EXTRACTION OF COPPER AT ELEVATED FEED CONCENTRATIONS

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ABSTRACT

A number of flowsheets have been designed and operated, or are currently being considered, to extract copper from leach solutions having much more copper than the 4 g/L levels typically found in heap leach liquors. Dealing with these solutions has required that the envelope for "normal" copper solvent extraction be pushed beyond the usually considered limits. Others have published information on flowsheets to recover copper from leach liquors containing over 25 g/L copper. Secondary solvent extraction circuits are often required to attain satisfactory overall recoveries. This paper reviews some of the issues faced in three pilot plant circuits that were operated by SGS Lakefield Research to produce cathode copper from solutions containing 8 to 20 g/L Cu. The primary objective was to maximize copper extraction using one solvent extraction circuit. The role of feed acidity and the disposition of impurities such as iron and chloride are considered. The challenges of running short SX piloting campaigns are discussed.

INTRODUCTION

Copper solvent extraction was originally developed in the 1960's to recover copper from relatively dilute leach solutions, typically heap leach liquors with copper tenors in the 1 to 4 g/L range. The use of the standard oxime reagents has become an accepted unit operation for this application. In designing circuits to treat 4 g/L copper liquors, a minimum of testwork is generally carried out. The two principal reagent manufacturers, Cognis (LIX reagents) and Avecia (Acorga reagents) have extensive application databases from which they can draw to predict the performance of their reagents with a particular copper SX feed. They both have software to generate equilibrium isotherms used to predict staging requirements. The extraction and stripping kinetics of oxime-based reagents have been extensively investigated and are well understood by the manufacturers. Their databases and the experience of their personnel allows them to recommend and specify reagent schemes, circuit layouts and process design parameters.

In more recent years hydrometallurgy is finding wider application in the treatment of complex ores that contain copper. Very often, the plant will need to process a sulphide concentrate rather than an oxidised copper ore that is readily leached at ambient conditions. It is probably going to be using more aggressive oxidative leaching methods, for example, oxygen pressure leaching. Higher percent solids are employed in the leaching stages both to keep plant sizes as small as practically possible, and to ensure that the heating requirements of the process are being fully met by oxidising the available sulphur. This results in more concentrated leach liquors with higher metal tenors than those produced in heap leaching.

The leaching processes employed produce solutions containing copper and other metal values, for example nickel or PGM, that may be sequentially recovered. Often, the overall economic feasibility of the project requires the recovery of more than one of the metals in solution.

Copper solvent extraction has been adapted to deal with the leach liquors from a number of these flowsheets, some of which have been or are currently operating. The challenges to conventional solvent extraction posed by leach liquors from concentrates have been discussed by Kordosky [1] and Tinkler [2]. Compared with heap leach liquors, the differences can be summarised as follows:

- higher copper tenors, typically over 20 g/L (and even up to 40 g/L);
- more iron in the pregnant leach solution (PLS), and generally wider range of other metals often present at concentrations comparable to copper.

This in turn presents a number of challenges in the design of the flowsheet. A description of the principal ones, which is by no means exhaustive, follows. Many of the factors are interrelated, and will affect other parts of the flowsheet as well each other.