Prediction of Electrical Properties of Carbonate Rocks Using Porous Structure

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The electrical resistivity of the reservoir is an important physical parameter, providing information on the types of formation, porosity and saturation of the reservoir. Although the heterogeneity introduced by diagenetic process make them a difficult material to study. In porous media without clay minerals or containing Fe, the electrical resistivity of rocks saturated with saline solution depends mainly on parameters, such as the volume of the flow spaces by an electric current, the pore morphology, the shape and size of the pores and the resistivity of the brine saturated in the porous space. Archie (1942)[1] relates electrical resistivity to porosity by defining the Formation Factor F as the ratio of the electrical resistivity of the porous medium fully saturated with brine, Ro to brine Rw. An exponent m is used to relate the formation factor F and the porosity in the equation $F = \frac{R_o}{R_w} = \frac{1}{\phi^m}$ in which the empirical exponent is related to the pore geometry of porous media and, therefore, reflects the properties of porous structures (Schon, 2011)[2], known as cementation exponent or porosity exponent (Archie, 1942)[1]. Resistivity is affected by pore geometry (Wang, 2019)[3]. In order to understand the influence of porous geometry on resistivity, this work analyzed the relationship between the electrical properties (F and m) of synthetic carbonate rocks with their porous system studied by X-ray tomography. The data were analyzed by Multiple Linear Regression. X-ray microtomography is a tool for visualizing the internal structure of rocks. The data were acquired using the X-ray imaging (IMX) beamline facilities, Brazilian Synchrotron Light Laboratory (LNLS) at CNPEM (Brazilian Research Center in Materials and Energy area). To safely derive resistivity properties, it is essential to use two geometric parameters: Gamma and DomSize. Porosity proved to be the main control factor for electrical properties, and a description of Gamma and DomSize geometrical properties is essential to improve the estimate and understand of the influence of porous space on electrical properties.

Key words: Carbonate Rocks; Cementation Exponent; Formation Factor; Porous Structure; Gamma; DomSize

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