Can Nanoparticles Improve the Characteristics of Drilling Fluids?

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Abstract

The present work discusses the latest applications of nanoparticles (NPs) in the oil and gas industry, especially their implementations to improve the properties of drilling fluids. Successful drilling operations depend strongly on the effectiveness of the drilling fluids. Over the last few years, several researchers have examined the use of various types of NPs as additives with the drilling fluids. NPs can be defined as the simplest structure with a size in the range of nm. Physically, any collection of atoms bounded together as structure with any dimension in the range of less than 100 nm is considered as NPs. The effectiveness of NPs can be accredited to their small sizes and thus, high surface-area-to-volume ratio. Different types of NPs have been investigated to enhance the performance of the drilling fluid to mitigate the drilling problems, particularly at high pressure and high temperature (HP/HT). A thin filter cake and less filtrate invasion can be produced at these conditions when using NPs, which might help in reducing the differential pipe sticking and formation damage problems. In different investigations, NPs were also showed promising enhancements on the rheological characteristics of the drilling fluids. Another application when drilling shale formations using water-based drilling fluids. Swelling and collapse of shale is expected at these conditions, which might result in complicating the drilling operation. Adding NPs to the drilling fluid was found to minimize the shale permeability by physically plugging the nano-size pores. This can provide a potential solution for environmentally-sensitive areas where the oil-based mud is commonly used. This research paper presents a brief review of the most valuable findings in the literature regarding the efficient use of NPs in the field of drilling fluid. Additionally, different recommendations are stated, which might help researchers to better understand NPs' functionality and dynamics in this area of application.

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