Analysis of Low Field Nuclear Magnetic Resonance Spectra to Determine Wettability and Clay Content

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ABSTRACT

Using low-field Nuclear Magnetic Resonance (NMR), wetting phenomena in unconsolidated samples containing clay can be assessed. The results are determined quickly and they are reproducible, as the experimental procedure in different types of clays has proven. The proposed method is already proven in soils and is extended to unconsolidated sands.

Other methods for measuring soil wettability, such as the Molarity of Ethanol Droplet (MED) and Water Drop Penetration Time (WDPT) do not always produce reliable data due to sample heterogeneity and the fact that soil-water-air systems cannot be directly compared to soil-aqueous ethanol-air systems. Alternatively, the outcome of NMR can be obtained easily, whether a sample is wettable or water-repellent, and with only a small amount of sample, which is of great importance especially in measuring water uptake and retention in the field. The addition of water in dry wettable porous media produces predominant amplitude peaks at transverse relaxation times (T_2) of 100 ms or less while addition of water in dry water-repellent porous media with the same pore structure produce predominant amplitude peaks at T_2 values near 1000 ms.

Also, experiments demonstrate that from the NMR spectrum partially saturated synthetic samples the clay content can be predicted with the usage of appropriate algorithms.

Applications of this work that would be of relevance to the oil and gas industry include determining the composition of oil sands and enhancing recovery from these formations.