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X 線 CT による CO2-EOR 室内試験の可視化と定量評価
X-ray CT visualization technology for CO2-EOR laboratory test

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X-ray CT visualization technique has come to be actively utilized in the field of earth science not only medical and industrial fields. With this technique, it is possible to monitor the fluid movement of the internal structure and confirmed in a pore of the rock samples in a nondestructive manner. In particular, it is possible to quantitatively evaluate the physical properties such as porosity and fluid saturation in the rock sample by analyzing the X-ray CT data. Such techniques are also used in research related to oil development.

There are three main categories of EOR (Enhanced Oil Recovery); thermal recovery, gas injection and chemical injection. In particular, CO_2-EOR, one of the gas injection method is a technique which has attracted attention of many new markets among EOR technology.

We developed an experimental system in which the CO_2-EOR laboratory tests and X-ray CT visualization can be performed simultaneously using a rock sample. The experimental system is intended to quantitatively evaluate whether there is an effect on CO_2-EOR for the rock sample. Berea sandstone (diameter: 35mm, length: 80mm) were used for this experiment. The experiment was carried out under conditions that simulate the temperature and pressure of the underground; confining pressure 12MPa, pore water pressure 10MPa and temperature 40 ℃. Injection of the fluid was controlled by a high-precision syringe pump. In addition, specially designed high-pressure vessel to X-ray transparent was utilized for X-ray CT visualization. Porosity of the rock sample determined by X-ray CT image was about 20.21%, which is consistent with the porosity obtained in the previous test by the saturated immersion method. The sample has been saturated with KI aqueous solution, and then mixed with oil (KI-Oil mixed state; oil saturation rate 58.50%). The CO_2-EOR test was carried out until the CO_2 injection reaches 2PV (pore volume), finally, about 66.10% of the oil recovery rate was confirmed. Figure 1 shows a CT image when the CO_2 injection amount reaches the 0.25PV.

In this study, the CO_2-EOR laboratory test of porous sandstone and X-ray CT visualization were carried out to obtain the porosity, fluid saturation and oil recovery rate. We report the experiment method and results in detail. This study is expected to contribute to the development of CO_2 injection methods for efficiency improvement of CO_2-EOR (for example, micro-bubble CO_2-EOR).

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