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The impact of extensional viscosity on oil displacement efficiency in polymer flooding

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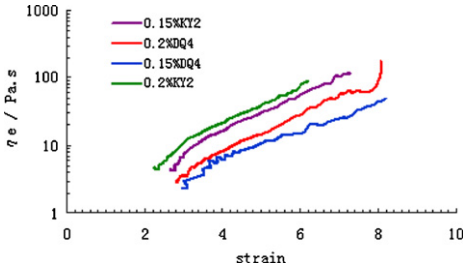
HIGHLIGHTS

- Effect of extensional viscosity of polymer solution on the oil flooding is studied.
- The value of extensional viscosity is much higher than that of shear viscosity.
- Extensional viscosity and stiffen of polymer increase oil displacement efficiency.

GRAPHICAL ABSTRACT

The mechanism of polymer boosting microscopic oil displacement efficiency could be explained with the extremely high extensional viscosity and extension stiffen characteristic in extension process of polymer solutions in porous medium.



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ABSTRACT

The flow behavior of polymer flooding solution can not only be described simply with shear flow field, but also with convergent and extensional flow field. The extensional viscosity of polymer solutions used in polymer flooding in Daqing Oilfield was investigated with CaBER1 extensional rheometer, and the results showed that the extensional viscosity of which is much higher than shear viscosity with three orders of magnitude. The extensional viscosity of the polymer solutions sharply increased when polymer molecules were stretched to the limit, which means that an extension stiffen phenomenon occurred. The extremely high extensional viscosity and an extension stiffen characteristic in stretching process of polymer solutions could increase capillary number substantially to raise microscopic oil displacement efficiency.

1. Introduction

It was difficult to understand the extensional flow behavior of non-Newtonian fluids because it had ever been only obtained with the inferential method and could not be easily predicted from shear characterization alone in the past. Such fluids included polymer solutions, surfactants and polymer melts and the extensional flow behavior of which need to be investigated.

In the 1990s, Bazilevskii et al. [1] introduced the concept of capillary breakup rheometer to extract the extensional rheological information from the breakup kinetics of stretched fluid filaments. In the past decade, a certain progresses have been made in the instrument development and the result analysis methods used in the research of extensional rheological properties of polymer

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