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Physical Properties Measurements and Results Comparison of Carbonates using NMR

*Chi-Woo Shin[1)], Joo Yong Lee[2)] Taewoong Ahn[3)] Won Suk Lee[4)]

[1),2),4)] *Department of Petroleum and Resources Technology, UST, Daejeon 34113*
[2),3),4)] *Petroleum and Marine Resources Division, KIGAM, Daejeon 34132*
[2)] *jyl@kigam.re.kr*

ABSTRACT

The purpose of this study is to improve the reliability and applicability of NMR(Nuclear Magnetic Resonance) measurements of physical properties by comparing NMR methods with conventional methods for physical property measurements.

Helium porosity can be measured using Boyle's law. Measurement of porosity using helium is still the most commonly used method. The principle of the porosity measurement method using NMR is to measure the relaxation time after vibrating hydrogen atoms by applying a magnetic field in a core saturated with distilled water or brine. Permeability can be calculated using NMR analysis of rock. The most widely used relationship is the Coate's Model and that is expressed as $k_{coates} = \left(\frac{\emptyset}{C}\right)^4 \left(\frac{FFI}{BVI}\right)^2$, where $\emptyset$ is the total porosity of the rock and BVI(Bulk Volume Irreducible) means irreducible water saturation of the rock. FFI(Free Fluid Index) is calculated by excluding BVI at total porosity and means movable water saturation. C is Coates coefficient and reflects the stratigraphic characteristics, typically used 10 for clastic rock.

The porosity changes according to the τ value. The τ value obtained from the standard sample is 47 ~ 48μs, and the porosity value is smaller than helium porosity from about 2% to as much as 7%. However, when the τ value was arbitrarily adjusted to 40 μs , it was confirmed that the error was reduced to 1~3%. As the τ value decreases, the value of NMR porosity is close to the value of helium porosity. Therefore, it was confirmed that it is necessary to control the τ value in consideration of the pore size when the porosity is measured using the NMR measurement. In the case of the permeability experiment, through value of comparing gas permeability with NMR permeability was similar, it confirmed reliability and applicability.

[1)] Student
[2),4)] Professor, Principal Researcher
[3)] Senior Researcher

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