Bit Technology results in faster, cleaner wellbores

OPTIMIZING BIT PERFORMANCE

NEAR BIT VIBRATION data has proven to be a valuable tool for assessing bit selections, design features and running parameters. Typically, engineers have only had limited access to this type of data because MWD tools capable of making vibration measurements are generally placed considerably above the bit in the BHA where the dynamics can be significantly different than at the bit. These conventional MWD tools are expensive to operate. The recent development of a low cost memory mode vibration logging tool has made obtaining relevant data much more economically feasible. The tool is very small, allowing it to be placed directly above the bit without disturbing the BHA. Data from this tool has recently been successfully used to optimize drill bit performance in various applications. Specifically, the effects of run parameters, bit design and BHA configuration were analyzed. The author will present data from these field runs.

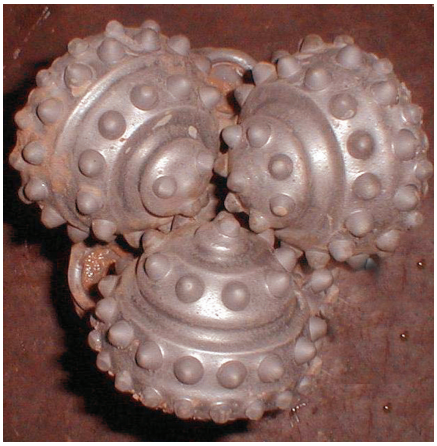
Optimization of Bit Drilling Performance Using a New Small Vibration Logging Tool (SPE/IADC 92336) **A E Schen**, **B H Stanes**, **ReedHycalog**; **A D Snell**, **Schlumberger**.

NEW PDC DESIGN

An advanced series of PDC drill bits incorporating a new, highly abrasion resistant PDC cutter has extended effective PDC bit application to hard rock drilling. In direct offset comparisons, the advanced series of PDC bits fitted with the new cutters delivered significant increases in footage drilled and rate of penetration.

To achieve an optimum drilling efficiency and bit life to lower costs and mitigate risk in hard rock environments, the series is designed using a combination of advanced modeling capabilities and sophisticated analytical tools. These tools allow the designs to be "customized" for specific applications, optimizing cutting efficiency and durability according to specific rock properties and drilling parameters.

A transitional drilling model simulation allows evaluation of how cutting forces are affected during transitional drilling, common in hard rock environments. The bit design is globally balanced to optimize axial, lateral and torsional forces. The design can be modified by adjusting features such as profile shape, cutter rake angles, impact arrestors and cutter type to optimize bit performance when drilling in hard and transitional environments.



Data from a low cost memory mode vibration logging tool has made obtaining relevant bit vibration data much more economically feasible in order to assess bit selection, design features and running parameters. The tool is small enough to be placed directly above the bit without disturbing the BHA. SPE/IADC 92336.

Additionally, recognition of a third dimension of PDC performance, Thermal Mechanical Integrity (TMI), has led to development of a new PDC cutter. This new cutter provides 13.5 times the abrasion resistance of the industry standard, without sacrificing impact resistance.

The author will discuss the science behind this advanced series of bits, including the impact of thermal mechanical integrity (TMI) on cutter performance. New laboratory capabilities and testing results are described, and actual field case histories are presented to demonstrate performance improvements of these PDC bits in hard rock applications.

New Bit Design, Cutter Technology Extends PDC Applications to Hard Rock Drilling (SPE/IADC 91840) **R I Clayton**, **Halliburton**.

HARD, ABRASIVE FORMATIONS

An operator attempted to drill the 16-in. and 8 ⅜-in. sections using TCI and PDC. In the 16-in. section, TCI had low ROP with short life that required multiple runs to reach section TD. In the 8 ⅜-in. section, abrasive wear caused by hard/sharp sandstone limited PDC life. 16-in. PDC delivered acceptable ROP but impact damage resulted in inconsistent run lengths. New PDC bit/cutter technology was needed.

The service company re-engineered the interface between the diamond table/substrate that resulted in a tougher, more abrasion resistant cutter capable of maintaining a sharp edge in hard lime/abrasive sands. Patented depth-of-cut technology provides stability through interbedded formations.

Drilling the 16-in. section in the Hawiyah field (interbedded carbonates, abrasive sandstone, dense dolomite) the new PDC cut average cost per foot from $163 to $94, a reduction of 43% over a five well offset average. It increased average ROP from 14.8 ft/hr to 22.3 ft/hr, an increase of 51% and set a field single run footage record of 4,432 ft. The run saved four trips, saving the operator $1550/hr in rig cost and motor rental. Similar savings were realized in the 8 3/8-in. section.

Expanding Application of PDC into Harder, More Abrasive Formations (SPE/IADC 92435) **Z A Klink**, **D E Scott, Hughes Christensen**.

DRILLING CONCENTRIC HOLES

The industry has a common perception that concentricity can only be delivered through concentric cutting mechanisms. This paper shows otherwise. The performance risks and suitability of an eccentric underreaming device are compared with concentric underreamers. Usage in over 100 well sections is tabulated and reviewed to verify that the device drills concentric hole in differing formations and applications.

Pilot and underreamer cutter characteristics are matched for directional control, durability and hole quality. Specific attention is paid to North Sea and Gulf of Mexico run history covering usage with push and point-the-bit rotary steerables. In exploratory, deepwater or complex well paths, the device is placed above a 3-D rotary steerable full logging suite. Computational fluid dynamics, nozzle and PDC cutter layouts are also discussed with regard to optimizing cuttings evacuation, hole cleaning, BHA stability and ROP. Twenty different well con-