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Preparation and performance evaluation of novel polymeric sand inhibiting and water control agents

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Annotation: Sand production and high water cut can significantly disrupt the normal operation of oil and gas wells, making the development of effective sand inhibitors and water control agents imperative. Cationic monomers enable polymer molecules to adsorb onto the surface of sand grains, while hydrophobic monomers facilitate the formation of a dense three-dimensional network structure on the surface of sand particles. By incorporating both monomers into the polymer backbone, a novel sand inhibiting and water control agent is synthesized, resulting in enhanced sand inhibition and water control effects through their synergistic interaction.

Keywords: preparation; sand inhibiting; water control; synergistic effect

To address the issues of sand production and high water cut in the development of loose sandstone reservoirs (where sand production leads to high water cut and high water cut exacerbates sand production, with both factors influencing each other and requiring simultaneous treatment), and to achieve water control and oil stabilization in oil and gas wells, polymeric sand-inhibiting and water-control agents have gained significant attention from researchers [1-2]. On one hand, these agents can adsorb onto the surface of sand grains via electrostatic interactions, forming an intermolecular network structure that bridges or binds the sand grains, transforming individual free grains into sand grain aggregates, thereby enhancing their stability. On the other hand, their molecular chains contract in the presence of oil and expand in the presence of water, obstructing the water flow channels without affecting the oil flow, thus significantly reducing the permeability of the water layer and demonstrating effective water control [2-3]. Based on these properties, this study screened three cationic monomers (methacryloxyethyltrimethylammonium chloride, dimethyldiallylammonium chloride, dimethylamino and three hydrophobic monomers (styrene, stearylmethylacrylate, propylene tetramer), and prepared a polymeric sand-inhibiting and water-control agent using acrylamide, methacryloxyethyltri chloride, and styrene as raw materials. The results showed that, at a concentration of 5000 mg/L, the sand-leakage time of the agent was 553 s, the sand production rate was 0.026 g/L, and the established standard water-oil resistance ratio was 5.41. This agent significantly reduced the water cut of the production fluid by 18.6%, demonstrating superior sand-inhibition and water-control effects. This polymeric sand-inhibiting and water-control agent provides a theoretical basis and technical means for the efficient development of loose sandstone reservoirs.

References

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