SPE 116673

Sand or Mud Removal in Low Bottom Hole Pressure Wellbores Using Jet Pump and Concentric Coiled Tubing Leads to Improved Production

Li, J., A. Crabtree, M. Kutchel, J. Diaz, BJ Services Company, W. Reyes, R. Dugarte, L. Peña, PDVSA

Copyright 2008, Society of Petroleum Engineers

This paper was prepared for presentation at the 2008 SPE Annual Technical Conference and Exhibition held in Denver, Colorado, USA, 21–24 September 2008.

This paper was selected for presentation by an SPE program committee following review of information contained in an abstract submitted by the author(s). Contents of the paper have not been reviewed by the Society of Petroleum Engineers and are subject to correction by the author(s). The material does not necessarily reflect any position of the Society of Petroleum Engineers, its officers, or members. Electronic reproduction, distribution, or storage of any part of this paper without the written consent of the Society of Petroleum Engineers is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of SPE copyright.

Abstract

Horizontal drilling and completion are common practice for accessing conventional and heavy oil reservoirs. During the drilling process, the formation pore pressure is less than the drilling fluid's hydrostatic pressure. This can lead to some fluid loss before a filter cake is formed to prevent further mud losses. For unconsolidated formations, it is prefer to keep the filter cake in the place to maintain the hole's integrity during the well completion period while running the liner. However, the filter cake can be broken down by the sliding and rotating of the bottom hole assembly. These breakdowns can lead to high completion fluid losses to the formation. Sand production is also a common problem associated with unconsolidated formations. These drilling & completion practices, sand production, have resulted in a demand for well intervention that can economically remove mud damage and produced fill throughout the whole length of horizontal wells.

Since 1995, a technology combining concentric coiled tubing (CCT) with a jet pump has been developed and used to remove both the drilling fluids, filter cake and solids. Initially it was developed for horizontal heavy oil reservoirs where pressures are low and oil viscosity is high, without placing hydrostatic loads on the reservoir. The job data from more than 600 sand/well vacuuming operations worldwide has been compiled into a database.

This paper reviews the well information and the key operating parameters: maximum depth, bottom hole pressure gradient and pump rate. The engineering challenges, best practices and lessons learned from the sand/well vacuuming process are also summarized. Analysis of this data yields a better understanding about the vacuuming technology and provides good guideline for future operations.

Case histories are provided demonstrating how to deploy the different sand/well vacuuming bottom hole assemblies (BHA) for different applications. Post job analysis indicates CCT vacuuming technology reduces the skin damage and increases the production compared to non-vacuumed wells. Moreover, the details estimated from sand and other fluid influx profiles along the wellbore during the vacuuming process, are used to evaluate well production and develop a management strategy.

Introduction

During the drilling operation of most horizontal heavy oil wells, the drilling fluid hydrostatic column causes fluid loss to the formation due to the low bottom hole pressure (BHP). Otherwise, the presence of the filter cake adhered to the formation face creates an artificial layer between the formation face and the slotted liner, affecting the production from the reservoir, in other words, creating an additional pressure drop from the formation to the wellbore. After the drilling operation is completed, the production pump is run in hole and used to retrieve drilling fluids and the filter cake. The problem with this method is that the suction produced by the production pump is mainly a localised pressure drop in the zones nearest to the pump, without creating significant suction at the toe of the well. Therefore, the well will produce mainly from the heel and will have a lower production contribution from the toe.

Sand production is also a common problem faced by many of heavy oil producers worldwide. The slotted liner acts as a partial barrier, grading effects at the slots often still result in sand migration into the wellbore and a low production rate. The low production flow rates contribute to increased deposition of the sand within the highly deviated wellbore.

Several cleanout options have been developed over the decades employing a number of different techniques approaches[1]. However, coiled tubing (CT) or conventional jointed pipe often require the use of high circulation rates, special fluids or reverse circulation techniques to remove the solids. With the use of high rates and high specific gravity water based fluids, conventional sand cleanout methods apply excessive down hole pressure on the formation and result in lost circulation returns in the low formation pressure reservoirs, typically of 0.04 psi/ft. This makes sand removal virtually impossible and