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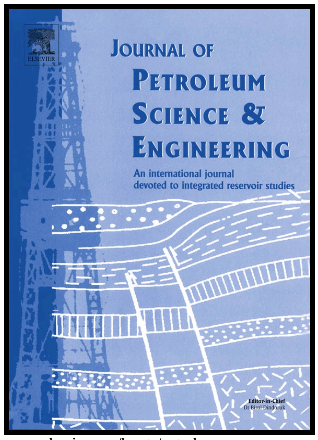

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Numerical Simulation of Limited-Entry Multi-Cluster Fracturing in Horizontal Well

Yang Li[a,b], Jingen Deng[a,b], Wei Liu[a,b*], Wei Yan[b], Yongcun Feng[c], Wenke Cao[a,b], Pengfei Wang[a,b], Youlin Hou[a,b]

[a]College of Petroleum Engineering, China University of Petroleum, Beijing 102249, China

[b]State Key Laboratory of Petroleum Resource & Prospecting, Beijing 102249, China

[c]The University of Texas at Austin, Austin, Texas 78703, USA

[*]Corresponding author: Tel.: +86 13811408220. liuwei@cup.edu.cn

Abstract

Limited-entry technique has become one of the primary engineering approaches to promote even growth of multiple fractures in hydraulic fracturing. In this paper, we developed a three dimensional (3D) hydro-mechanical coupling finite element model to investigate the simultaneous growth of multiple fractures during the multi-stage/multi-cluster fracturing of horizontal wells. The focus is to elaborate the effect of entry friction on the growth of fractures initiated from multiple perforation clusters. To this end, we developed a new element to account for the local pressure drop due to perforation entry friction and thus to dynamically partition the flow of the fracturing fluid among multiple fractures. The effectiveness of this element was validated by two element-level test examples. Propagation of the hydraulic fractures was modeled by using a zero-thickness cohesive element, which can simulate the fracture propagation and fluid flow within the fractures in a completely coupled manner. With this 3D model, parametric studies were performed to illustrate the impact of perforation parameters and stress shadowing on the simultaneous propagation of fractures from multiple perforation clusters within a stage. Results indicate that a sufficiently large perforation pressure drop can counteract the stress shadowing among the multiple fractures and can help to equalize the length of multiple fractures. The differences of down-hole pressures among cases with different