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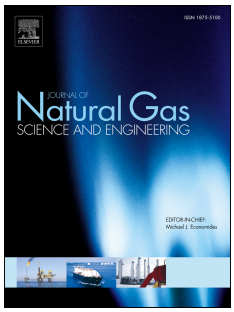

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Effect of Casing Rotation on Displacement Efficiency of Cement Slurry in Highly Deviated Wells

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Abstract

Rotating casing is helpful to improve cementing quality. In the case of casing rotation and non-rotation, the influence of density difference and casing eccentricity on displacement efficiency and displacing interface in highly deviated wells have been numerically simulated based on Herschel-Bulkley model. The simulation results indicate that the displacement efficiency increases first and then decreases as the density difference or casing eccentricity increases. Under the same displacement conditions, rotating casing can improve displacement efficiency. In order to visually observe the casing rotation change the fluid flow state, the displacement process and displacing interface are experimentally simulated by using substitute drilling fluid and cement slurry. To select reasonable casing rotation speed while cementing, the impact of casing rotation speed on displacement efficiency is analyzed by combining experiments and simulations. Considering cementing requirements and operating risks, the casing rotary speed is recommended at 20 - 30 r/min in highly deviated wells.

Keywords: Casing rotation, Highly deviated well, Eccentric annulus, Casing rotation speed, Displacement efficiency

1. Introduction

Highly deviated and horizontal wells are becoming more and more important in oil and gas development process (Kruger et al. (2007); Inglis (1987)). In the case of offshore oil fields, highly deviated wells are of great significant compared with conventional vertical wells, which is not always feasible to reach the reservoirs. In addition, high deviated wells can save investment by reducing the number of wells, and increase productivity by improving the contact area between the wellbore and the reservoir (Fayers et al. (1995)).

Good cementing is beneficial to wellbore integrity. However, high deviated wells bring challenges to cementing quality, which is greatly influenced by the displacement efficiency of cement slurry (Sabins et al. (1990); Keller et al. (1987)). The eccentric casing (Yonggang (1995); Yonghai et al. (2005); Tardy and Bittleston (2015)) is a key factor affecting the displacing efficiency as drilling fluid cant be easily removed by cement slurry at a narrow gap. The solid deposition of the drilling fluid on the low side of the wellbore is easy to form retention layer of drilling fluid. The density difference (Burdylo and Birch (1990); Nguyen et al. (1992)) between drilling fluid and cement slurry also affects the displacement efficiency. It is easy to form fluid channeling after cementing as part of the annulus can not be cemented. Thus, increasing the displacement efficiency of cement slurry is essential to guarantee the cementing quality in the oil and gas well cementing construction.

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