Hydraulics session includes cuttings, pressure loss

CUTTINGS TRANSPORT

UNDERBALANCED AND NEAR balanced drilling techniques offer several significant benefits over conventional drilling including reduction of formation damage, lost circulation and differential sticking, and increased penetration rate. However, cuttings transport in multi-phase flow drilling operations is not fully understood.

The authors will present a study of cuttings transport at intermediate inclinations using aerated fluid (water and air). The experimental program included over 300 tests performed with a large-scale facility (flow loop 100 ft in length with 8-in OD casing and 4 ½-in. OD drillpipe). The angles of test section inclination were 30º, 45º and 60º from vertical. Four pipe rotational speeds (0, 40, 80, and 110 rpm) were used for different liquid and gas flow rate combinations.

The authors will discuss the volumetric requirements for cleaned-hole condition with no pipe rotation at intermediate inclinations. The liquid and gas flow rates required for assuring certain amount of volumetric cuttings concentration are described.

Practical Correlations and Analysis of Cuttings Transport with Aerated Fluids in Deviated Wells (IADC/SPE 87180) **R J Avila**, **PDVSA**; **E Pereira**, **S Miska**, **N Takach**, **University of Tulsa Drilling Research Projects**; **A Saasen**, **Statoil ASA**.

SURGE PRESSURES

Pressure surges have long been known to cause well-control problems. As early as 1934, pressure surges resulting from pipe swabbing were identified as a possible cause of fluid influx, and in extreme cases, blowouts and lost-circulation problems.

In most wells, the magnitude of the pressure surges is not critical because proper casing design and mud programs leave large enough margins between fracture pressures and formation-fluid pressures. A certain fraction of wells, however, cannot be designed with large surge-pressure margins, and some operations are particularly prone to large pressure surges, in particular, the running of low-clearance liners in deep wells.

The author will describe the technical details for calculating dynamic surge pressures with high viscous forces in the low clearance liner annulus. Several sample problems of realistic low clearance liner runs will be used to show the unusual pressure distributions developed by these cases. The potential problems running low clearance liners will be examined and possible solutions presented.

Surge Pressures in Low Clearance Liners (IADC/SPE 87181) **R F Mitchell**, **Landmark Graphics**.

PRESSURE LOSS CALCULATIONS

The prediction of friction pressure losses is very important in many oil?field operations, including drilling, completion, fracturing, acidizing, workover and production. Many theoretical and experimental studies have dealt with the flow of fluids through pipes and annuli for friction pressure loss calculations. Most of these studies have concentrated upon the fluids rheological models, pipe roughness, and geometrical parameters. However, the important effect of tool joint in conjunction with the drillpipe in estimating the friction pressure loss in annuli has yet not been investigated.

Experimental studies have been undertaken at the Well Construction Technology Center of the University of Oklahoma to investigate the effect of tool joints (external upset) on the friction pressure loss of commonly used drilling fluids. As part of the flow loop, 2 7/8 in. drillpipe inside 5 1/2 in. casing have been adopted. The flow loop consists of seven joints of drillpipe (six tool joints) and five joints of casing, providing a total casing and drillpipe lengths of 190 and 211 ft respectively. The pressure drops are measured across 191 ft of drillpipe and 170 ft of annular section. The entrance and exit lengths are 12 and 10 ft respectively. A friction reference module with the same dimensions of drillpipe and casing is also constructed and is 57 ft long and contains no tool joints. The pressure drop is measured across 35 ft. The reference module permits a direct comparison of friction pressures from the two flow loops, one with the tool joints and the other without it.

This paper presents the experimental data of the tests performed with three different fluids and discusses the results in light of the effect of tool joints on the annular friction pressure. It is found that the effect of the presence of tool joints on the annular friction pressure is very significant and the present industry approach to estimate the friction pressures for this case is far from the reality.

Analysis of Tool Joint Effect for Accurate Friction Pressure Loss Calculations (IADC/SPE 87182) **Y Jeong**, **University of Oklahoma**.

TOOL JOINT EFFECT

The prediction of friction pressure losses is very important in many oil field operations, including drilling, completion, fracturing, acidizing, workover and production. Many theoretical and experimental studies have dealt with the flow of fluids through pipes and annuli for friction pressure loss calculations. Most of these studies have concentrated upon the fluid's rheological models, pipe roughness and geometrical parameters. However, the important effect of tool joint in conjunction with the drillpipe in estimating the friction pressure loss in annuli has yet not been investigated.

The tool joint is a necessary part to extend the drillpipe. The space between tool joint and casing is narrower than the space between drillpipe and casing because of the larger diameter of tool joint than that of the drillpipe. Therefore, there will be an additional pressure loss due to fluid flow expansion and contraction.

Experimental studies have been undertaken at the Well Construction Technology Center of the University of Oklahoma to investigate the effect of tool joints (external upset) on the friction pressure loss of commonly used drilling fluids.

The authors will present the experimental data of the tests performed with three different fluids and discusses the results in light of the effect of tool joints on the annular friction pressure. It is found that the effect of the presence of tool joints on the annular friction pressure is very significant and the present industry approach to estimate the friction pressures for this case is far from the reality.

Analysis of Tool Joint Effect for Accurate Friction Pressure Loss Calculation (IADC/SPE 87182) **Y Jeong**, **S N Shah**, **University of Oklahoma**.

HOLE CURVATURE EFFECT

Increased deepwater, ultra-deepwater and extended reach drilling operations have necessitated predicting wellbore pressures within a narrow margin of pore and frac pressures. Field tests have shown that the API pipe flow equations gravely underestimate the drillstring frictional pressure losses and largely overestimate the annular pressure losses for highly deviated, tortuous deep wells.

The author will describe a method to calculate the pressure losses that better represent the actual curved wellbore.

The author will also address the adverse impact of the pressure loss calculations in highly tortuous wells and presents an approach whereby the accuracy of the calculation is enhanced.

A pressure drop magnification factor is defined to account for additional pressure drop due to the curvature. The practical usefulness of the theory, backed by the fundamental and optimal analysis, will be demonstrated with two field examples.

The Effects of Hole Curvature on the Wellbore Pressure Loss Prediction for Highly Tortuous Ultradeep Wells (IADC/SPE 87183) **R Samuel**, **Landmark Graphics**.

CONTROLLING GAS ACCUMULATION

Horizontal wells often include sections with angles greater than 90 degrees due to steering uncertainties or the well path following the reservoir updip. If gas is present inside the wellbore either because of underbalanced drilling or taking a kick, the gas can accumulate in the resultant high spots and complicate effective well control.

Failure to continuously remove gas during underbalanced drilling can result in accumulation that ultimately “spills” into the vertical section of the well. The authors will present a case history showing excessive surface pressures encountered during underbalanced drilling for gas as an example of this effect.

Experimental Assessments of Flid Velocity to Control Gas Accumulation and Removal While Drilling “Horizontal” Wells (IADC/SPE 87185 – Alternate) **F Ustun**, **Schlumberger**; **J R Smith**, **D E Kikitopoulos**, **Louisiana State University**; **Adam T Bourgoyne**, **Jr**, **Bourgoyne Enterprises**. ■