

## **Research and Application of Plugging Drilling Fluid with Low-Activity and High Inhibition Properties**

**Lei Yu<sup>1</sup>, Jinghui Zhang<sup>1</sup>, Gongrang Li<sup>1</sup>, Huaizhen Zhao<sup>1</sup>, and Tianke Liu<sup>2</sup>**

<sup>1</sup>Drilling Technology Research Institute, Sinopec Shengli Oilfield Service Corporation, Dongying, Shandong, 257000, China;

<sup>2</sup>Huanghe Drilling Corporation, Sinopec Shengli Oilfield Service Corporation, Dongying, Shandong, 257064, China

### **ABSTRACT**

With their high clay mineral content, oil-bearing mudstone in Shahejie Formation are dominated by illite/smectite formation and illite. Due to development of micro-fractures, drilling operations in these formations are perplexed by collapsing, chipping and other problems related to instability of sidewalls. To eliminate these problems, low-activity plugging drilling fluids with high inhibition performances were developed. In accordance with the theory of activity equilibrium and by using the semi-permeable membrane properties of oil-bearing mudstone, the activity of drilling fluids was reduced by adjusting volume of activity regulators. At the same time, optimal inhibitors were deployed to enhance inhibition performances of the drilling fluids. In addition, plugging performances of the drilling fluids were enhanced through optimization of solid granularity and collaborative performances of multiple plugging agents to generate plugging drilling fluids with low activity and high inhibition properties. Lab tests showed the innovative plugging drilling fluids with low activity and high inhibition properties had activities lower than those of oil-bearing mudstone, whereas inhibition performances of the drilling fluids were similar with those of oil-based drilling fluids. In addition, the newly-developed drilling fluids had outstanding plugging performances with dynamic filtration losses reduced significantly at 10 min and gradually leveled off after 60 minutes. Generally speaking, the performances of the plugging drilling fluids with low activity and high inhibition properties were sufficient to satisfy demands of drilling operations with no collapsing, chipping or other sidewall instability incidents observed in oil-bearing mudstone and shale mudstone intervals. Research results showed that plugging drilling fluid with low-activity and high inhibition properties could effectively alleviate water absorption expansion and hydration dispersion of oil-bearing mudstone and shale to plug micro-fractures effectively. In this way, collapsing, chipping and other problems related to instability of sidewalls during drilling of horizontal intervals in mudstone and shale formations could be eliminated effectively.