IMPROVEMENT OF NUMERICAL METHODS IN PETROLEUM ENGINEERING PROBLEMS

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In oil reservoirs, most modern injection processes such as miscible and chemical displacements, tracer flow, hot water or steam injection involve a convective-dispersive transport. Although it is possible to develop one-dimensional analytical solutions to the governing partial differential equations, multidimensional and multiphase form of the equation has to be solved nwnerically. This paper discusses some of the difficulties in solving the convective-dispersive equation numerically and offers solutions using methods that use different degrees of accuracy and robustness. In addition, a review of finite-difference and finite-volume solution techniques applied to the simple convection-dispersion equation has been presented. Any improvement in solving this equation will find a variety of applications in petroleum engineering.

In the case study, the convective-diffusive equation is solved numerically using various numerical schemes. Numerical simulation shows that the accuracy of the DuFort-Frankel scheme is the greatest. However, this scheme is not unconditionally stable as previously perceived in the literature. In addition, the Barakat-Clark scheme was found more accurate than the fully implicit scheme. For all cases, the discretization step in space was found to have little impact on final results.