École des Ponts
ParisTech

Opening for a Full time Post-doctoral Research Associate in Geomechanics

Project: Modelling of fracturing mechanisms in unconsolidated sand reservoirs under fluid injection

Research Unit : Laboratoire Navier, Ecole des Ponts ParisTech

Industrial partner: TotalEnergy

Duration: 18 months

Project start date: January 2024

Context

In hydrocarbons producing fields, Produced Water Re-Injection (PWRI) is known as an economically attractive and environmentally friendly method to manage the produced water. This method has the advantage to maintain the pressure level in the reservoir in order to enhance the hydrocarbon production. However, this technique faces challenges such as the deterioration of the injectivity due to the filtration, around the injection well, of suspended solid particles contained in the produced water. Re-injection in the so-called 'fracturing regime' is an option to maintain the injectivity by fracturing the clogged zone formed by the agglomeration of fine particles at the face of the injected formation. However, controlling the injection in the fracturing regime is a key issue for the safety of the production as fracturing should not deteriorate the cap rock integrity.

Hydraulic fracturing has been extensively studied for brittle rocks with low permeability and is dominated by tensile failure. However, the mechanisms involved in fracturing of unconsolidated reservoirs which behave as cohesionless granular materials are fundamentally different and are controlled by shear failure, fluidization and induced channelization around the injection point.

Research program

Recent experimental studies performed at Laboratoire Navier have shown that under radial injection conditions, sand packs containing fines can be fractured. The fracturation process is evidenced by significant pressure drops and an increase of the overall permeability. X-ray CT observations confirm the existence of short radial cracks characterized by higher porosity and pore size and reduced amount of fines.

The objective of the study is to perform numerical simulations of the laboratory tests using Elfen Finite Element and Discrete Element Software developed by Rockfield. Modelling of injectivity impairment due to transport and deposition of particles will be developed for various injection scenarios reproducing tests conditions (injection of pure water or water containing a suspension of fine particles). The effect of tests conditions (stress level, initial permeability, injection scenario, nature of the injected fluid) on the pseudo-frac pressures will be studied and compared to the laboratory results. Finally, the extrapolation of laboratory results to field conditions will be discussed.

Profile

PhD in geomechanics
Good background in mechanics
Experience in numerical modelling

Contact and application

Interested candidates should send an application (including a CV, a list of publications, a cover letter describing interests and qualifications related to the projet, all compiled in a single PDF file) to:

Prof. Jean Sulem
Director of Laboratoire Navier
jean.sulem@enpc.fr