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Implicit and Explicit Parallel Algorithms for Simulating 3D Oil Recovery problem

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Computer technology and high-performance systems are the fastest-growing industry in the world. Therefore, the new technology give us the opportunity to solve complex problems in engineering research more efficiency. One of major problem in this area is mathematical and computer simulation of oil reservoirs. The hydrodynamic models are developing and the physical and chemical properties of underground fluids are investigating in far more detail every year. Consequently, the urgent tasks of usage of parallel algorithm for solving problems in the oil industry are growing continuously.

In this paper the three-dimensional oil displacement problem is considered, which uses chemical EOR method. The mathematical description of the problem was given by system of equations, which consists of continuity equations of the oil and water phase and the transport equations of polymer, surfactant and heat. We considered two typical schemes explicit and implicit schemes for presented 3D problem. The parallel implementations of these two schemes are realized using MPI and CUDA technologies. The parallel algorithm was tested on GPU Tesla K20 processor and supercomputer TCluster of al-Farabi KazNU.

The results of the numerical investigation on three-dimensional domain are presented and distributions of main parameters are determined. To assess the quality of the parallel algorithm calculated the speedup and efficiency for different number of processes and different mesh sizes on supercomputer.

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