Assessment of Critical Conditions Required for Effective Hole Cleaning in Horizontal Wells - Effects of Fluid Rheological Properties and Near Wall Turbulence on the Particle Removal From Bed Deposits

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ABSTRACT

Hole cleaning is a complex process as there are many variables affect cuttings removal (e.g. drilling fluid type, density, flow rate and rheological properties, cuttings size, hole inclination angle, drill pipe rotation speed and eccentricity). Among these variables, the drilling fluid flow rate and rheological properties are the most critical ones as they have strong influence on hole cleaning while at the same time, field control of these variables can be managed conveniently. Understanding the fluid/particle interaction, in particular, how drilling fluid velocity and rheological characteristics affect particle removal from bed deposits is, therefore, key to the design and development of optimum hydraulics program for effective hole cleaning.

Despite significant progress made in drilling fluids, tools, and field practices, along with more than 50 years of university and industry research, field experience indicates that hole cleaning is still a major problem on most highly inclined and horizontal wells.

As part of the systematic efforts to develop a unified theory of hole cleaning, a comprehensive research study has been conducted at the University of Alberta, which has two major components: i-) experimental investigation of the near bed turbulence and how it would relate to particle removal from bed deposits (i.e. fluid velocity effect); ii-) experimental investigation of how the critical conditions (i.e., flow rate, shear stress) for the particle removal from bed deposits changes with fluid shear dependent viscosity and viscoelastic properties (i.e., fluid rheological characteristics effect).

In this talk, I will present some of the results from our experimental investigations of the effects of fluid rheological properties and near wall turbulence on the particle removal from bed deposits in horizontal wells. Within the light of experimental results from the our studies along with the most recent findings in the sediment transport field, I will also discuss the inadequacies and unjustified assumptions currently used for mechanistic and semi-mechanistic (empirical) hole cleaning models and suggest alternative solutions to these shortcomings.