Fluid flow modelling in oil reservoirs

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Abstract

The modelling of fluids flow in oil reservoirs is a complex problem because of multiple phases interaction, different physical and chemical processes occurs at the same time and is subjected to many input data uncertainties.

Water, oil and gas are almost always present in reservoirs what difficult the characterisation of the fluid as a single component and needs to be treated separately. The interaction between phases is normally presented as diffusion between phases and as resistance to change in inter-facial geometry. Apart of this there are differences in the ruling principles at different scales: while at microscopic scale surface tension controls the fluid configuration, at macro-scale the rock heterogeneity's and fluid mobility rule the flow. The construction of the geological model and the measurement of properties are also sources of errors due to the difficulty of interpretation of studies or disruption of tests.

All these uncertainties have to be accounted by the numerical model in order to get a feasible solution of the flow in porous media. The best approach nowadays is a fully implicit technique based on grid blocks, but can give very large systems and sometimes can be ill-conditioned. To avoid this it is possible to improve the character of the problem by splitting it into a general pressure equation plus one conservation equation per component (solved explicitly). Other possibilities are solving the three-dimension governing system using FDM and FEM, but they are very computational costly and therefore not useful to do several simulations. New numerical methods have been applied to this problem (mixed FEM, multi-block and multi-scale, Stochastic, etc.) but they are not yet enough well developed to be used in reservoir simulation.

The numerical approaches to the fluid flow problem in oil reservoirs and the pros and cons of each one will be widely developed in the final presentation.

References

[1] Margot G. Gerritsen and Louis J. Durlofsky. *Modeling fluid flow in oil reservoirs.* Annual Review of Fluid Mechanics, Vol. 37: 211-238, 2005 .