Environmental impact of increasing production of gold from hydrothermal resources

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Abstract
As the Witwatersrand Basin of South Africa loses its dominance in world gold production, and production from hydrothermal resources continues to increase so there is an upward trend in the exploitation of the so-called refractory zones associated with these deposits.

These ores are pyritic in nature, often containing appreciable quantities of arsenic as arsenopyrite. Much of the gold is occluded in the crystal structure of the sulphide minerals, particularly the arsenopyrite. As a consequence, a much higher level of processing is required when compared to conventional "oxidised" ores, with greater pressure on the environment.

Together with this trend in gold production, significant advancements have been made in the development of alternative recovery technologies. From the environmentally hazardous Edwards roasters through the more sophisticated fluosolids system, to second generation hydrometallurgical processes of pressure and biological oxidation.

The paper demonstrates how technological developments have not only been driven by the normal quest for lower costs and higher recoveries, but in this case by consideration for plant safety and the environment. The modern plant is considered "environmentally safe" with respect to current discharges. However, will they be just as safe in the long term?

Keywords: Refractory gold, environment, bacterial oxidation, pressure oxidation.

1 Introduction

Western world production of gold has been increasing rapidly over the past few years, and growth is expected to average some 4% per year over the 10 year period '86 to '96. During this period the Witwatersrand Basin's share of production has decreased from 49% in 1986 to 34% in 1993, and is expected to decline further to some 30% by 1996/97.

Production from resources outside the Witwatersrand Basin is predominantly from so-called hydrothermal deposits. These deposits are generally pyritic in nature often containing appreciable quantities of arsenic as arsenopyrite. More often than not the gold is locked into the crystal structure of the sulphide mineral and is difficult to extract by cyanidation. Thus the term refractory.
Impact of gold production from hydrothermal resources

Currently most of the gold produced from hydrothermal deposits emanates from the surface oxidised zones and at this stage they do not give rise to processing difficulties. As these zones become depleted and the mines move deeper into the sulphide zones so we are seeing a rapid increase in production from the refractory sulphides. Figure 1 compares the growth in production from refractory ores with overall growth in the western world's newly mined gold. This figure illustrates an average growth rate from refractory gold of some three times that of overall rate of increase in production.

Fig. 1 Comparison of refractory versus total gold

2 Basic Mineralogy of Refractory Ores

The gold contained in the sulphide zones of a hydrothermal type deposit is generally associated with the minerals pyrite, arsenopyrite and pyrrhotite.