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Inhibitive properties comparison of different polyetheramines in water-based drilling fluid

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Wellbore instability due to reactive shale hydration and swelling is always a challenge in the oil and gas industry. Many approaches have been proposed to alleviate or resolve the problem. Among these methods, polyetheramines are believed to be the best available technology for shale inhibition currently. Based on these amine compounds, high performance water-based drilling fluids were established and widely used around the world with great success.

However, the relationship between the polyetheramine structures and modes of interaction and performance mechanism has been little emphasized. In this paper, several inhibitive evaluation methods including bentonite inhibition test, shale cuttings hot-rolling dispersion test, sedimentation volume test, and filtration test were carried out to compare the inhibitive properties of several candidate polyetheramines with different molecular weights and structures. Meanwhile, in order to identify the relationship between the inhibitive performance and molecular structure, a series of analytical methods including surface tension determination, zeta potential measurement, XRD, contact angle measurement, water adsorption test were conducted.

The results indicated that the lower the molecular weight was, the better the inhibition was. The increase of amine group number enhanced the inhibition. Meanwhile, the hydrophobic backbone was favorable to inhibition with certain degree. Among the polyetheramines, polyether diamine with molecular weight of 230 and oxypropylene segment showed the best inhibitive performance in comparison with others. The coordination of electric static interaction, hydrogen bonding and hydrophobic shielding effect contributed to the top inhibition level.

The results allow a better understanding of the interaction between inhibitors and clay, which are favorable for novel shale inhibitors design to narrow the performance gap between water-based drilling fluids and oil-based drilling fluids in the future.

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