What is CO_2 Enhanced Oil Recovery, a form of CCUS?

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Enhanced Oil Recovery (EOR) is a technology recovering oil that had not been recovered from oil reservoir due to several physical reasons. CO_2-EOR is an EOR technology and is well known as a form of CCUS. CO_2-EOR can improve the oil recovery through multiple mechanisms, and it can be divided into two types such as CO_2 miscible EOR and CO_2 immiscible EOR.

The boundary between CO_2 and oil disappears and they become one phase fluid (see Fig. 1) in the CO_2 miscible EOR. Because the properties of the miscible fluid are similar to those of gas, it can be quite easily flow through the porous media compared to high viscous liquid oil. High oil recovery can be therefore obtained by this EOR. The pressure at which CO_2 and oil become miscible is called the minimum miscibility pressure (MMP). The MMP is usually quite high, therefore, there are a limited number of such high pressure oil reservoirs to which this technology can be applied. We examine the techniques lowering the MMP using chemicals to increase the number of oil reservoir to which this technology can be applied.

The properties of oil can be improved due to the dissolution of CO_2 into oil, and oil recovery can be improved in the CO_2 immiscible EOR. For example, the volume of oil in which CO_2 is dissolved expanded as shown in Fig. 2, which leads to the reduction of density and viscosity of oil. Enhancement of oil recovery can be obtained due to such swelling and viscosity reduction of oil in which CO_2 is dissolved. Although the enhancement of oil recovery with this method is lower than that with the miscible method, it is advantageous in that it can be applied to many oil reservoirs. It is generally believed that more than 60 % of the injected CO_2 can be stored in oil reservoir in the form of dissolved oil while 40 % of the injected CO_2 is recovered with oil in this method. We are investigating the recovery of heavy oil, which is usually recovered by thermal method such as steam injection, using this method.

In this presentation, I would like to introduce our studies on CO_2-EOR and provide an explanation of CO_2-EOR.

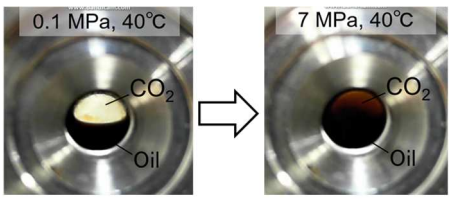
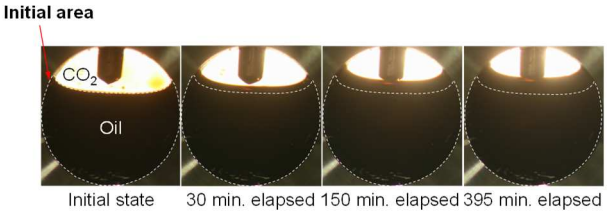


Fig. 1 CO_2 and oil miscible observed under high CO_2 pressure conditions



25℃、5.6MPa

Fig. 2 Oil swelling due to dissolution of CO_2 into oil