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Field Implementation of Gravel Packing Horizontal Wells Using a Solids-Free Synthetic Fluid With Alpha/Beta Wave Technology

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Abstract

This article details the planning and execution phases of the first open hole gravel pack operation performed whith the alpha beta wave deposition technique using a non aqueous system as a carrier fluid. The operation was performed at Marlim Field, offshore Brazil, and constitutes the first field implementation of a research and engineering effort which started two years ago.

The idea in this first field operation was to avoid many changes in the original well design for the area and to concentrate novel steps in the fluid for gravel packing openhole design, friction loss evaluation, fluid substitution and rheology characterization are some of the new aspects detailed for the fluid design. Based on these results, optimized procedures were proposed for the operation. A broad description of the technical aspects, field pumping profiles and packing quality is also presented.

Introduction

Most of the large production wells in sandstone reservoirs require sand control due to the poorly consolidated formations. Open hole gravel pack (OHGP) is still the most popular solution for sand control in offshore deepwater reservoirs. The petroleum industry has developed a number of fluid systems for a successful OHGP: including a water-based drill-in fluid (DIF) and gravel carrier fluid, (widely applied in Brazil, Marques et al.[1], Farias et al.[2]) or using a synthetic DIF and water based gravel carrier fluid[3].

In spite of the industry's effort to develop high performance water-based fluids[4,5], the use of synthetic fluids guarantees superior wellbore stability, lubricity, inhibition and drilling performance. Substituting synthetic DIF for water-based gravel carrier fluids is a complex operation, due to the potential for fluid interaction, formation damage and problems of offshore logistics. Another challenge is to provide a reliable sand control technique in the horizontal section with operational safety and minimum formation damage.

Parlar et al.[6] presented field implementations of OHGP operations considering high viscosity non-aqueous fluid (NAF) and alternate path concepts.

The field job herein detailed is the first field implementation of a corporate program within Petrobras which focused on developing technology for performing OHGP with NAF systems, considering alpha and beta-wave deposition. This gravel pack placement strategy is considered to be reliable, cost effective and widely validated within PETROBRAS using brines as carrier fluids. The ability to run such operations with NAF systems allows aims the application in different scenarios, such as:

- "Infill drilling" projects, allowing for considering re-entries in existing vertical wells in mature fields. The strategy includes opening a 8 ½" window in the 9 5/8"casing, drilling build-up and reservoir sections in the same phase, enabling the use of conventional screens and sand control equipment.
- Reduction of time and costs in the execution of conventional horizontal wells by drilling build-up and reservoir sections in the same phase and performing OHGP with a compatible carrier fluid.
- Execution of horizontal wells with OHGP in reservoirs sensitive to aqueous fluids.

Well Design

The main objective of the well was to produce oil from the Marlim field's 230 and 250A sands at a 670m water depth.

After launching the 30" torpedo casing, the pilot well was drilled to1, 115m with a 26" rock bit and the 20" casing shoe was set at 1,100m. The BOP stack was run and tested, and the well was drilled to 1,862m. The 13 $^{3}/_{8}$" casing was then run to 1,848m.

The pilot well was then drilled to 2,896m with a 12 $^{1}/_{4}$" PDC bit, using non aqueous DIF from 0 to 53 degrees.