Oil Reservoir Permeability Estimation from Well Logging Data Using Statistical Methods
(A Case Study: South Pars Oil Reservoir)

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Abstract

Permeability is a key parameter that affects fluids flow in reservoir and its accurate determination is a significant task. Permeability usually is measured using practical approaches such as either core analysis or well test which both are time and cost consuming. For these reasons applying well logging data in order to obtaining petrophysical properties of oil reservoir such as permeability and porosity is common. Most of petrophysical parameters generally have relationship with one of well logged data. But reservoir permeability does not show clear and meaningful correlation with any of logged data. Sonic log, density log, neutron log, resistivity log, photo electric factor log and gamma log, are the logs which effect on permeability. It is clear that all of above logs do not effect on permeability with same degree. Hence determination of which log or logs have more effect on permeability is essential task. In order to obtaining mathematical relationship between permeability and affected log data, fitting statistical nonlinear models on measured geophysical data logs as input data and measured vertical and horizontal permeability data as output, was studied. Results indicate that sonic log, density log, neutron log and resistivity log have most effect on permeability, so nonlinear relationships between these logs and permeability was done.

Keywords: Permeability; Oil Reservoir; South Pars; Well Logging; Statistical Nonlinear Models; SPSS.

1. Introduction

The permeability is the capability of the penetration of a fluid such as oil, gas or water into the reservoir. The higher permeability causes the easier penetration of oil and gas into the reservoir rock. In this case, the oil can be extracted with higher rate and lower cost. The permeability is shown by "k". The higher the effective porosity degree (φ_e) of the reservoir, the easier oil flow and the higher permeability of the reservoir would be. Darcy is the unit of the permeability. Different types of the permeability can be classified as absolute, relative and effective. Such definitions have completely been presented in most of studies carried out on this issue. Determination of permeability parameter is vital in processes such as storage estimate and development of oil reservoirs. Understanding of the correct values of permeability is considered as an effective tool for oil engineers in the process of production and management of an oil field. Usually, two direct (core and well test analysis) and indirect (geophysical logs assessment) methods are applied to determine the correct values of permeability in the oil industry [1-3].

Experimental relationships based on the Kozeny-Carmen theory have also been developed that relates permeability to other logs or other parameters such as resistivity and irreducible water saturation. Since core permeability data are