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Current trends and challenges in reservoir simulation

Reservoir simulation is a critical element in the development, planning and production management of oil and gas fields. The ultimate goal of reservoir simulation is to aid the decision making process throughout all stages of field life. The major sources of uncertainties are the linearization of all governing equations – a standard practice in reservoir modeling. It is currently considered that obtaining exact solutions is not achievable due to the lack of non-linear solvers. In literature, it has been shown that this assertion is not justified for most of the realistic range of petroleum parameters, even for single-phase flow. The impact of linearization is even more important for multiphase flow. Recent literature shows that few models include non-Darcy flow under multiphase flow conditions, even fewer use non-Darcy equations for dual-porosity, dual-permeability description, and none uses transition between various flow regimes within porous media and fracture networks. Further, there are a limited number of studies on non-Newtonian nature of petroleum fluids. So, there is an immense need to focus on developing new sets of mathematical models of complex reservoir rock and fluid systems that will lead to the development of more accurate, and state of the art performance prediction tools. However, challenges remain on how to solve these highly non-linear models, and validate the numerical findings through experiments. Experimentally, capturing memory is a real challenge because it cannot be visualized and tracked easily with conventional experimental practices. Numerical solutions of non-linear equations, including considerations of time function both in fluid and rock systems, will produce multiple solutions, forming a cluster of points. Challenge remains how to tag these points with confidence. In parallel, specifically designed experimental trials will be a choice to validate these mathematical models. These models, combined with non-linear solvers that are capable of tracking multiple solutions, will possibly make the most comprehensive reservoir simulator to-date. The resulting simulator can be applied to highly heterogeneous and heavy oil reservoirs.

Figure : Proposed steps for numerical simulation

Biography

M Enamul Hossain has expertise in reservoir engineering and simulation, sustainable drilling engineering, and enhanced oil recovery where he has contributed over 150 articles, 7 books, and 7 patents. Currently, he is holding the Statoil Chair in Reservoir Engineering at Memorial University of Newfoundland, St., John's, Canada. In over 22 years, he has developed new methodologies, techniques, and materials in areas of his expertise. He is the Associate Editor of Journal of Nature Science and Sustainable Technology (JNSST), Journal of Characterization and Development of Novel Materials (JCDNM), Nova Science Publishers, USA and Journal of Sustainable Energy Engineering (JSEE), Scrivener and Wiley publishing, USA. He has been an active member of a number of international societies, including the SPE. He is the Founder and Chairman of Aziza Trust and was one of the Board of Directors of Aziza Group in Bangladesh, Bright Coral in Canada.

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