Rock physical and Digital Simulation with Verification

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Abstract. In recent years, with the development of earth science, the position of rock physics is improving in oil and gas exploration and rock analysis, meanwhile rock assay is necessary means to know the oil and gas geological features. This paper designs nine rock physics models, these models are divided into three groups, and every three in cement chips were added to different contents. By testing rock samples, then analyze the results to obtain variation between them. Because the largest density is iron, graphite followed when adding density larger than its own material in artificial rock samples, after mixing with a density greater than the density itself, and with the increase in volume when the content of the material, the density gradually increased to approaching the density of the material, on the contrary, the addition is smaller than its own density, mixed density smaller;the volume resistivity of the conductive particles content increases with the resistivity decreases, when adding to a high-impedance particles, the overall resistivity will increase; in short, the media contents on the particle composition and petrophysical properties of the rock sample in a great extent.

1. Introduction

Rock physics is specializing in the various physical properties of rocks and generation mechanism of a discipline[1]. In history, rock physics originated in physics, the basic aim is to provide theory inference and interpretation of geophysical observation data base.Rock physics is the main application field of geophysics, in addition, also used in many subjects such as geology, mining, oil, materials and engineering field, because the problems of every field is various,and the rock physical parameters is also different[2]. Even for the same rock physics parameters, different areas will be given a different name and explanation.In 2000 year, Glover and others and made 10 pieces of porosity for 4 ~ 44% skeleton conductive artificial stone, skeleton entirely composed of copper oxide material, tested the saturated rock conductivity of different water conductivity, studied the saturated rock skeleton electric conductive sample conductivity and relations between the change of water conductivity.Clennell in 2010[3,4], and others use in northern Australia continental margin field produced by the different pyrite content of 30 pieces of the core sample , the pyrite content on rock resistivity change impact studies.Hanai - Bruggeman[5,6] equation of effective medium model respectively to calculate the rock contains pyrite conductivity and dielectric constant of different frequency, the model in the case of high content iron ore underestimated the pyrite, this is because in the distribution of the pyrite in underground rock continuity and connectivity is better than stated in the model.Clennell waiting for sample no desaturation to experiment on different pyrite content, therefore, resistivity and saturation cannot be established, pyrite content, porosity, formation water resistivity, the functional relation between the frequency. Anyway, so far, the experimental study of rock electrical properties of pyrite is less, and concentrated on pyrite content water sample regularity of rock electricity experiment, instead of progressing desaturation experiment of pyrite, less on oil and gas pyrite progressing systematically litho-electric experiment research law, also did not establish the resistivity and saturation[7], pyrite content, formation water resistivity and porosity of the practical theory of relation between parameters.

2.Theory and Processing

*P*etrophysical parameters that affect the rock more, in order to study the impact of different particle composition and content of the petrophysical parameters (density, magnetic susceptibility, electrical and sound velocity), and in this study, the use of different media particles of iron, graphite and non-conductive particles logs sawdust, and measure the relevant petrophysical parameters 9 model.

2.1 Processing and production petrophysical model

(1)Way to obtain materials through petrophysical model: 300 mesh iron powder 500g, 80% to 86% purity graphite 500g, 100% wood sawdust 500g, P.042.5 bulk cement 2000g.

(2)Model container material, use utensils made of glass cubes, and produced 15 approximately the same cube container length and breadth approximately 12cm, 5cm, 5cm.

(3)Petrophysical model making

① cement-iron model, in order to study the media content on petrophysical parameters were added in cement 10g, 200g, 300g irons and cement were mixed petrophysical model produced three different iron content;

② cemen-graphite model, in cement were added 10g,100,200,respectively graphite mixed with the cement produced three different content graphite petrophysical models;

③ cement-wood model, in cement were added 10g, 50g, 100g wood chips were uniformly mixed with cement and sawdust produced three different levels of petrophysical models.Above models are produced at constant temperature and pressure conditions

(4)Rock Model molding and consolidation, the removal of the glass unit, remove the

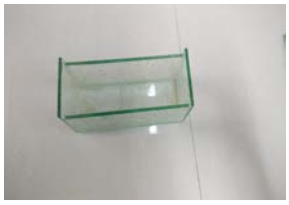

Fig. 1 Making model

Fig. 2 Rock samples

Through the 9 artificial rock samples were subjected to physical testing, measuring its petrophysical parameters (density, magnetic susceptibility, electrical and sound velocity), the measured data will be compiled into a chart and a graph to compare with the theoretical analysis.

3.Data analysis and interpretation

To study the effect of particulate media composition and content of the rock density, the paper selected nine artificial rock samples, including iron-concrete model 3, graphite-Model 3 cement, wood-cement Model 3.Finally,the theoretical and measured density curves were analyzed. Principle adopted for the buoyancy method 3 class model among nine artificial rock samples, measured by the density of cement 1.9g / about cm3, and the density test values approximate iron 7.8g/cm3, due to the uncertainty of wood materials, wood density in general about 0.6g/cm3 Graphite purity 80% -86%, due to a bad scene powdered graphite density measurement, but it is graphite density 1.9g/cm3 or less. For these reasons, it is the gap between modeling and measurement. But the overall trend can be determined. According to test different content of each material density curve.

$$\rho = \rho_1 \frac{\rho_1 + 2\rho_2 - (\rho_1 - \rho_2)V}{\rho_1 + 2\rho_2 + (\rho_1 - \rho_2)V} \qquad (1\text{-}1)$$

In the equation (1-1), ρ_1 means surrouding material resistivity, ρ_2 Mineral grains restivity.When mineral grains is sheet ,than the above quation is not fit,the below quation is better for Calculate the resistivity.

$$\rho = \rho_1(1-V) + \rho_2 V \qquad (1\text{-}2)$$

Figure (a) shows the Fe - cement density curve model with iron volume fraction, wherein the dotted line is the theoretical density curve, the solid line is the measured density curve. Although there are differences in the two curves, the overall trend is consistent.Curve seen from the figure, when the volume fraction of iron is approximately 0:00, the measured and theoretical density approximately

equal, with the iron content increases, the density increases gradually and almost linearly increases. This is due to the iron density greater than the density of cement, more obvious changes, when the two are mixed, with iron content continues to increase, the density 1.9-7.8g/cm3 to change the volume when iron content approaching 1:00, its density value tends to iron density; Fig. (b) C-cement volume content models with varying density graphite graph, where dashed lines represent the theoretical curve, the solid line is the measured density curve, although the two curves differ greatly, reflect trends consistently, with graphite volume content increasing, density becomes smaller, since the graphite density less than the density of the cement, so that after mixing the two measured densities range from 1.2-1.9g/cm3 changes; Fig. (c) Sawdust-Cement Model Theoretical and measured density curve closer, since sawdust density more than the density of the cement, with increasing volume fraction of sawdust, density change significantly, when the wood meal content is 0:00, the measured density value close to the density of the cement, when the volume content of wood 1:00, mixture density was close to wood density.Fig.(d)For low resistance of surrounding rock, mineral particle resistivity curve for high resistance;Fig.(e)For high resistance of surrounding rock, mineral particle resistivity curve for low resistance.We can clearly see that the low resistance body effects are greater than the high resistance body.

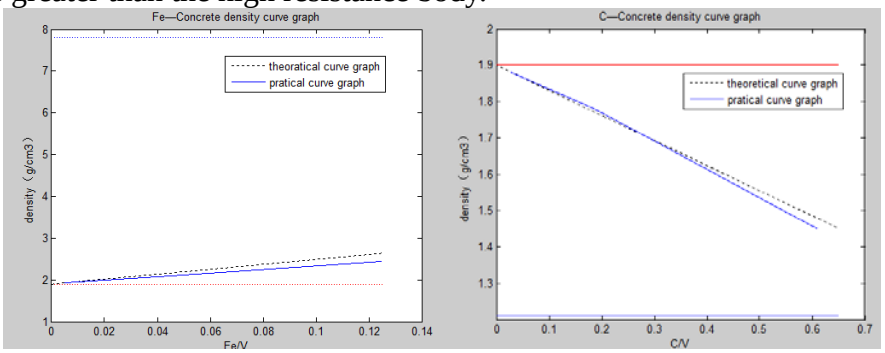

Fig. (a)Fe-Cement curve graph

Fig. (b)C-Cement curve graph

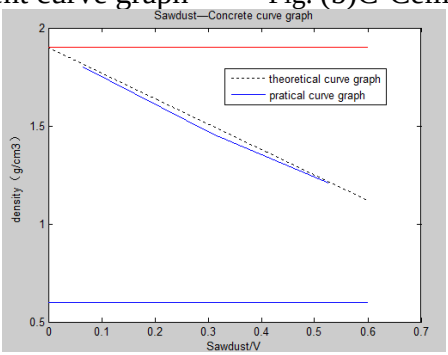

Fig. (c) Sawdust-Cement curve graph

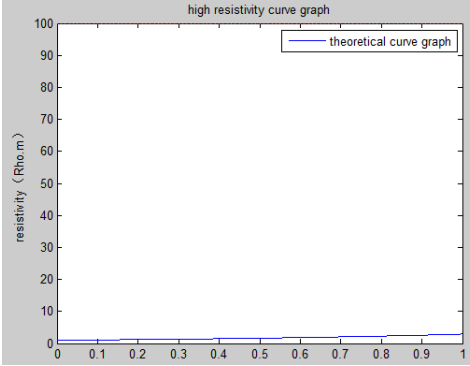

Fig. (d)High resistivity curve graph

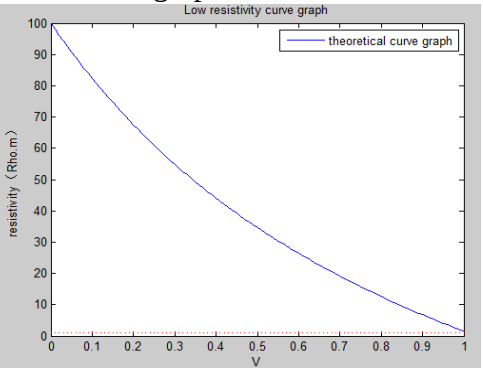

Fig. (e)Low resistivity curve graph

4.Summary

The density of artificial rock sample will change as the different particle composition density ,moreover,the variation trend of the rock sample are similar to density of mineral particle; so

as to the mixture of two petrophysical models, when the density of the feed is greater than the density of another component , with the ingredient content increasing, the density of its model will also increase and ultimately tends to the density of the components, but model density will decrease if the density which the rock samples particle are smaller than ambient density .As to the resistivity of rock physics model, if the rock sample contains low resistance material, its overall electricity group rate will drop significantly, on the other hand, when adding to high resistance mineral,though the resistivity of rock samples will increase,their changement are rather little than adding low resistance mineral.

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