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Swellable Packer Technology Resolves Water Production Problem — Case History in Campos Basin, Brazil

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Abstract

The Pampo Field is in southern Campos Basin, Rio de Janeiro, Brazil and contains sandstone and shale reservoirs with good quality oil (14 to 32 API). In Dec. 2004, a major operator in the region drilled a horizontal well, which was completed with an openhole gravel pack. During production, water break through was noted from the upper producing part of the reservoir in the horizontal section, and this phenomenon steadily increased. Due to the higher hydrostatic pressure from the water-producing area, oil production from the lower section of the reservoir was inhibited. A work over was performed to isolate the water-producing zone by isolating the interior of the gravel screens.

This paper will discuss a new technology for the Campos Basin area that was capable of resolving the water production problem. A concentric string was developed to run inside the gravel pack screens and included sliding sleeve circulating devices and two swellable packers that were connected at the end of the string and were spaced out to isolate the water producing shale. The objective of this configuration was to decrease flow from the upper producing portion of the sandstone to isolate the water production area and allow higher production from the lower producing portion of the sandstone (3595 to 3935 m).

Swellable packer technology was successful in providing the required results. In this technology, a rubber configuration that expands to create a permanent seal when exposed to liquid hydrocarbons such as crude oil, diesel, oil-based mud, etc. is placed around the packer, and thus, when it expands, it can provide a long-term water shut-off tool. This case history will show that the swellable packers:

- Performed with predicted results from the simulated design
- Helped reduce water production
- Gained operator approval for other operations.

This paper describes the well scenario in which swellable packer technology was used to perform zonal isolation in an offshore horizontal well in Campos Basin, Rio de Janeiro, Brazil to effectively control water influx and manage oil production.

Introduction

The Pampo concession is situated in the southern part of the Campos Basin, approximately 80 km from the Rio de Janeiro state coast. Water depth is approximately 108 m. **Figure 1** is a map of the area and shows the Pampo Field. Several lithologies including carbonates, sandstone and conglomerates prevail in the target formations. The producing formation is from the upper and lower sandstone located above and below the shale section. The oil produced from these formations is of good quality with gravity ranging from 14 to 32 API.

The well was drilled and completed with an openhole gravel pack (OHGP) in late December of 2004. The horizontal section is about 950 m long. The producing formation is in the Enchova Sandstone-20 (upper Sand stone at 3085 to 3565 m; a shale section between 3565 to 3595 m; and the lower sandstone formation located from 3595 to 3935 m). Oil production was as expected initially, but soon, water presence with a steady water increase in the water/oil ratio (WOR), mostly from the upper sand, was observed. After several tests, it was confirmed that water production was coming from the upper sandstone or the initial part of the horizontal section of the well (3085 to 3565 m). Due to the higher hydrostatic pressure that resulted from the high WOR, the production from the lower part of the horizontal section was inhibited to the point that the WOR