Kinetic Study of Chalcopyrite Passivation During Electrochemical and Chemical Leaching

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A series of electrochemical and chemical leaching experiments has been carried out to clarify the role of solution potential and temperature under a variety of experimental conditions similar to those found during mesophilic and thermophilic bioleaching of chalcopyrite. Anodic characteristics showed that passivation of chalcopyrite was more severe at 25 deg C, and in the potential range 0.4 to 0.6 V (SCE). At 65 deg C there was no clear evidence of chalcopyrite passivation. During the anodic scan the chalcopyrite surface was polarized or altered in some manner by the formation of solid products. In order to test whether the formation of such polarized layers can impede the transport of ferric ions to the chalcopyrite surface, cathodic characteristics were determined. It was observed that the reduction of ferric ions was much slower when the surface was polarized at high potentials (above 0.55 V SCE). Results suggest that controlling the electrochemical conditions of the medium could counteract the passivation of chalcopyrite during bacterial leaching.

Based on these results a systematic kinetic study was then conducted with fine chalcopyrite grains by controlling the solution potential of the slurry via the addition of hydrogen peroxide. Results indicated that the oxidation rate of chalcopyrite was strongly dependent upon the solution potential (as dictated by the ratio of Fe(III) to Fe(II)). Maximum chalcopyrite dissolution occurred for a Fe(III)/Fe(II) ratio of about 5. At higher ratios, the leaching rate was markedly reduced. Elemental sulfur was formed over the whole of the solution potential range. In order to elucidate the exact role of elemental sulfur in the passivation of chalcopyrite, the residue of the ferric leaching was rinsed in carbon disulphide solution and releached. Results show the contribution of elemental sulfur to the passivation of chalcopyrite at various temperatures and solution potentials.