

論文 / 著書情報  
Article / Book Information

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Title(English)	Study on Suppression of Viscous Fingering In Three Dimensional Porous Media by Using X-Ray Microtomography
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種別(和文)	論文要旨
Type(English)	Summary

(博士課程)

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## 論文要旨

THESIS SUMMARY

系・コース： 機械・機械 系  
Department of Graduate major in コース  
学生氏名： Mahardika Mohammad Azis  
Student's Name

申請学位(専攻分野)： 博士 (工学)  
Academic Degree Requested Doctor of  
指導教員(主)： 末包 哲也  
Academic Supervisor(main)  
指導教員(副)：  
Academic Supervisor(sub)

要旨(英文800語程度)

Thesis Summary (approx.800 English Words)

Chapter 1 mainly explains the background and objective of this research. Viscous fingering occurs when less viscous fluid displaces a more viscous fluid. The difference in mobility ratio results in instabilities at the interface and develops into viscous fingering. Viscous fingering is detrimental for such applications as oil fields, carbon capture sequestration, groundwater, etc. In this research, we focused on the oil recovery process. In oil fields, water flooding resulted in low oil production because oil was bypassed due to viscous fingering. Therefore, it is essential to suppress the viscous fingering to improve the oil recovery. Therefore, the purpose of this research is to suppress viscous fingering in several conditions that exist in the field.

In Chapter 2, miscible fluid displacement with influence of viscous and gravitational force in porous media were investigated. Two different configurations were investigated, with viscous force stabilized by gravitational force and vice versa. The interface stability were predicted by using critical velocity. By using x-ray CT, the viscous finger and gravitational finger were visualized and analyzed. Each configuration and fingering pattern's characteristics are differentiated by finger length and sweep efficiency.

In Chapter 3, polymer flooding enhances oil recovery by increasing the viscosity of displacing fluid and results in stable displacement. However, the injection with continuous polymer increased the cost of production; therefore, a small injection portion of polymer followed by water flooding are typical examples in the oil field. Another problem occurs in this example, as water and polymer induce viscous fingering. When the water breakthroughs the polymer layer, the polymer's efficiency is greatly reduced. To stabilize the interface between water and polymer chemical reaction that induce the changes of viscosity was investigated. The chemical reaction successfully reduced the breakthrough time compared with water (without chemical reaction).

In Chapter 4, heavy oil that has very high viscosity cannot be recovered by using polymer because the viscosity of polymer induces very high pressure; therefore, another method needs to be discovered. Heavy oil is composed of organic compounds.  $\text{CaOH}_2$  induces a chemical reaction between the oil and reactant and produces viscoelastic material. The  $\text{CaOH}_2$  flooding were investigated for displacing the heavy oil. Viscoelastic material produced from chemical reaction successfully displaced the oil and suppress the viscous fingering. A 2D experiment (micro-scale) was followed to investigate the mechanism that occurs in 3D (macro-scale). Gel produced in the chemical reaction blocked the preferential path of the fluid and a new path is observed. The second mechanism, high shear, breaks the gel into smaller and pushes the oil.

In Chapter 5, in summary, study on viscous fingering suppression for different condition was analyzed. In case of gravitational force exist, viscous fingering was suppressed as displacement velocity is not beyond the critical velocity. While, viscous fingering suppressed from chemical reaction that increase viscosity in the interface and producing viscoelastic material. In former case, the increase in viscosity reduced the breakthrough time while in latter case the viscoelastic material blocked the permeable path and induce new path for the displacing fluid hence increase the sweep efficiency.

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。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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