

Role of solution hydrodynamics on the deposition of CaSO_4 scale on copper substrate

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ABSTRACT

The present investigation highlights the role of solution hydrodynamics on the deposition of calcium sulfate scale on copper substrate. The study was carried out using a rotating cylinder electrode (RCE) system at various pre-set rotational speeds, at 60 and 70°C on 120 and 600 grits polished cylindrical specimens. The effects of temperature, surface roughness, and flow conditions on the deposition of calcium sulfate scale on copper substrate are presented. The results indicate that the solution hydrodynamics play an important role on the rate of deposition of calcium sulfate scale on copper specimens. In addition, the analysis of scaling data further corroborated well with the theoretically predicted diffusion controlled process. Morphology of deposited crystals was obtained from scanning electron microscope (SEM) micrographs and composition was determined with energy dispersive X-ray spectrometer (EDS) method. SEM revealed prismatic needle- and rod-like crystals growth at nucleation sites branching out randomly over the substrate. The secondary growth on the already existing primary crystals of CaSO_4 was also seen. EDS confirmed the composition included Ca and S as expected. Furthermore, X-ray diffraction (XRD) analysis of scale showed hemi-hydrate ($\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$) form of gypsum.

Keywords: Scale; Calcium sulfate scale; CaSO_4 ; Hemihydrate; Gypsum; Copper; CaSO_4 on copper; Rotating cylinder electrode

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