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Pore Scale Study on Transport Plugging and Displacement Performance Evaluation of a Novel Microencapsulated Polymer Delivery System

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The key challenge in polymer flooding for reservoir depth profile control is finding a solution to the contradictory relationship between injectivity and effective displacement. One promising approach is the synthesis of microencapsulated polymers with delayed release characteristics, achieved by encapsulating the polymer within microcapsules. However, the accurate assessment of their targeted viscosity enhancement relies on a thorough understanding of the transport plugging and displacement performance of the microencapsulated polymer within porous media.

We evaluated the underlying properties of the microencapsulated polymer. Based on this, microfluidic technology was used to study the flow behavior of the microencapsulated polymer at the pore scale. We utilized a high-speed camera and two high-precision pressure sensors to capture real-time flow images and pressure variations of microencapsulated polymer in a single-contracted PDMS microchannel. Subsequently, we studied the migration characteristics of microencapsulated polymers through parallel microchannels with multiple-width ratios. Finally, we evaluated the oil displacement performance of microencapsulated polymer under different trigger stages using a complex network glass etching model.

The micro-resistance factor was defined as the ratio of the pressure difference between the microencapsulated polymer inside the microchannel and the pressure difference during water injection only. The experimental results demonstrate that the particle size of the microencapsulated polymer can expand up to 3-5 times, while the solution viscosity can increase by more than 25 times. The microencapsulated polymer particles exhibit particle adsorption, blockage, and free passage within the microchannel. The severity of microchannel damage is more pronounced at lower injection flow rates, and the micro-resistance factor of the microcapsules increases with higher concentration. For particle sizes/throats less than 1, the micro-resistance factor is approximately 1. Blockage and adsorption behaviors of capsule particles gradually increase flow resistance, but blockage has a more drastic impact. The microencapsulated polymer tends to enter wider throats in parallel microchannels, but long-term injection causes more severe damage to smaller throats. In terms of micro-flooding experiments, the flooding effect of un-triggered microencapsulated polymer is similar to that of water flooding. As the triggering degree of the microencapsulated polymer increases, the occurrence of the viscous finger-pointing phenomenon significantly weakens, effectively displacing the remaining oil at the edge of the pore model, and enhancing the oil recovery rate by 22.8%.

This study investigated the flow characteristics and oil displacement performance of microencapsulated polymers at the pore-throat scale. This microscopic analysis provides valuable insights into understanding their deep migration and targeted viscosity enhancement. These findings hold great significance for the advancement and practical application of novel oil displacement agents.

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References

Zeinijahromi A, Lemon P, Bedrikovetsky P. Effects of induced fines migration on water cut during water flooding[J]. Journal of Petroleum Science and Engineering, 2011, 78(3-4): 609-617. Civan F. Modified formulations of particle deposition and removal kinetics in saturated porous media[J]. Transport in porous media, 2016, 111: 381-410. Cao, Dongqing, et al. Polymeric microsphere injection in large pore-size porous media. Petroleum, 2020, 6.3: 264-270. Yao C, Liu B, Li L, et al. Transport and retention behaviors of deformable polyacrylamide microspheres in convergent–divergent microchannels[J]. Environmental Science & Technology, 2020, 54.17: 10876-10884.

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