Title of article: A New Theory for Interpreting Rate Decline Trends in Solution-gas Drive Reservoirs

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Abstract

A number of attempts have been made to establish the theories of rate decline in solution-gas drive reservoirs with multiphase flow. However, none of these attempts have established a functional link between the empirical and the theoretical domains of decline curve analysis for such reservoirs. The absence of such a link has inhibited the formulation of simple techniques for reservoir properties estimation. The purpose of this work is therefore to establish the missing link.

In this work, functional relationships between the empirical b_{emp} and the theoretical b_{th} were derived. The derivation was based on a novel definition of a new parameter known as time-weighted average of the theoretical exponent b_{th} .This new parameter was found to be related to the empirical exponent b_{emp}, thus establishing the link. A reservoir simulator was used to generate sets of production data used in verifying the derived relationships. Results presented in this paper show that the relationships derived herein are valid, even for heterogeneous reservoirs. The work also offered theoretical justifications for the various ranges of b_{th} values, and for the first time, four distinct rate decline regimes in solution-gas drive reservoirs were identified. Sensitivity analyses were performed on the results. The effects of non-Darcy flow on decline parameters were also investigated. Lastly, this work provided a mathematical justification for the existence of the hyperbolic family of curves in decline analysis of solution-gas drive reservoirs.