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Industrial Rock Characterization using Nuclear Magnetic Resonance (NMR): A Case Study of Ewekoro Quarry

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Abstract : Industrial rocks were collected from a quarry site at Ewekoro in south-western Nigeria and analysed using Nuclear Magnetic Resonance (NMR) technique. NMR measurement was conducted on the samples in partial water-saturated and full brine-saturated conditions. Raw NMR data were analysed with the aid of T2 curves and T2 spectra generated by inversion of raw NMR data using conventional regularized least-squares inversion routine. Results show that NMR transverse relaxation (T2) signatures fairly adequately distinguish between the rock types. Similar T2 curve trend and rates at partial saturation suggests that the relaxation is mainly due to adsorption of water on micropores of similar sizes while T2 curves at full saturation depict relaxation decay rate as: 1/T2(shale)>1/ T2(glauconite)>1/ T2(limestone) and 1/T2(sandstone). NMR T2 distributions at full brine-saturation show: unimodal distribution in shale; bimodal distribution in sandstone and glauconite; and trimodal distribution in limestone. Full saturation T2 distributions revealed the presence of well-developed and more abundant micropores in all the samples with T2 in the range, 402-504 µs. Mesopores with amplitudes much lower than those of micropores are present in limestone, sandstone and glauconite with T2 range: 8.45-26.10 ms, 6.02-10.55 ms, and 9.45-13.26 ms respectively. Very low amplitude macropores of T2 values, 90.26-312.16 ms, are only recognizable in limestone samples. Samples with multiple peaks showed well-connected pore systems with sandstone having the highest degree of connectivity. The difference in T2 curves and distributions for the rocks at full saturation can be utilised as a potent diagnostic tool for discrimination of these rock types found at Ewekoro.

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