Consistency Test Calculation Porosity of Logging Resistivity Through the Measurement of Common Resistant in Artificial Core Sample

Yuliora E  
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1 Mechanical Engineering Research Group, Polytechnic of Bengkalis, Jl. Bathin Alam, Sungai Alam, Bengkalis, Riau, Indonesia, 28711.  
2 Physics of the Earth and Complex Systems Research Group, Faculty of Mathematics and Natural Science, Bandung Institute of Technology, Jl. Ganesha no. 10 Bandung, Indonesia, 40132.

Abstract. Research has been done about petrophysics of reservoir as an accumulated hydrocarbon. Every rocks have unequal of resistivity, from this resistivity the porosity ($\phi$) quantifiable with using Archie equation. Core sample are made for consistency test calculation porosity of logging resistivity data through the measurement of common resistant in artificial core samples with variation of composite. The result measurement resistivity of shaly sands core samples is 1,19 $\Omega$m consist of clean formation to sandstone 1.29 $\Omega$m, shale 2,58 $\Omega$m and fresh water 0.734 $\Omega$m with measurable porosity is 39.38 % (shaly sands), 19.09 % (sandstone), 42.51 % (shale) and formation factor (F) of shaly sands core samples is 1.62 (shaly sands), 1.75 (sandstone), 3.51 (shale) with this results indicated that decrease in formation factor of shaly sands core samples comparable with increase of porosity of shaly sands core samples. So the data can be used to analyze oil deposit on a reservoir having specific characteristics, so as to increase productivity oil ans natural gas.

1. Introduction
Reservoir rocks is Igneous rocks as container filled and saturated of gas and oil. The main requirement rocks reservoir is pore in rocks to accumulated gas and oil is porosity. To calculate porosity and resistivity of layers we used characteristics of petrophysic rocks. characteristics of petrophysic rocks can be analyzed with result of logging process. Well logging is record process result measurement of the rocks based on the characteristics physical [2].

Evaluation rock formations is a process of analysis features and the nature of the rocks reservoir by using the measurement result the borehole [4]. The purpose of did evaluation formation is to the knowledge of the rocks is in reservoir and then the knowledge of the hydrocarbon ( oil , gas or kondensat ), how many hydrocarbon can be produced , how the properties of , the state of rocks and fluid contained in it , is the amount of the womb hydrocarbon there is enough economical to be produced .To answer all the questions above then done evaluation formation covering cutting evaluation , coring , and well logging that .

Resistivity is capability of materials to hinder the course of the tide electricity in through those rocks [3]. Logs resistivity used to mendeterminasi zone hydrocarbons and zone water,
identify zone permeable with mendeterminasi porosity resistivity , because rocks and matrik not conductive so the rocks capability to conduct an electric current depends on fluid and pore those rock.

Coring is method to take core from borehole [2]. Coring important to calibration modelling of petrophysics and to get information not be able in log. After drilling, core is saved because Core representing such the condition of rocks its place upon its was and are not was suffering from a so many information that can be acquired.

To ensure consistency well logging data , we need an evaluation directly .A used to evaluate the state of a formations directly can be done by coring or core of sampling .In this study author trying to make sample artificial core porous rock as a media to know consistancy log entry resistivity. Knowing porosity and resistivity measurable of a sample of artificial core we can know consistancy of data by compares the results plot porosity by a factor of the formation of porous rock obtained from the data well logging. So the data can be used to analyze oil deposit on a reservoir having specific characteristics, so as to increase productivity oil ans natural gas.

2. Theory
The comparison between volume an empty space / pore total not filled by a solid object (pores , cracks) that is between elements a mineral of rocks , to the volume of total rocks:

\[
\phi_{\text{tot}} = \frac{V_b - V_s}{V_b} = \frac{V_p}{V_b} \times 100\% \quad (1)
\]

Resistivity is the ability of an ingredient for can send an electric current that flows him .If an ingredient easy flow an electric current so resistivitynya low and if the material having resistivity high so material is not easy flow an electric current .Equation common used to calculate resistivity observable between 2 side of any surface at a given temperature expressed as:

![Figure 1. Resistivity of cylinder conductor.](image)

\[
R = \frac{rA}{L} \quad (2)
\]

\[
r = \frac{V}{I} \quad (3)
\]
Gustave e. Archie, that voters importance in log analysis is the relations between porosity, resistivity, and saturation hydrocarbon of a rock a reservoir. The equation worn by archie or archie’s equation [1] is:

\[
R = \frac{VA}{IL} \tag{4}
\]

Figure 2. Data of logging resistivity [5]

Figure 2 is an example of a data logging that resistivity that is indicative of the price porosity and resistivity rock formations reservoir. Of the equation model pipe kapilaritas archie developed into law:

\[
\frac{R_o}{R_w} = a \phi^{-m} \tag{6}
\]

\[
F = a \phi^{-m} \tag{7}
\]

The value of F this is an impediment in electrical conductivity in rocks, can be seen that the total amount of ro will be more bigger than before with increase the value of F. In his postulate Archie said that the value of m would not be equal and vary depending on rocks of cementation [1].

3. Experiment Method

To making core sample Csd ( core ) sandstone, Cs ( core cement ), Cey ( core clay ), Cr-1 ( shaly sands ), Cr-2 ( limy sands ), and Cr-3 ( clayey sands ) used molding cylindrical from a pipe PVC in diameter 5,8 centimeters and 15 inches tall. For a sample of core csh ( core shale ), clm ( core limestone ) not using mold pipe pvc but those rocks cut to shaped beams with size 3x0,9x5 centimeters and 3,7x3,2x3,9 cm.
To make core formations sample combined polluter 65 % sandstone, 5 % adhesive of cement and 30 % defilers (shale, limestone and clay). Making core clean sample formation done by dissolving a starter (sandstone, clay, cement) with water and then inserted into the mold pipe with the same pressure and dried using an oven electricity temperatures 150 °C for 2 hours. After core dry weigh dry perfect mass then wading into a container contains water for 10 hours, it is called with the penjenuhan. Then core saturated by water again weigh mass the core to calculate porosity the core. figure 3 to describe experiment method.

![Figure 3](image_url)

**Figure 3.** The scheme measurement of the core sample resistance

### 4. Experiment Result

Measurement porosity in samples clean core formations performed on 5 kind of rock were sample 10 core. So that the porosity and resistivity of rocks dirty formation is presented in Figure 4 and Figure 5

![Figure 4](image_url)

**Figure 4.** Porosity of dirty formation sample core
Figure 5. Resistivity of clean formation sample core

Figure 6. Plot of Log F to Log φ from experiment

In Figure 6 to Describing consistency results eksperiment with the data logging resistivity.

from

1. Sampel core Cr1d \( F = \frac{1.03}{\varphi^{0.39}} \)
2. Sampel core Cr2d \( F = \frac{1.01}{\varphi^{0.35}} \)
3. Sampel core Cr3d \( F = \frac{0.9}{\varphi^{0.21}} \)
4. Sampel core Cr2y \( F = \frac{1.01}{\varphi^{0.33}} \)
5. Sampel core Cr-1 \( F = \frac{118}{\varphi^{0.37}} \)
6. Sampel core Cr-2 \( F = \frac{114}{\varphi^{0.37}} \)
7. Sampel core Cr-3 \( F = \frac{116}{\varphi^{0.34}} \)
Based on data porosity and resistivitas above, using the equation archie and obtained factors masing-masing core formation, with information factors this formation then we can analyzed core or reservoir which can accommodate oil reserves.

5. Conclusion
The log $\phi$ to log $F$ in dirty formation, shaly sands showed that sample core it has porosity higher than elementary substance sandstone but smaller than material shale, while for limy sands having its porosity is greater than porosity elementary limestone, and to clayey sands having its porosity less than the prositas elementary substance (sandstone) and materials clay. The log $\phi$ to log $F$ in shaly sands showed that sample core it has factors the formation of rock formations ($F$) smaller than $F$ elementary substance (sandstone) and materials shale, while for limy sands having $F$ greater than the for basic sandstone and limestone, and to clayey sands having its porosity is higher than $F$ elementary substance (sandstone) and materials clay. So the data can be used to analyze oil deposit on a reservoir having specific characteristics, so as to increase productivity oil ans natural gas.

6. References
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