



Calcium Carbonate Crystal Growth in Porous Media, in the presence of Water Miscible and Non-Miscible Organic Fluids

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The deposition of sparingly soluble salts (scaling) within porous media is a major problem encountered in many industrial and environmental applications. In the oil industry scaling causes severe operational malfunctions and, therefore, increasing the total operating and maintenance cost [1]. The most common types of sparingly soluble salts located in oil fields include carbonate and sulfate salts of calcium, strontium and barium [1,2].

Multiple phase flow and tubing surface properties are some of the factors affecting scale formation [3]. The main purpose of the present work was the investigation of the precipitation mechanisms of calcium carbonate (CaCO_3) through in situ mixing of two soluble salt solutions in a flow granular medium, in the presence of water miscible organic fluid (ethylene glycol) or non-miscible organic fluid (n-dodecane). All series of experiments were carried out in a two dimensional porous medium made of Plexiglas. For all solutions used in the experiments, the contact angles with the surface of the porous medium and the interfacial tensions were measured.

During the experiments, the calcium carbonate crystal growth was continuously monitored and recorded through an optical microscope equipped with a digital programmed video camera. The snap-shots were taken within specific time intervals and their detailed procession gave information concerning the crystal growth rate and kinetics. The pH of the effluent was measured and fluids samples were collected for calcium analysis using Atomic Absorption Spectroscopy (AAS). In all experiments effluent calcium concentration decreased as a function of time, suggesting that CaCO_3 precipitation took place inside the porous medium. Crystals of the precipitated salt were identified using Infrared Spectroscopy (IR) and the morphology of the crystals was examined using Scanning Electron Microscopy (SEM).

The induction time for precipitation of CaCO_3 crystals in the presence of n-dodecane was significantly reduced compared to the induction time where no oil phase was present. The interface of n-dodecane and supersaturated solutions seems to be very active and favored the formation of the CaCO_3 crystalline enhancing the heterogeneous nucleation which generally demands a decreased energy barrier.

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