— University of Mosul —
College of Petroleum & Mining Engineering

Petrophysical properties of rocks

Lecture second

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Porosity

The porosity of a rock is a measure of the storage capacity (pore volume) that is capable of holding fluids. Quantitatively, the porosity is the ratio of the pore volume to the total volume (bulk volume). This important rock property is determined mathematically by the following generalized relationship:

$$\emptyset = \frac{\textbf{Pore Volume}}{\textbf{Bulk Volume}} = \frac{V_P}{V_B} * 100\%$$

Where:

$\emptyset$ **= porosity**

V_P **= Pore volume**

V_B **= Bulk volume =** $(V_P + V_G)$

As the sediments were deposited and the rocks were being formed during past geological times, some void spaces that developed became isolated from the other void spaces by excessive cementation. Thus, many of the void spaces are interconnected while some of the pore spaces are completely isolated. This leads to two distinct types of porosity, namely:

- Absolute porosity

Effective porosity

Absolute Porosity

The absolute porosity is defined as the ratio of the total pore space in the rock to that of the bulk volume. A rock may have considerable absolute porosity and yet have no conductivity to fluid for lack of pore interconnection. The absolute porosity is generally expressed mathematically by the following relationships:

$$\emptyset_a = \frac{\text{Total Pore Volume}}{\text{Bulk Volume}} \quad \text{----------} \quad (2)$$

$$\emptyset_a = \frac{\text{Bulk Volume} - \text{Grain Volume}}{\text{Bulk Volume}} \quad \text{----------} \quad (3)$$

$$\emptyset_a = \frac{VB - VG}{VB} * 100\% \quad \text{----------} \quad (4)$$

Where:

$\emptyset_a$= Absolute porosity

V_G = Grain volume

Effective Porosity

The effective porosity is the percentage of interconnected pore space with respect to the bulk volume, or

$$\emptyset_e = \frac{\text{Interconnected Pore Volume}}{\text{Bulk Volume}} \quad \text{----------} \quad \textbf{(5)}$$

Where: $\emptyset_e$ = Effective porosity

1. Clean sandstones: $\Phi_e = \Phi_t$
2. Carbonate, cemented sandstones: $\Phi_e < \Phi_t$

The effective porosity is the value that is used in all reservoir engineering calculations because it represents the interconnected pore space that contains the recoverable hydrocarbon fluids.