Release of Crude Oil from Silica and Calcium Carbonate Surfaces - DTU Orbit (09/11/2017)

Release of Crude Oil from Silica and Calcium Carbonate Surfaces: On the Alternation of Surface and Molecular Forces by High- and Low-Salinity Aqueous Salt Solutions

Adsorption and desorption of a North Sea crude oil to silica and calcium carbonate surfaces were studied by a quartz crystal microbalance, while the bare surfaces and adsorbed oil layers were characterized by atomic force microscopy and contact angle measurements. Water contact angles were measured on the bare surfaces, surfaces with an adsorbed oil layer, and surfaces after being exposed to aqueous salt solutions. This showed that the silica surface became more hydrophobic after oil adsorption, while the wettability of the calcium carbonate surface was not significantly changed by adsorption of an oil layer. A surface energy component analysis based on the acid base theory showed that oil adsorption on the surfaces depends upon apolar, acidic, and basic oil components of the crude oil and that the adsorbed oil components differ for adsorption to silica and calcium carbonate. Desorption of the crude oil was investigated by exposing the surfaces with an adsorbed oil layer to a series of NaCl and CaCl2 solutions of decreasing salt concentrations. Here, it was found that the oil release from silica was achieved only by injections of low-salinity solutions, and it is suggested that this observation is due to an expansion of the electrical double layer. The oil release from calcium carbonate was achieved by injection of both high- and low-salinity solutions of NaCl but not injection of a high-salinity solution of CaCl2. These observation are attributed to dissolution of calcium carbonate or reduction in ion bridging in the presence of high-salinity NaCl, while the low-salinity effect again was attributed to an expansion of the electrical double layer.

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