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Non-acid Solution for Mineral Scale Removal in Downhole Conditions

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Abstract

Mineral scales, in particular calcite (CaCO_3) and siderite (FeCO_3) have been associated with formation damage in oil fields in Colombia. Scale deposition has been observed within the production flowline as well as in the formation.

For many years, this scale problem has been addressed through the use of traditional acid treatments. However, this approach caused additional problems such as re-precipitation due to spent acid, clay swelling, and corrosion, giving rise to rapid losses in production, fine migration, and asset integrity concerns.

With this in mind, a process to identify the Best in Class non-acid scale dissolver was developed. Through this process, the service company developed a new alternative based on a material with neutral pH, high dissolution capacity, and no re-precipitation. After thorough laboratory evaluation and testing, the product was successfully applied in the field. The first six applications allowed an increase in crude production of approximately 300,000 bbl.

This paper details the methodology developed for evaluation and selection of the Best in Class scale dissolver used in this application, as well as the development and implementation of the strategy that allowed the successful field application of the selected material. The practical improvements achieved through this approach and how the approach can be used to develop effective troubleshooting and improvement processes will be discussed.

Introduction

The formation of mineral scale within the near wellbore area, production tubing, and topside process equipment presents a challenge to the oil and gas industry. The precipitation of mineral scale is a common cause of formation damage during the production of hydrocarbons and can cause significant production decline (Cowan et al., 1976). Carbonate scales (calcite, CaCO_3 , and siderite, FeCO_3) can be formed due to pressure or temperature changes. Sulfate scales, on the other hand, are typically formed due to the mixing of incompatible waters. Scale problems are normally managed by the application of scale inhibitors. There are, however, some instances where scale inhibition alone is not sufficient to prevent production decline due to scale deposition. In these cases, scale removal using scale dissolvers may be required (Clemmit et al., 1985).

Scale dissolvers are typically aqueous solutions of either acids/chelants for carbonate scale or alkaline chelating agents for sulfate scales (Fredd et al., 1998; Frenier, 2001; Benson et al., 1997; Weintritt et al., 1967; Schutte, 1987; Clemmit et al., 1985; Jordan et al., 2006) also, carbonate scale can be removed by using corrosion-inhibited hydrochloric acid (Bakken et al., 1996; Ramstad, 1997; Benson et al., 1997; Rhudy, 1993).

This paper will focus on the chemical removal of calcite and siderite scale associated with formation damage in oil fields in Colombia and the process used to develop a scale control strategy that includes the use of a material with neutral pH, high dissolution capacity, and no re-precipitation issues.