Bit technology improves PDCs, roller-cone seals and hydraulics

IADC/SPE 59108

New PDC Bit Technology and Improved Operational Practices Saves $1 Million in Central North Sea Drilling Program

New processes, technologies and operational practices were incorporated into an HPHT central North Sea (Block 22/30, Shearwater field) drilling program, which resulted in savings in excess of $1 million. The methodology was applied to a second well in the same block and field, which saw similar savings.

Recent research works by several authors have resulted in the identification of 2 failure mechanisms for PDC bits, static and dynamic. Failure in hard Limestone drilling is normally seen on the inner portion of the bit (cone to nose on the profile of the bit), while failure in abrasive Sandstone is traditionally seen on the outer portion (shoulder to gage area) of the bit. The different placements of the normally highly damaged portions of a PDC bit (as has been described) in hard Limestone and abrasive Sandstone drilling made it highly difficult to address the issue of PDC bit durability without sacrificing rate of penetration (ROP) in applications where both lithologies are encountered.

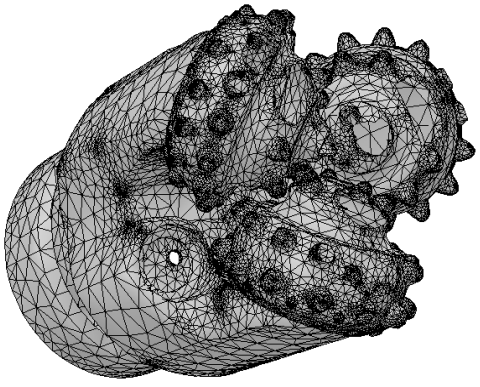
New PDC bits and operational practices were developed for this challenging application which proved a total success. This process was applied to only the 16- and 12 ¼-in. sections, the most challenging sections.

—G Mensa-Wilmot, Smith GeoDiamond
–M Booth, Maresk Contractors
–A J Mottram, Smith International North Sea Ltd

IADC/SPE 59109

Application of Metal-Bearing Seal Roller-Cone Bit Reduces Rig Time/Drilling Costs in Green Canyon, Deepwater Gulf of Mexico

The application of a metal-bearing seal roller-cone bit in Green Canyon, deepwater Gulf of Mexico has had a beneficial impact on drilling costs. Improvements in seal reliability and cutting structure durability have resulted in more time "on bottom" and have given the operator the confidence to apply the roller-cone steel-tooth bits as a viable alternative to PDC bits in demanding directional work. The authors will document that the roller cone bit can consistently turn 1 million revolutions without a bearing or seal failure.



IADC/SPE 59111: 3-d computational fluid dynamics (CFD) models of the entire flow field between rollercone bits and boreholes have been used to identify fluid dynamic parameters that are characteristic of bits that drill well in bit and bottom balling environments. From this, a nozzle system has been developed with characteristics of both bit and bottom balling nozzle systems.

—S McLeod, Chevron Deepwater, *et al*

IADC/SPE 59110

Application of Rotary Steerable System/PDC Bits in Hard Interbedded Formations: A Multidisciplinary Team Approach to Performance Improvement

The SognjefJord reservoir (Jurassic) in Troll Field, Norwegian North Sea, is drilled horizontally using a 9 ½-in. hole between 1,800 m and 3,100 m. The reservoir consists of loose sands, subdivided into clean and micaceous units and local hard calcareous cemented zones. These sections must be drilled in a tight horizontal plane, approximately one meter above the oil-water contact to maximize oil production.

Historicall,y this section has been drilled with steerable motor assemblies and tungsten carbide insert rollercone bits. The use of PDC bits was precluded due to problems associated with toolface control in the loose sands. With the advent of a rotary steerable tool and the prospect of long runs with specialized PDC bits, a joint task force was assembled to improve drilling performance in the reservoir section.

The team concentrated on rock strength analysis, simulator testing of new PDC designs, BHA vibration modelina and analysis of depth based drilling, MWD & vibration data.

—C Rayton, Hughes Christensen
–Z Djerfi, Baker Hughes Inteq

IADC/SPE 59111

Advanced Hydraulic Analysis Optimizes Performance of Roller-Cone Drill Bits

For nearly 30 years after the introduction of jet bits, all rollercone bits had virtually identical nozzle systems. It would be ideal if one nozzle system could be developed that performs well in both bit and bottom balling environments.

3-dimensional Computational Fluid Dynamics (CFD) models of the entire flow field between rollercone bits and boreholes have been used to identify fluid dynamic parameters that are characteristic of bits that drill well in bit and bottom balling environments. From this work, a unique nozzle system has been developed that has characteristics of both bit and bottom balling nozzle systems. The performance of this new nozzle system has been evaluated in a high pressure drilling simulator and in the field. It has proven to yield significantly higher rates of penetration.

The authors will present the results of CFD analysis, simulator tests and field case studies of rollercone bits with several nozzle systems currently available and discuss how to select the appropriate nozzle system for a particular field application.

—LW Ledgerwood, Hughes Christensen Co, *et al*

IADC/SPE 59112(ALTERNATE)

Design Index: A Systematic Method of PDC Drill-Bit Selection

This paper outlines the development of

a systematic method of bit selection, The system is a simple metbodology wbich can be readily adapted by engineers to suit their conditions. A basic geological model was devclopcd for each hole section. Formation strength and drillability arc calculated from porosity, sonic travel time, matrix rock velocity, degree of compaction, abrasiveness and hole cleaning requirements. The geological model can be adapted to any area by specifying the main rock types and their permeabilities in the section to be drilled. If not Imown, typical properties can be obtained from tables included.

—J O'Hare and O Aigbekaen, KCA Drilling Ltd

IADC/SPE 59113 (ALTERNATE)

New Technology in Diamond Drill Bit Improves Performance in Variable Formations

Technological advances in the design and manufacture of drill bits have greatly expanded the applications of both PDC and impregnated diamond bits. However, there are still many intervals of hard rock drilling which have sections that are too hard or abrasive for a conventional PDC bit, but also contain sections that are not sufficiently abrasive to be effectively drilled with a conventional diamond impregnated bit.

IADC/SPE 59113: A new PDC bit was run successfully in the Huamampampa formation in Tarija, Bolivia. In a long, 8 ½-in. hole section with 10%-90% shale, the bit type drilled to TD with a higher overall ROP than any offset.

A very successful run has recently been completed with a new diamond bit in the Huamampampa. formation in Tarija, Bolivia. In a long, 8 ½-in. hole size section, where the shale content ranged from 10 to 90%, this new bit type drilled to TD with a higher overall rate of penetration than any offset. The combination of PDC cutters with hot pressed diamond impregnated inserts in a diamond impregnated matrix has, therefore, proven to be a very versatile cutting structure in variable formations.

—T Beaton, Smith International Inc
–K Johnson, Tesoro Petroleum Corp