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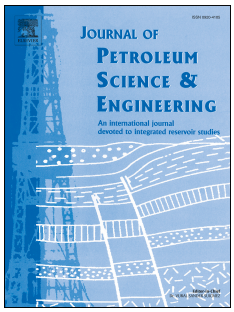

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Transient Pressure Behavior of Multi-stage Fractured Horizontal Wells in Stress-sensitive Tight Oil Reservoirs

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Abstract

Due to well-developed natural fractures, tight oil reservoirs always described as stress sensitive dual media reservoir. So far, the pressure distribution model for multi-stage fractured horizontal well (MFW) in stress sensitive reservoir is almost solved by numerical method. This paper gives the semi-analytical solution to this problem. Firstly, with consideration of stress sensitivity, a transient pressure behavior model of MFW was established. Using perturbation transform, Laplace transform, image theory and superposition principle the mathematical model was solved. Finally, by applying stehfest numerical inversion and perturbation inverse transform, we get the transient pressure for MFW in the time domain.

According to the result of calculation, the flow process of MFW can be identified as six regimes: Ⅰ linear flow, Ⅱ the first radial flow, Ⅲ double radial flow, Ⅳ radial flow in the natural fractures system, Ⅴ cross flow, Ⅵ radial flow in the entire reservoir. Stress-sensibility primarily influences the latter five stages. The well bore dimensionless pressure drop is several times larger comparing with the situation that don't take the stress sensitive into account, and the dimensionless pressure drop derivative curve will tilte up in the later flow process, showing the characteristic of closed boundary. Accordingly, the calculating error will be larger and can mislead the interpretation of well testing.

Keywords: Tight oil reservoir; Stress sensitive; Fractured horizontal well; Source function; Flow regimes

Introduction

Generally, tight oil reservoirs contain a large number of natural fractures. Fractured reservoirs were first described by Barenblatt et al (1960), they consider that there are two systems existing in natural fractured reservoirs: matrix system and fracture system; Matrix system is evenly distributed in fracture system. Matrix system primarily provides the storage space and fracture system primarily provides the flow channel. In 1962, based on the assumption of Barenblatt et al(1960), Warren and Root built well testing model for dual media reservoirs. After that, scholars (Kazemi, 1969; Swaan, 1976) established unsteady crossflow models between matrix system and fracture system. According to these models, researchers(Ozkan,1988; Ozkan,1991; Chen & Raghavan,1996; EL-Banbi, 1998;