Influence of Water on the Retention of Organic Probes on Clays Studied by IGC

Henri Balard, Alain Saada, Bernard Siffert and Eugène Papirer

Institut de Chimie des Surfaces et Interfaces, 15, rue Starcky - B.P. 2488, F-68057 Mulhouse Cedex, France

Abstract: Oil recovery is strongly related to the wettability of reservoir rocks that are formed of quartz grains attached by mineral hydroxides and clay minerals. Illites and kaolinites are the most active due to their high specific surface areas and electrical charge densities. Therefore, these minerals' relative affinities for oil or water when in contact with a water-oil mix are of great importance. In order to model such a complex system, we used a mix of organic model molecules of the oil constituents and water vapor. Their interactions were estimated by inverse gas chromatography (IGC). IGC experiments were performed using a carrier gas with controlled humidity. By means of IGC at infinite dilution conditions, the dispersive component of the surface energy, γ_s^d, was determined. A strong decrease of γ_s^d, due to water molecules shielding the highest-energy sites, was observed. The energetic surface heterogeneity of the clays was examined using IGC at finite concentration conditions, allowing the determination of organic probe adsorption isotherms in the presence of water. From these isotherms, adsorption energy distribution functions were computed for propanol-2 and pyridine probes. Water mainly modifies the illite distribution functions, whereas practically no change was observed in the case of kaolinite. This observation is related to the higher hydrophilicity of illite as compared with kaolinite, and explains the different behaviors of the 2 clay families in oil reservoirs.

Key Words: Illite • Inverse Gas Chromatography • Kaolinite • Surface Energetic Heterogeneity • Water Adsorption

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