論文 / 著書情報
Article / Book Information

題目(和文)	X線マイクロトモグラフィーを用いた三次元多孔質の空隙スケールにおける化学的原油増進回収に関する研究
Title(English)	Pore-scale Study on Chemical Enhanced Oil Recovery in Three-dimensional Porous Media using X-ray Microtomography
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種別(和文)	論文要旨
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	機械 系 機械 コース	申請学位（専攻分野）： Academic Degree Requested	博士 （ 工学 ） Doctor of
学生氏名： Student's Name	SHE Yun	指導教員（主）： Academic Supervisor(main)	末包哲也
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In Chapter 1, the research background and objective were described. The crude oil is one of the most important world energy supplies. However, the oil production from oil reservoirs is low and over 50% crude oils cannot be produced after primary and secondary recovery stages because of viscous fingering and capillary forces. The chemical enhanced oil recovery (CEOR) methods have been extensively reported to optimize these two factors from a macroscale. Unfortunately, the pore-scale oil displacement mechanisms cannot be well understood since the oil reservoirs are opaque. In addition, the effect of acid compositions in crude oils was not systematically considered. Thanks to the advanced X-ray microtomography, we could have a deep insight into these micro-pore spaces from a three-dimensional (3D) visualization. Based on this imaging technique, this thesis aims to optimize various CEOR methods considering the effect of acid compositions from a 3D pore-scale visualization.

In Chapter 2, the performances and mechanisms of traditional surfactant and alkaline flooding were compared for acid-existing oil recovery. We found that the emulsification ability in alkaline flooding is much stronger than that in surfactant flooding, leading to a significant improvement of oil recovery. This is because chemically produced surfactants are more effective than that of convective transport of surfactants. Therefore, the alkaline flooding is recommended to applied for oil recovery with acid compositions. To optimize the surfactant flooding, a novel cationic surfactant was introduced to improve the convective transport by a fast accumulation of surfactant aggregates.

In Chapter 3, the effect of different acid concentrations on the performance of alkaline flooding was investigated. The oil recovery efficiency increases with increasing acid concentrations because of stronger emulsification ability and viscous fingering suppression (stable displacement control). The complete emulsification occurs in high-acid concentration at which the large oil clusters are completely emulsified into tiny-size oil droplets and could readily pass through the pore spaces, leading to an entrained flow. Therefore, the alkaline flooding is suggested to be applied for the high-acid oil reservoirs. However, it is not effective for non-acid or low-acid oil recovery because the capillary forces still dominate.

In Chapter 4, we created a novel solvent-based microemulsion flooding to improve the oil recovery regardless of the acid concentrations. The emulsion flooding was selected because of its good control for stable displacement. The solvent agent was used to prepare the emulsions due to its role of miscible behavior, which has an ability to eliminate the capillary forces. In addition, the solvent-based emulsion could reduce half percentage of solvent usage, thereby significantly decreasing the cost. The pore-scale detection proved that this new agent has a good control for stable displacement and can eliminate the capillary forces due to the quasi-miscible behavior, which could produce the oil recovery efficiency approaching 100%. Therefore, we conclude that the solvent-based microemulsion flooding can be applied for any type of reservoirs regardless of oil acids and wettability (negative or positive capillary forces).

In Chapter 5, the key conclusions of each chapter were summarized and some important proposals for industrial oil recovery application were provided. The optimal CEOR methods should consider the acid concentrations and cost in an actual oil recovery application. The alkaline flooding is suggested to apply for a high-acid oil reservoir. For a low-acid oil reservoir, the novel cationic surfactant is recommended since it could adsorb the acid components to formulate a dual-surfactant system and work more effectively than an individual surfactant alone. For a non-acid oil reservoir, the solvent-based microemulsion flooding shows the best performance because of the capillary forces elimination. In an energy crisis, the oil production is a main concern instead of cost; the solvent-based microemulsion is highly recommended because it is independent on acid or wettability conditions.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
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