Simulating Pressure Distribution of a Horizontal Well in an Oil Reservoir Subject to Single Edged and Bottom Constant Pressure

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Abstract

In this study the pressure distribution in an oil reservoir with a horizontal well is investigated. A horizontal well with single-edged and constant bottom pressure is outlined. A reservoir bounded with two constant pressure boundaries, like an edge and bottom water, requires that the production engineer should adhere diligently to a production schedule, developed by a reservoir engineer, for clean oil production to be possible. This means that arbitrary production practices through selection of production rates could lead to production of these external fluids. This can mar the economics of the project. Production schedules or plans show acceptable rates, well design and production time that can guarantee only clean oil production. In this study, pressure behaviour of a horizontal well drilled and completed in a reservoir subject to with simultaneous single-edged and bottom water drives is investigated in detail. All possible flow periods or patterns that can be exhibited by the well are determined. Fluid flow in oil reservoirs in real time is governed by a heterogenous diffusivity equation, which describes reservoir pressure as a function of reservoir, fluid and wellbore properties. To solve this unsteady state problem, Green's functions were deployed to represent the boundaries of the reservoir selected for study. The Green's functions selected are for flow from start of transient to late time, when all the external boundaries are felt. Newman product rule was used to derive a dimensionless pressure expression for the reservoir system oil flow. The source of pressure transient was production throughout. All the resulting integrals were performed numerically. MATLAB programming was used to plot the curves by applying spline functions interpolation. Influence of reservoir, fluid and wellbore properties on reservoir pressure was investigated in real time. To assist interpretation, dimensionless pressure derivatives were also computed. Near wellbore problems, like skin and wellbore storage, which affect well performance only at very early time, were not considered in the study. From the results, PD and $PD\,'$ vary directly with hD and inversely as LD. The $PD\,'$ gradually reduces to zero when PD begins to exhibit a constant trend. $PD\,'$ vary inversely with hD and yeD at all flow times. The number of flow periods varies with reservoir size, well length and production time. The time at which the $PD\,'$ starts to exhibit a downward trend is the external fluid breakthrough time. The breakthrough time is affected by well design. Longer wells exhibit delayed breakthrough time because of lower pressure drawdown associated with increased well length. If production rate is sustained for any particular well design, the well will completely water-out. Finally, infinite conductivity $xD = 0.732$ and uniform flux condition do not really affect PD and $PD\,'$ at early time.