УДК 552.08

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ОПРЕДЕЛЕНИЕ СРЕДНИХ ЗНАЧЕНИЙ РЕЗЕРВУАРА СВОЙСТВ (ПРОНИЦАЕМОСТЬ, ПОРИСТОСТЬ) СТАТИСТИЧЕСКИМИ МЕТОДАМИ

Аннотация: *Использование статистических методов для определения средних значений свойств резервуара продуктивных формирований, таких как пористость и проницаемость, а также для определения того, совместимы ли образцы с нормальным распределением или нет, определение пороговых (критических) значений пористости и с учетом более высоких значений, которые получены. Таким образом, зная размер продуктивного пласта и запасы добычи углеводородов(углеводородов), определение критического значения проницаемости и распределение проницаемости на исследуемом месторождении.*

Ключевые слова: *Поле, углеводороды, проницаемость, пористость, свойства, резервуар.*

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DETERMINATION OF MEAN VALUES OF THE RESERVOIR PROPERTIES (PERMEABILITY, POROSITY) USING STATISTICAL METHODS

Annotation: *Using statistical methods in determining the mean values of the reservoir properties of the productive formations such as porosity and permeability and determining whether the samples fit the normal distribution or not, setting the cutoff values of the porosity and considering the values that are greater than it produced, thus knowing the size of the productive formation and the production reserve of hydrocarbons, determining the permeability cutoff value and distribution of permeability capacity in the studied field.*

Key words: *Field, hydrocarbons, permeability, porosity, properties, reservoir.*

Introduction

Statistical methods were used by the scientists J. Low and A. Bulnes. In order to determine the mean characteristics of the formation based on a large amount of data, the statistical methods will reduce efforts and provide us with additional information on the physical properties of the field [1,2].

Porosity

In some reservoir the net productive sand can be determined by a porosity distribution. The Studied field "cutoff" value of porosity is selected, so that only samples with porosities greater than the cutoff value are considered "net pay" the cumulative volume capacity for the classified data of the field is calculated and plotted [3,4]. In fig (1) for the studied field 98% per cent of the storage capacity is represented by samples having porosities of 7% or greater.

Thus, a cutoff value of 7% percent porosity could be used to determine net pay and still include at least 98% percent of the producible hydrocarbons.

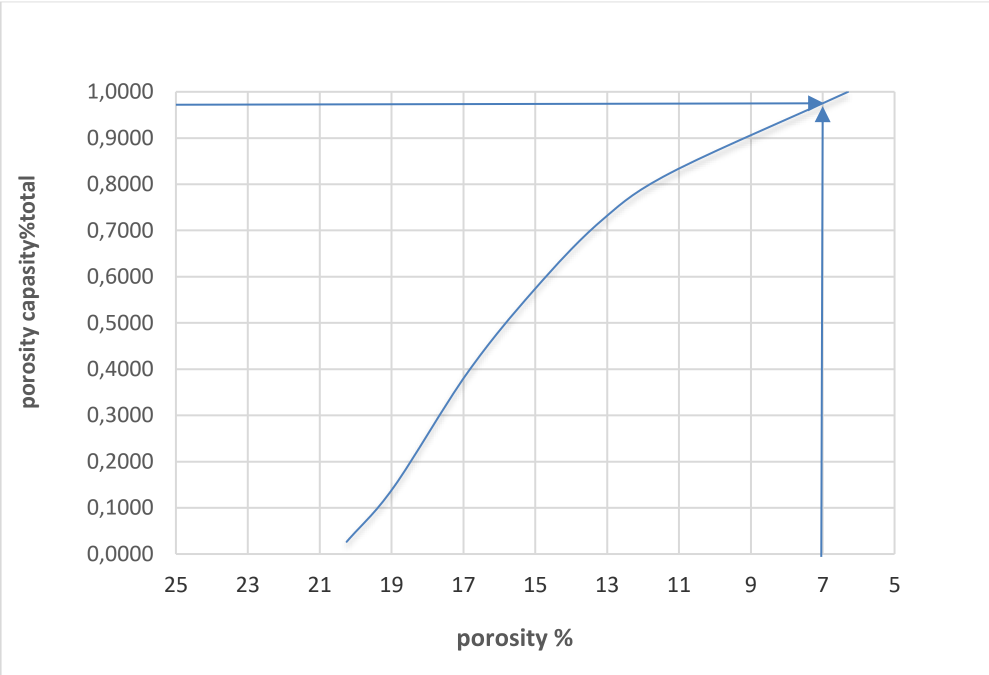

Fig.1. Distribution of porosity capacity

Permeability

Classification of permeability data.the permeability data obtained from core analysis must be studied and classified before application of statistical methods for its reduction to an average value. In the discussion of porosity, it was shown that the samples resulted in a normal type distribution, so that all the sample could be treated together [5,6].

The first step in analyzing the porosity data was determining whether or not the sample fitted a normal distribution. This same procedure is followed with the permeability data expected in the selection of the permeability ranges [7,8]. the permeability ranges are selected on equal intervals of the logarithm of permeability in accordance with the recommendation of law [9,1]. A histogram of all permeability samples for the studied is shown in fig (3), where the range limits are

$J=\log(k_i/kj)$, $k_j=2^i ki$

J=1,2,3,4 kj= rang limits ki=initial permeability

And the value of k was selected to be 1.2 [3,10].

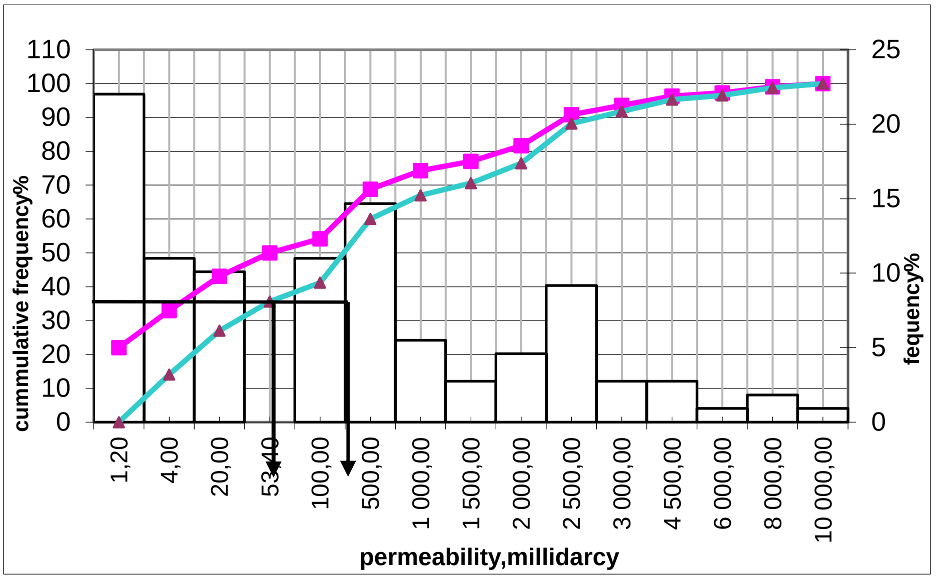

Fig.2. Permeability histogram and distribution for samples in the studied field

The cumulative number of samples of is plotted against the $\log_{10}k$ for the selective samples of the field studied in fig (3). Note that the data can be fitted by three straight –line segments [3,11].

The exponential-type variation for afield can, for evaluation purposes, be broken into several straight –line segments such as the three segments shown in fig (3). The exponential distribution is defined by the stratification ratio r, which is defined as the ratio of maximum permeability to the minimum permeability of a straight segment. Normal and exponential expressions fitted to permeability distributions are useful not only in classifying the data but also in describing permeability stratification in gas cycling and water flooding.

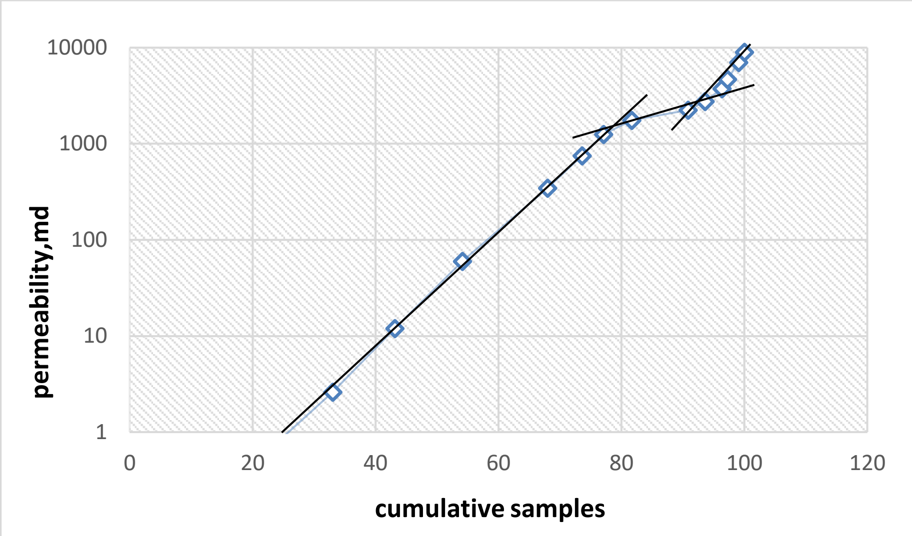

Fig.3. Permeability distribution on semi log paper

Calculating Mean Permeability:

To obtain a statistical average permeability which will describe the over- all performance of a reservoir, it is necessary to determine which statistical averaging procedure is to be used .In the classification of the permeability data, it was indicated that the permeability should be classified on a logarithm of permeability, the geometric mean is the average to use with such correlations [3,12].

The geometric mean permeability is defined in Eq:

$$\log\overline{k_g} = \frac{\sum_{i=1}^{l} \log k_i}{L}, \ \log\overline{k_g} = \sum_{j=1}^{n} F_j \ .\log(\bar{k}_a)_j$$

$\bar{k}_g$: geometric mean permeability

K_i: permeability of sample i.

L: total numbers of samples

N: total number of classified intervals.

F_j: cumulative frequency of intervals, fraction

$(\bar{k}_a)_j$: arithmetic average permeability of logarithmic class interval j.

For comparison, average permeabilities are calculated for the studied field by both the geometric and arithmetic mean procedures.

The arithmetic mean procedure is applied to all samples and to those sample having a permeability greater than 1.2 md. The geometric procedure is applied only to those having a permeability greater than 1.2 md.

Permeability, like porosity, can be and is used to determine the net sand to be used in volumetric calculations .A cutoff value of permeability can be selected from a permeability capacity curve, so that net sand will be selected on the basic of the samples which have a permeability equal to or greater than the cutoff value. The cumulative permeability capacity for all samples in the studied field is shown in fig (4).

Eighty five percent of producing capacity of the studied field is represented by samples having a permeability greater than 2500 md.

Ninety eight percent of the capacity is represented by samples having permeabilities greater than 500 md. Thus, it would appear that a permeability cutoff 1.2 md would include essentially all the productive sand.

Using a permeability cutoff value of 1.2 md for the studied field, the geometric mean calculated is 163.96 md. The arithmetic permeability for samples with a permeability greater than 1.2 md is 1104 md.

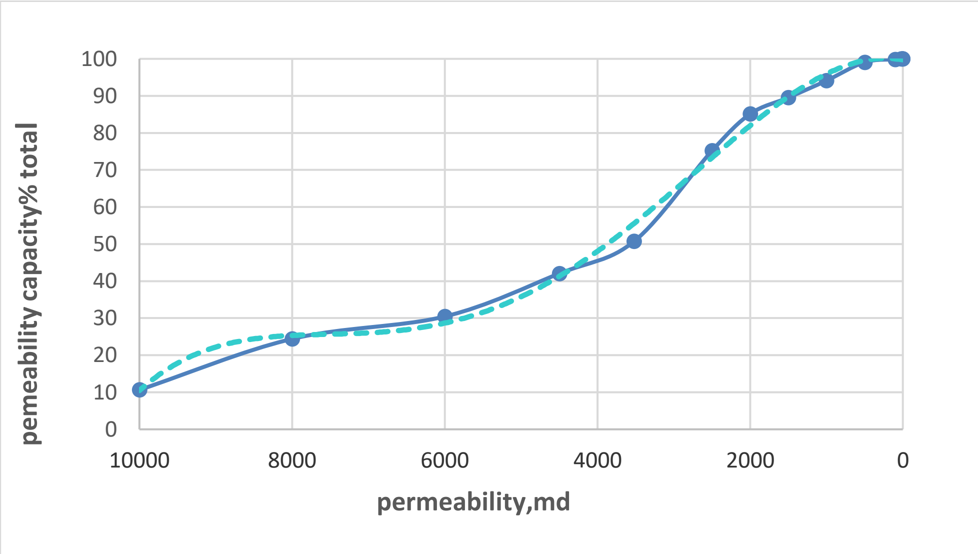

Fig.4.Distribution of permeability capacity in the studied field

Result and Discussion:

For the studied field 98% per cent of the storage capacity is represented by samples having porosities of 7% or greater.

Thus, a cutoff value of 7% percent porosity could be used to determine net pay and still include at least 98% percent of the producible hydrocarbons.

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Normal and exponential expressions fitted to permeability distributions are useful not only in classifying the data but also in describing permeability stratification in gas cycling and water flooding.

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