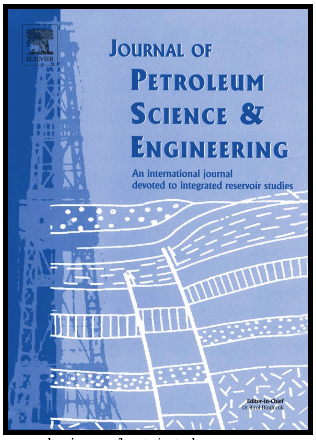
Author's Accepted Manuscript



www.elsevier.com/locate/petrol

A 3D PERIDYNAMIC SIMULATION OF HYDRAULIC FRACTURE PROCESS IN A HETEROGENEOUS MEDIUM

S. Nadimi, I. Miskovich

PII: S0920-4105(16)30208-X
DOI: http://dx.doi.org/10.1016/j.petrol.2016.05.032
Reference: PETROL3475

To appear in: *Journal of Petroleum Science and Engineering*

Received date: 20 August 2015
Revised date: 27 February 2016
Accepted date: 26 May 2016

Cite this article as: S. Nadimi and I. Miskovich, A 3D PERIDYNAMIC SIMULATION OF HYDRAULIC FRACTURE PROCESS IN A HETEROGENEOUS MEDIUM, *Journal of Petroleum Science and Engineering,* http://dx.doi.org/10.1016/j.petrol.2016.05.032

A 3D PERIDYNAMIC SIMULATION OF HYDRAULIC FRACTURE PROCESS IN A HETEROGENEOUS MEDIUM

S. Nadimi[a], I. Miskovich[b]

[a]Department of Chemical Engineering, The University of Utah, UT 84112, USA

[b]Department of Mining Engineering, The University of Utah, UT 84112, USA

Abstract

A non-local state-based peridynamic method (PD) is employed to simulate the initiation and propagation of the hydraulic fracturing. This study presents a novel 3D simulation of the hydraulic fracturing initiation and propagation in a heterogeneous geological medium by a linear-viscoelastic PD model. The interaction between induced fractures and a pre-existing fracture, as well as the influence of the angle of approach and differential horizontal stress on the fracture propagation behavior was investigated through the simulation. In the lower approach angles and differential horizontal stress, the pre-exiting fracture was dilated by the hydraulic fracture; in higher approach angles with higher differential horizontal stress, the hydraulic fracture crossed the pre-existing fracture. The accuracy of the 3D model was validated by experimental hydraulic fracturing data published based on the laboratory tests. Finally, the influences of the three different injection rates on fracture initiation and propagation, induced fracture surface and shear dilation were investigated. The simulation showed that the maximum dilatation and fractured zone occurred at the injection rate of 0.61 m^3/min. The 0.61 m^3/min injection rate caused the highest complete damage (0.9–1) with 5.24 % of the total number of atoms. As a result, the peridynamic approach presents promising results in predicting fracture propagation and damage area.

Keyword: Hydraulic fracturing, Peridynamics theory, Numerical modeling, PD viscoelastic model, Heterogeneous medium