The Passivation of Iron during the Leaching of Pre-Reduced Laterites in Ammoniacal Solutions

Aleks Nikoloski, Michael J Nicol and John Fittock[#]
Extractive Metallurgy, Murdoch University
South Street, Murdoch, Western Australia
[#] QNI Ltd, Townsville, Queensland, Australia

This paper summarizes the results of a detailed electrochemical study of the behavior of iron and its alloys with nickel and cobalt in ammoniacal carbonate solutions with a composition similar to that encountered in plants using the current version of the Caron process.

On the basis of voltammetric measurements and of open circuit potential measurements as a function of time, with the use of rotating iron disc electrodes, it was shown that iron passivates in aerated solutions which contain nickel and cobalt ions together with thiosulphate. Scanning electron microscopy and energy dispersive X-ray analyses reveal the presence of a cobalt/nickel sulphide layer on the surface of the freshly passivated electrode. After several hours in the passive state the sulphide layer gradually re-dissolves, leaving behind only the passive iron oxide surface.

It is proposed that in addition to dissolved oxygen, both thiosulphate and cobaltic ions act as the oxidizing agents in the dissolution process. The sulphide layer is formed on the iron and the alloys as a result of the reduction of thiosulphate at the surface. It is suggested that the passivation occurs as a result of the inhibition of the anodic reaction by the presence of the metal sulphide layer.

It has been demonstrated that the reduction of water does not contribute the dissolution. The rate of dissolution has been studied as a function of time in the pre-passive state and the results have been interpreted in terms of a mixed-potential model for the process.