PREDICTION OF CUTTINGS BED HEIGHT WITH COMPUTATIONAL FLUID DYNAMICS IN DRILLING HORIZONTAL AND HIGHLY DEVIATED WELLS

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Abstract

In oil well drilling, the efficient transport of drilled cuttings from the well bottom to the surface is an important process affecting the overall drilling performance. Accumulation of cuttings on the low side of the wellbore annulus causes serious problems such as stuck drill pipe and excessive frictional pressure losses while drilling directional and horizontal oil wells. Prediction of the cuttings bed height in the wellbore annulus as a function of planned operational drilling parameters such as wellbore geometry, pump rate, drilling fluid rheology and density, and maximum drilling rate is very important for optimizing these parameters. In order to predict cuttings bed height in horizontal and highly deviated wellbores during drilling, the cuttings transport process is modeled by using Computational Fluid Dynamics methods. Movement, concentration and accumulation of drilled cuttings in non-Newtonian fluids flowing in concentric/eccentric annular geometry with the inclusion of turbulence modeling are analyzed by time-transient approach in the study. Discrete Phase Model is used to represent solid particles which allow the calculation of particle-fluid interactions. Simulation results are numerically compared to experimental data from various studies. Published data of axial velocity profile measurements of non-Newtonian fluids flowing in turbulent regime, the average velocity of cuttings moving over an already-formed cuttings bed by sliding/rolling action is used for validation of the CFD model. Validation results show that CFD is capable of modeling cuttings transport process with a reasonable accuracy.