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New Steel Tooth Cutting Structure Breaks Multiple Records in Australasia

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Abstract

Approximately 90% of the large diameter holes in Australasia (Indonesia, Australia, PNG and New Zealand) are drilled with steel tooth roller cone bits. A new steel tooth bit design has proven to significantly improve the drilling economics in these applications. This paper describes the drilling challenges posed by these applications, details the new bit design features, and presents case studies showing the performance improvements these new bits provide when compared with conventional steel tooth bits.

The new design bits feature a novel cutting structure with pyramid-shaped teeth, additional rows of teeth, wide grooves between rows, anti-tracking row(s) with tight pitches, thick hardfacing deposits, and a bar trimmer type gauge design. The result is a steel tooth bit that delivers significantly higher ROP and longer life than current designs, with high reliability, and predictable steering behavior for directional applications. Hole sections can often be completed with fewer bits, which further improves drilling economics. These bits achieve ROPs faster than even that of large diameter PDC bits in the Australasian applications, thus the reason that steel tooth bits are primarily used.

An operator in Balikpapan, Indonesia drilled a long S-shaped hole with a new 17 1/2-in. steel tooth bit at 40% higher ROP than the best of nine direct offsets that were drilled with conventional steel tooth bits. Another operator offshore Western Australia conducted a head-to-head comparison of a new 16-in. steel tooth bit against a conventional steel tooth bit in identical hole sections. The new bit drilled over 70% faster and over 25% farther than the regular bit. A third operator in the Northwest Shelf area off Western Australia employed a new 17 1/2-in. steel tooth bit to complete a section normally drilled with 12 1/4-in. PDC bits. The new steel tooth bit drilled over 25% faster than the fastest PDC offset run. Additional case studies will be presented further documenting these positive field results.

Introduction

While PDC bits continue to replace many traditional tungsten carbide insert (TCI) roller cone bits in medium hard to hard formation drilling applications, steel tooth (ST) bits have maintained a relatively constant share of certain hole sections, such as large diameter (typically 16-in. and larger) surface holes, and intermediate sections with water-based mud (WBM) and sticky shales. This holds true in Australasia, where approximately 90% of large diameter holes are drilled with ST bits. One reason these large ST bits have retained their share of these drilling applications is the continued improvements in bit technology and performance, as described below.

Improved ST bits with a novel single energizer metal seal (SEMS) bearing were introduced to the industry in 1998, and have since migrated to drilling basins around the globe.¹⁻⁷ A step change in bit life and reliability was realized over former elastomer-sealed roller cone bits, with operators routinely achieving runs up to twice as long, particularly at higher RPMs (175 – 275 RPM). The new SEMS bits proved to maintain their typical bit life and reliability at elevated rotary speeds, while elastomer sealed bits tended to experience reduced seal life due to accelerated seal wear rates when rotary speeds exceeded 200 RPM. Another step change improvement in bit life and seal reliability was realized in 2005, when a second-generation single energizer metal seal system (SEMS2) was introduced to the market.^{8,9} This long-life, high-reliability, high RPM-compatible sealed bearing system provides a suitable platform from which to launch improved ST bits for many markets worldwide.