

Applied Magnetic Resonance 2005 vol.29 N3, pages 503-513

Effect of oxygen on the NMR relaxation properties of crude oils

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Abstract

Nuclear magnetic resonance relaxation measurements of bulk fluids provide a sensitive probe of the dynamics of molecular motion. Dissolved oxygen can interfere with this technique as its paramagnetic nature leads to a reduction of the paramagnetic relaxation times of the fluids. We studied this effect for the relaxation properties of crude oils that are in general characterized by a distribution of relaxation times. The samples were stock tank oils that have been exposed to air. We compared T1 and T2 relaxation time distributions and their correlation functions of the initial (oxygenated) samples with those from the deoxygenated samples. Oxygen was removed from the oils with a freeze-thaw technique. As expected, the effect of oxygen is most apparent in oils with long relaxation times. In these oils the effect of oxygen can be described by an additional relaxation rate $1/T_{1,2}^{ox}$ to the transverse and longitudinal relaxation rates that is sample dependent but does not vary within the relaxation time distribution of the oil. Values of $1/T_{1,2}^{ox}$ for different crude oils were found to be in the range of 2.5 to 8.3 s. For crude oils that have components with relaxation times less than 100 ms, no significant oxygen effect is observed. © Springer-Verlag 2005.
