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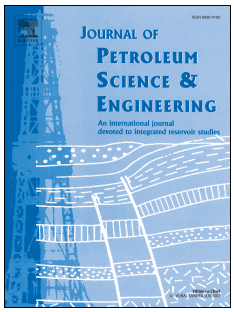

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Development of a transient method on predicting multi-annuli temperature of subsea wells

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Abstract

Thermal expansion induced by the temperature difference between the hot wellbore fluid and the cold fluid in the trapped multi-annuli, severely threatens the casing safety and the well integrity of subsea wells. With the aim to obtain the multi-annuli behavior of the transient temperature increase in subsea wells, mathematic models of heat transfer in the wellbore and multi-annuli are established. The wellbore is divided into different sections vertically from the bottom to the wellhead according to the amount of annuli considering the different processes of heat transfer in various sections. And the finite difference method and the Crank Nicolson scheme are used to solve the partial differential equations. As the traditional semisteady-state method doesn't take into account the transient heat transfer from wellbore fluid to the annuli, we demonstrate that the temperature of the multi-annuli is highly over-estimated at the early stage of production. Compared to the traditional semisteady-state method, our transient method reveals the temperature increase performance of the multi-annuli at the initial stage of production. Given that the production rate is an important factor that affects the temperature of the multi-annuli, we present the relationship between the temperature in the annuli and the production rate. It turns out that the temperature in the annuli rises significantly when improving the production rate. So knowing how the production rate influences the temperature in the annuli is beneficial to making an appropriate production plan and sustaining production.

Keywords: the wellbore heat transfer, the transient method, annular pressure, the Crank Nicolson, the finite difference

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