time



Prof. Abbas Firoozabadi, Distinguished Research Professor of Chemical and Biomolecular Engineering at Rice University, will speak on Thursday, April 4, 2024. The topic is “Numerical Simulation of Hydraulic Fracturing in Isothermal and Non-isothermal Conditions by Water and by CO2 and Fluid-Rock Surface Energy.”

Abstract

Numerical simulation of fracturing by different fluids relies on interfacial energy density, discretization, and appropriate numerical solution of differential equations that define the problem. The phase-field approach with incorporation of critical energy release rate is the basis of the rock failure and fracture propagation. Critical energy release rate is a key parameter of numerical simulation of fracturing by different fluids. Molecular and atomistic simulations are conducted to get firm ideas on the critical energy release rate.

There are advantages in formulation based on the Euler-Lagrange equation in simulation of fracturing. The mixed finite element may be a natural choice for discretization in fracturing. We can predict fracture branching without parameter adjustment. At superhot temperatures found in many regions of the world, the estimate of renewable geothermal energy exceeds hydrocarbon energy resources. At higher temperatures even without thermal stress, fracture intensity from fracture branching and from natural microfractures may provide the path for effective heat extraction. At superhot temperatures, there may be a significant reduction in breakdown pressure. CO2 fracturing may be even more effective than water fracturing in such conditions. Lower fracturing pressure reduces seismic activity and helps

with safety of fracturing. This presentation covers fracturing of both shale and granite rocks.

Biography

Abbas Firoozabadi has a Ph.D. degree from the Illinois Institute of Technology and did post-doctoral research at the University of Michigan, Ann Arbor, MI. Professor Firoozabadi has taught graduate-level courses on equilibrium and irreversible thermodynamics at the University of Texas-Austin, Imperial College London, Yale University, Tokyo University, Rice University, and Peking University. He has established a research consortium at the Reservoir Engineering Research Institute (RERI) in Palo Alto, CA with funding from major energy companies in the US and abroad, and US-DOE.

His published work covers multi-component-multiphase flow in fractured media and equilibrium and flow in unconfined and confined media. He has received four of the five major awards of the Society of Petroleum Engineers (SPE) including the Anthony Lucas Gold Medal. Professor Firoozabadi is a member of the US National Academy of Engineering (NAE).