Characteristic Correlation between Induced Stress and Transient Pore Pressure Change in Multistage Fractured Horizontal Wells

Lei Xiao[1], Gang Zhao[2], Hairuo Qing[3], Wanju Yuan[2] and Chang Su[2]

Abstract

Multistage fractured horizontal wells (MFHW) in unconventional reservoirs usually experience long transient flow period and sharp production decline. Poroelastic effects have significant impact on the in-situ stress state. Field observations have confirmed the induced stress evolution as pore pressure changes due to production. However, measured data could only reveal the stress evolution phenomenon but are limited to systematically characterize the induced stress change with respect to time and space. A boundary element method (BEM) is proposed to simultaneously model transient pore pressure and the induced stress evolution change of MFHW in a bounded reservoir with no flow boundaries. The induced stress components on fractures show transient characteristics which are consistent with the linear, transitional, pseudo-radial, and boundary dominated flow regimes commonly identified in well testing. The evolution of stress path, which describes the induced minimum horizontal stress per unit pore pressure change monitored at the well, is non-linear and shows quantifiable characteristic trends during different transient flow regimes. Our modeling results reveal that the characteristic correlation between induced stress and transient pore pressure change shows promising field applications to estimate stress evolution of MFHW from measured reservoir pressure data.

[1] Husky Energy Inc.
[2] Faculty of Engineering & Applied Science, University of Regina
[3] Department of Geology, Faculty of Science, University of Regina

Lei Xiao is an engineer-in-training in the New Grad Program at Husky Energy. He is rotating in different roles, including enhanced-oil-recovery reservoir engineering, thermal-production engineering, and gas-resources-development engineering. Xiao's research interests include CHOPS wormhole characterization, semianalytical modeling of coupled fluid flow and solid deformation, and hydraulic fracturing of unconventional reservoirs. He holds a bachelor's degree in petroleum engineering from the China University of Geosciences (Beijing) and master's and PhD degrees in petroleum systems engineering from the University of Regina, Canada.