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Study on Flow Mechanism and oil Displacement Mechanism of Microcapsule Polymer in Porous Media

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Polymer microcapsules refer to microsphere particles with a core-shell structure using polymer as the core. Microcapsule Polymer is a new type of oil-displacing reagent that is suitable for deep profile control which has broad application prospects in enhancing oil recovery. However, microcapsule polymer has obvious time-varying characteristics and its flow mechanism and oil displacement mechanism also need to be further clarified. Therefore, we use microfluidic technology to study its flow mechanism and oil displacement mechanism.

We built a microfluidic experiment platform, which is composed of syringe pumps, micro-injectors, high-speed cameras, microscopes, pressure sensors, Polydimethylsiloxane (PDMS) chips and micro-etched glass chips. We firstly use a syringe pump to inject the aged microcapsule polymer into a single constricted channel PDMS chip. Then, we use a microscope and a high-speed camera to observe and collect images of the microcapsules flowing and use a sophisticated pressure sensor to record pressure data. Subsequently, we choose a complex network of micro-etched glass chips for oil-displacement experiments.

In this study, the micro-resistance factor is defined as the ratio of the inlet pressure for flow of microcapsules to that of only water. The experimental results show that with the increase of aging time, the microcapsules gradually become larger which can expand up to 20 times and the viscosity of the reagent will gradually increase to 20mPa·s. Microcapsules can undergo surface adhesion, throat blockage and elastic deformation inside the single-channel chip. The resistance factor remains around 1 when microcapsules flowing in the channel. While if the throat is blocked, the resistance factor will rise to a larger value. There are two patterns of blockage, single microcapsule blockage and multiple microcapsules blockage. The former pattern causes the resistance factor to rise sharply, while the latter blockage pattern makes the resistance factor rise slowly. But the blockage pattern of multiple microcapsules tends to produce a higher resistance factor. In the observed image, the microcapsules passing through the throat are all elastically deformed. The results of micro-etched glass experiments show that the microcapsules converge into clusters in the pores, which will preferentially block large channels, change the direction of fluid flow, and further displace oil that is not affected during water flooding.

This study firstly explains the relationship between the size of the microcapsules and the aging time and the flow mechanism of the microcapsules in porous media, then gives a further detailed description of the process of how to drive oil. This study provides important value for the promotion and application of new microcapsule polymer.

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References

Time Block Preference

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