

Dielectric Properties of Gas Condensate at High Temperatures

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Abstract

The objective of this work is to present the dielectric properties of gas condensate from 22° C to 125° C at a frequency of 2.2 GHz. This information at this frequency, will provide invaluable geochemical information about the gas condensate at downhole temperature conditions. Given the extremely low conductive losses of gas condensate, the complex permittivity of gas condensate is measured via a microwave resonant cavity connected to a vector network analyzer. The samples are heated via a microwave calorimeter that tracks the resonant frequency. The room temperature complex permittivity was be calibrated against previously obtained values through a second resonant cavity system. The measurements were conducted several times in order to obtain uncertainty values for the complex permittivity. A complete geochemical analysis, including SARA and GC analyses, of the samples was performed and the aromatic content correlated to the measured dielectric properties. The results show that, contrary to water, the conductive losses decrease with temperature and the dielectric constant shows a strong correlation with density. In addition, depending on the aromatic content and ratios the samples, it may not be possible to heat a sample to a desire temperature. More specifically, the heating capacity will depend on the dipole moment of the dominant aromatic components. Therefore, the permittivity measurements are an indicator of the type of aromatic components in the condensate. Moreover, in the case of less mature hydrocarbons, it will be difficult to pin point at specific components, but broader geochemical conclusions can still be made. The results obtained are a first step toward a downhole characterization of produced fluids. These results will allow for a downhole microwave fluid characterization tool to be designed and calibrated according to the values obtained from this study.