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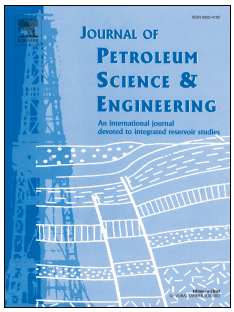

Cutting transport efficiency prediction using probabilistic CFD and DOE techniques

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Cutting transport efficiency prediction using probabilistic CFD and DOE techniques

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Abstract

Efficient cutting transport plays an important role in drilling operation. This process is controlled by many factors such as well geometry, drilling fluid properties, geological features and rate of penetration. In order to minimize the operational cost of inefficient hole cleaning, it is crucial to thoroughly investigate the simultaneous effect of various factors on the process of cutting transport.

In this regard, computational fluid dynamic (CFD) and design of experiment (DOE) techniques were used to predict the cutting transport efficiency (CTE) as a function mud velocity (V_m), drilling rate of penetration (ROP), mud weight (MW), cutting weight (CW), mud viscosity (μ_m), pipe rotational speed (N), and cutting size (CS).

The results of study based on probabilistic CFD calculations using DOE and Monte Carlo simulation (MCS) show that respectively factors of mud velocity, cutting weight, pipe rotational speed, mud weight, cutting diameter, mud viscosity, and drilling rate of penetration have the greatest impact on transportation of drilled cuttings from bottom of the well to the surface. In addition, result of MCS based on analysis of total variance reveals that 86.3% of cutting transport efficiency variation could be controlled by three factors of mud velocity, cutting weight and pipe rotational speed. Therefore, these factors should be carefully characterized during drilling and hole cleaning to maximize the cutting transport efficiency.

Keywords: Cutting transport efficiency, Computational fluid dynamic, Design of experiment, Monte Carlo simulation