

PROCEEDINGS

Inorganic Hybrid Gel Fracturing Fluid: A Strategy for Enhancing Temperature and Shear Resistance Ability

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ABSTRACT

Polyhedral oligomeric silsesquioxane (POSS), an inorganic cage-like functional moiety, can be incorporated into polymer systems through physical blending or chemical copolymerization, thereby significantly enhancing the performance of polymeric materials. However, its application in fracturing fluids for deep and ultra-deep oil and gas reservoirs has rarely been reported. In this work, a POSS-containing inorganic hybrid polymer (AAADP) and a conventional polymer (AAAD) were synthesized and structurally characterized, and their thickening capacities were comparatively evaluated. Subsequently, an inorganic hybrid gel fracturing fluid was prepared by crosslinking AAADP with an organic zirconium crosslinking agent, and its rheological properties, temperature and shear resistance, shear recovery behavior, gel-breaking performance, and core damage characteristics were systematically investigated. The results demonstrated that both AAADP and AAAD were successfully synthesized, while AAADP exhibited superior thickening capability, thermal stability, and shear resistance compared with AAAD. Moreover, at the same polymer concentration, the AAADP solution formed a more compact and robust network structure. The prepared inorganic hybrid gel fracturing fluid maintained a retained viscosity of 674 mPa·s after shearing at 200 °C, indicating excellent temperature and shear resistance, while also exhibiting a certain degree of shear recovery capability. In addition, the viscosity of the gel breaking liquid was lower than 10 mPa·s, and the core damage rate was only 18.62%, demonstrating promising application potential. This study is expected to contribute to the efficient development of deep and ultra-deep reservoirs and provide theoretical guidance for practical field applications.

KEYWORDS

Deep and ultra-deep reservoirs; POSS; gel fracturing fluid; temperature and shear resistance

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