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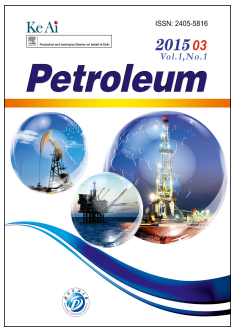

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Cross-Flow Analysis of Injection Wells in a Multilayered Reservoir

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Abstract

During fluid injection into a multilayered reservoir, a different pressure gradient is generated across the face of each permeable layer. This pressure gradient generates driving forces in the wellbore during well shut-in that causes the injected fluid moves from higher pressure layers to lower pressure layers, a phenomenon known as interwell cross-flow. Cross-flow behavior depends on the initial pressure in the permeable layers and may be referred to as natural cross-flow (identical or natural initial pressures) and forced cross-flow (different initial pressures because of exploitation). Cross-flow may induce sand production and liquefaction in the higher pressure layers as well as formation damage, filter cake build-up and permeability reduction in the lower pressure layers. Thus, understanding cross-flow during well shut-in is important from a production and reservoir engineering perspective, particularly in unconsolidated or poorly consolidated sandstone reservoirs.

Natural and forced cross-flow is modeled for some injection wells in an oil reservoir located at North Sea. The solution uses a transient implicit finite difference approach for multiple sand layers with different permeabilities separated by impermeable shale layers. Natural and forced cross-flow rates for each reservoir layer during shut-in are calculated and compared with different production logging tool (PLT) measurements. It appears that forced cross-flow is usually more prolonged and subject to a higher flow rate when compared with natural cross-flow, and is thus worthy of more detailed analysis.

Keywords:

cross-flow, multilayered, sandstone reservoir, sand production, skin factor

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