Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

HRE27-08 Room:104 Time:May 20 15:45-16:00

Water saturation estimated by X-ray CT scan and mass balance methods during relative permeability measurements

KOGURE, Tetsuya[1*], NISHIZAWA, Osamu[1], CHIYONOBU, Shun[1], YAZAKI, Yukihiro[1], Seiji Shibatani[1], XUE, Ziqiu[1]

[1]RITE

Predicting the migration of injected CO2 is a major concern in carbon dioxide capture and storage (CCS) projects. The prediction requires relative flow properties between the injected CO2 and water in a saline aquifer. Generally, numerical simulations of the multiphase flow in porous media use the relationship between the fractions of two fluids and their relative permeability, which is called a relative permeability curve. In CCS projects, the volumetric ratio between water and CO2 in saline aquifers varies widely through the injection of CO2. Therefore, a simulation of the migration of CO2 needs a relative permeability curve of water -CO2 system.

If the relative permeability curve of water-supercritical CO2 system can be obtained from laboratory measurements under the condition of the reservoirs, the migration of CO2 in the reservoirs can be predicted more precisely. However, a very few studies have tried to measure accurate relative permeability curves of water-supercritical CO2 system compared to those of water-oil system that has been usually measured in oil and natural gas development field. In many cases, outflow volumes of water and CO2 from a rock sample are measured in a water-CO2 separator. The separator should be pressurized so that CO2 remains as supercritical state. Experiments without a pressurized separator fail to measure the accurate volume of CO2 due to the change of CO2 phase from supercritical to gas. Furthermore, the pressure change causes degassing of water, which is the release of water-dissolved CO2 into a non-pressurized gas. Therefore, we developed a temperature controlled and pressurized separator to observe the interfacial surface between water and supercritical CO2 through a glass window. This enables us to estimate water saturation of a rock sample accurately using mass balance on the fluids passing through the sample.

In addition to the mass balance, X-ray CT scanner is often used to determine the water saturation. X-ray CT scan is used in many of recent studies for the measurements of relative permeability. This must be because the resolution of X-ray CT scanners has been improved in recent years. We measured the relative permeability of water-supercritical CO2 system through the estimation of water saturation obtained by both mass balance and X-ray CT scan. This study shows the methodology of measuring the relative permeability curve of water-supercritical CO2 system and discusses the results of the measurements.

The relative permeability curve is obtained by plotting the relative permeability values with respect to the degree of water saturation estimated by X-ray CT scan and mass balance methods. The values of water saturation are almost the same as each other though there is a little difference between those obtained by X-ray CT scan and mass balance methods. Consequently, both mass balance methods and X-ray CT scanning can estimate water saturation in a rock sample precisely. Ideally, both methods should be used simultaneously to cross-check the value of water saturation as shown in this study.

Keywords: relative permeability measurements, water-supercritical CO2 system, water saturation, mass balance methods, X-ray CT scanning