Practical implementation of the bacterial oxidation process of refractory gold ores

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Abstract

The effective treatment of refractory arsenopyritic gold ore is of growing significance, especially in countries such as Australia where many of the more readily accessible oxide deposits are approaching depletion. Traditionally these ores were subjected to roasting to liberate the occluded gold, often with preconcentration by flotation.

Bacterial oxidation is gaining increasing application as an important viable treatment process for refractory ores, providing benefits in cost, performance, and environmental aspects. Design of current large scale bacterial oxidation plants has presented new challenges to the engineer, particularly in materials selections and construction techniques for handling the corrosive pulps at low pH levels and elevated temperatures.

Reference is made in this paper to the experience gained from the recently completed Wiluna sulphide project in Western Australia, which when commissioned was the world's largest bacterial gold treatment plant with full sulphide oxidation.

Keywords: Arsenopyrite, bacterial leaching, refractory gold ores, sulphide oxidation.

1. Introduction

Refractory gold ores historically have produced only 30%-40% recovery when treated with cyanide for a typical grind of 70% to 80% minus 75 microns. Some recoveries have been considerably lower.

The commonly used pretreatment of refractory ores is by roasting and this process has been in operation since the turn of the century.
Roasting of concentrates or ore containing arsenopyrites requires a stage of roasting which leads to increased capital and operating costs.

In recent times, SO₂ producing processes such as roasting have become more and more environmentally unacceptable worldwide. Alternatives to roasting have been investigated for the past 20 years. These alternatives include the bacterial oxidation of refractory ores.

Against this background Asarco investigated the available processes to treat their refractory type ore reserves at Wiluna in Western Australia.

2. Wiluna gold mine: brief history

Gold was first found in the Wiluna area in 1896, but the main Wiluna orebodies were not discovered until 1903. Oxidised ore was mined from 1904 until 1911 when attempts to treat arsenic ores were unsuccessful.

Mining recommenced in 1931 with refractory underground ores being roasted.

Operations ceased in 1947.

The area was again explored by Asarco from 1982 and a 3 million tonne oxide ore reserve was established by 1985.

In 1984 a tails retreatment plant was commissioned and in 1986 a CIP plant was constructed. In 1989 the CIP plant was expanded from 400,000t/a to 1,000,000t/a and the tails retreatment plant was expanded to 300,000t/a.

From 1904 to 1992 over 16 million tonnes of gold ore were mined at Wiluna producing almost 3 million ounces.

3. Wiluna sulphide project

3.1 Process Selection

In the late 1980's with the depletion of their oxide reserves, Asarco investigated alternative processes to treat their proven sulphide reserves of 2,000,000 tonnes.

Testwork was commissioned for the following process routes:

• fine grinding
• whole-ore and concentrate roasting
• bio-oxidation
• pressure oxidation

Asarco established the following criteria for determining the most suitable process route for their Wiluna sulphide ores:

• amenability of the ore to the selected process route
• high gold recoveries
• a proven operating process
• operating costs consistent with the reserve head grade