Effect of galena on thiosulfate leaching of gold

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Abstract

Galena and reference quartz were artificially added into the ammoniacal thiosulfate solution to clarify the role of galena on thiosulfate leaching of gold. The effects of galena on thiosulfate decomposition and gold leaching and the possible effect mechanisms were studied by the thermodynamic calculation, leaching tests, SEM-EDS and XPS analyses. Results showed that from the onset of gold leaching, the leaching kinetics was restricted severely in the presence of galena. This is caused by the fact that galena is easily oxidized by copper(II) and the dissolved oxygen, thus the mixed slurry potentials initially experienced a significant decline to relatively stable lower levels of 230~240mV which are nearly 50mV lower than that of the quartz slurry. This is disadvantageous to gold leaching and results in undesirable gold dissolutions during the process. The results suggest that the decrease of slurry potentials from the presence of galena is the principal cause of a reduction in the gold leaching rate.

Key words: thiosulfate; gold leaching; galena; passivation

1 Introduction

Due to the increasing environmental concerns over cyanidation in the extractive metallurgy of gold, considerable attention has been dedicated to the study of alternative non-cyanide lixiviants for gold leaching. Thiosulfate, one of the most promising of these alternatives to cyanide, has been recognized as a potentially viable alternative lixiviant because it is nontoxic and inexpensive, and it can generate relatively strong gold complexes and promptly leach gold ores when catalyzed by cupric ions (Aylmore and Muir, 2005, 2001a; Xu, et al., 2016a; Zhang and Nicol, 2003). Its industrial application, however, is still rare today. The limiting factors which hinder the development and application of the technology are mainly the high consumption of thiosulfate and the passivation of gold (Chen, 2001; Jeffrey, et al., 2008; Senanayake, 2004; Wan and LeVier, 2003; Xu, et al., 2015).

Since gold leaching has been increasingly focused on complex gold ores, the successful application of gold leaching with thiosulfate is determined not only by the dissolution behavior of gold, but also by the impacts of the associated minerals (Feng and van Deventer, 2010). Commonly, pyrite, arsenopyrite, sphalerite, chalcopyrite and other copper sulfide minerals can be dissolved in varying degrees in oxidative thiosulfate solutions, especially when ammonia is in solution (Alonso-Gómez and Lapidus, 2009; Feng and van Deventer, 2002a; Ghosh, et al., 2003, 2002; Gong, et al., 1993; Sarveswara Rao and Ray, 1998; Chen, 2008; Xu, et al., 2016b, 2014). The presence of those associated minerals can influence the thiosulfate stability possibly through their semi-conductive properties, and the dissolutions of them retard the gold leaching kinetics by producing passivation layers at gold surfaces (Feng and van Deventer, 2003). Therefore, studying the effects of associated minerals on gold leaching with thiosulfate is of great importance.

The presence of pyrite, arsenopyrite and hematite could significantly diminish the dissolution of gold and catalyze the oxidative decomposition of thiosulfate to polythionates with oxygen