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Evaluation of Rotary Jetting Tool Application for Matrix Acid Stimulation of Carbonate Reservoir in Southern Area Field of Saudi Arabia

Surajit Haldar, SPE, Ahmed A. Al-Jandal, SPE, Saad M. Al-Driweesh, SPE, Saudi Aramco;
Samer AlSarakbi, SPE, Mauricio Armando Espinosa, SPE, Schlumberger

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Abstract

Stimulation of oil wells is becoming more and more challenging every year. Wells easy to select are fast diminishing. Today's candidate for matrix acid stimulation have high water cut, close oil-water contact, marginal pay zone to stimulate and complex completion, raising more challenges. Combining coiled tubing pinpoint treatment placement with diversion method is crucial for such wells. Traditional chemical diverters like gel plug, VES, foam or nitrogen diverts treatment fluid in the zone of broad permeability contrast.

Interestingly, encouraging results were experienced when coiled tubing coupled with downhole rotary jetting tools were used to augment chemical diversion. For the first time these tools have been used to facilitate stimulation of openhole completed wells in carbonate reservoir of Ghawar field with outstanding result.

Rotary jetting tool is useful mechanical mean to supplement coiled tubing pinpoint placement of stimulation fluids due to high power jetting and 360 degree rotation of the jetting tool. The high pressure drop across the nozzles is converted to high velocity flow which penetrates deeply and thoroughly inside the critical matrix and improves the quality of the treatment placement. Based on well conditions, proper nozzle size with optimized jetting power by speed-controlled rotating nozzle head is the key in this process.

Significance of this system is to eliminate the domination of the high permeable zone on the treatment distribution by improved pinpoint jetting efficiency with proven results. It reduces the treatment fluid volume per foot of formation. Sustained gain is achieved as the treatment is more than acid wash. The system also replaces traditional jetting and wash-tools that are without rotating capacity.

This paper evaluates the added value of high velocity downhole rotary jetting tools in pinpoint acid stimulation operations with all pros and cons. Case studies for both oil producers and water injectors will be discussed.

Introduction

Currently oil and gas exploitation strategy has shifted drastically from drilling vertical wells to drilling maximum reservoir contact (MRC) wells, primarily because of the enhanced productivity they provide from the reservoir. MRC wells have proved their success and economical option for field development in oil and gas fields. Although, with the improved mud chemistry, water-based fluids are used in oil and gas fields during drilling, they still create mud cake which sometimes causes formation damage. The filter cake comprises solids, such as calcium carbonate particles, formation fines, and polymers such as xanthan and starch. Proper removal of filter cake is required to ensure good well performance. Fluid invasion by polymer based drilling fluids can also cause operational problem and reduce wellbore stability. A high fluid loss results in a thicker filter cake. In many of the drilling fluid formulations, the weight ratio of starch to XC-polymer is greater than unity, and thus removal of starch alone from the filter cake can significantly reduce the flow initiation pressure and permeability impairment[1]. Typical cleanup solutions for filter cake that formed by water based mud include: acids, oxidizers, enzyme treatment, or a combination of these materials. These are all chemical solutions. However, mechanical means like water jetting have also been used to remove the filter cake.