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Sand Control in Long Horizontal Section Wells

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Abstract

Gravel Packing is today the most frequently applied sand control technique for horizontal wells in Campos and Espirito Santo basins, offshore Brazil. Due to the critical conditions, such as the deep and ultra deepwater and low frac gradients, a lot of precision is required to assure open hole gravel packing (OHGP) success. An important scenario for offshore development in Brazil includes heavy oil fields in deepwaters where 2000 m open hole horizontal sections may be required. Sand control options are a major subject and gravel packing is a strong candidate due to the wide experience acquired and the high reliability level in such technique application (if pressure loss issues can be overcome). Among the operational issues related to hydraulics, the following are critical: ECD restrictions, fluid substitution while running the screens and gravel pack placement (if this is the adopted sand control technique).

This paper focuses on the following aspects:

- The Petrobras experience in more than 240 OHGP completions in offshore environments
- Hydraulic limits for alpha/beta wave propagation
- Filtration Control and its impact on beta wave propagation
- Techniques for the extension of hydraulic limits (rat-hole zero, rat-hole bypass, multiple alpha waves, flow divergence tools, light weight proppants, etc.)
- A multidisciplinary approach to face challenging well designs for heavy oil reservoirs, including R&D, tool development and field implementation
- A methodology to evaluate the impact of the sand control technique on the productivity or injectivity indexes.

Introduction

Horizontal wells have been adopted as the major wellbore architecture for offshore development in non consolidated oil reservoirs along the Brazilian coast. Most of them presented horizontal sections between 500 and 700 m. Most drilling challenges, especially concerning wellbore stability and cuttings transport, were overcome with the experience acquired. The major completion issue deals with sand control: Open hole gravel packing techniques have been especially developed for Campos basin applications. Today more than 240 horizontal wells have been successfully gravel packed in Brazilian offshore fields (Marques et al, 2007).

By the end of last century, PETROBRAS started to discover significant amounts of heavy oil in offshore turbidites. Marlim Sul, Roncador, Marlim Leste, Albacora Leste, Jubarte and Oliva fields are good examples of heavy oil accumulations in Campos, Espirito Santo and Santos basins. Figures 1, 2 and 3 highlight the most important heavy oil provinces in the Brazilian coast.

Most of the technologies available for heavy oil field production were developed for Venezuela and Canada scenarios, both in onshore and shallow waters scenarios (Wood 2004). The combined effect of deep waters and heavy oils required new technological development, which motivated PETROBRAS to start an extensive R&D program, with emphasis in well technologies, lift and flow assurance, subsea production installations and production facilities and units (Trindade and Branco 2005).