Influence of flow rates and copper (ii) ions on the kinetics of gypsum scale formation in pipes

S. Muryanto, author

Abstrak

Experiments were performed in a piping system to examine the effects of flow rates and Cu2+, a common metal ion in wastewater, on the kinetics of gypsum (CaSO4.2H2O) scale formation. The scaling was monitored by measuring the decrease in Ca2+ concentrations, [Ca2+], of the scaling solution. AAS analysis shows that [Ca2+] reduces progressively after a certain induction time, during which time the concentration remains steady. Thus, the gypsum precipitation which leads to scaling in pipes does not occur spontaneously. Higher impurity concentrations (0 to 10 ppm Cu2+) result in longer induction time (26 to 42 min), which indicate that Cu2+ could inhibit the scale formation. Impurity concentrations and the scale mass generated are negatively correlated. Reduction in scale mass was as high as 61% depending on impurity concentrations and flow rates. Data of [Ca2+] versus time were used to calculate the reaction rate of the gypsum precipitation which led to scaling. It was found that the reaction follows a first order kinetics with respect to [Ca2+], with rate constants ranging between 5.28 and 7.37 per hour, which agree with most published values for mineral scale formation.