

ABSTRAK

STUDI KOMPARASI PERILAKU PELINDIAN EMAS PADA BIJIH EMAS KADAR RENDAH BERTIPE *LOW-SULFIDATION* MENGGUNAKAN *UMPAN FRESH ORE* DAN KONSENTRAT FLOTASI

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Harga emas di pasar dunia dalam beberapa tahun terakhir menunjukkan peningkatan yang signifikan sehingga mendorong industri pertambangan untuk meningkatkan efisiensi pengolahan bijih emas, khususnya pada bijih berkadar rendah yang semakin banyak ditambang. Salah satu pendekatan yang dapat dilakukan adalah melalui evaluasi rute proses pengolahan yang tepat berdasarkan karakteristik mineralogi bijih. Pada sistem endapan epithermal bertipe low-sulfidation, emas umumnya berasosiasi dengan mineral silika sehingga dapat mempengaruhi efektivitas proses ekstraksi. Penelitian ini bertujuan untuk mengevaluasi kinerja proses flotasi dalam meningkatkan kadar emas serta menganalisis perilaku pelindian sianida pada *fresh ore* dan konsentrat flotasi, serta membandingkan efisiensi teknis dan ekonomi dari kedua rute pengolahan tersebut.

Penelitian dilakukan melalui analisis karakteristik mineralogi, pengujian flotasi, serta pengujian pelindian menggunakan metode *Intermittent Bottle Roll Test* (IBRT) dan *Diagnostic Leach Test* (DLT). Analisis kinetika pelindian dilakukan menggunakan pendekatan *Shrinking Core Model* (SCM), sedangkan analisis statistik menggunakan desain percobaan faktorial 2^2 dengan variasi konsentrasi NaCN (300 ppm dan 600 ppm) serta persen padatan (35% dan 45%). Hasil analisis mineralogi menunjukkan bahwa bijih didominasi oleh mineral silika sebesar 81,4%, terutama kuarsa, dengan kandungan mineral sulfida sekitar 4%, yang mengindikasikan bahwa emas sebagian besar hadir sebagai inklusi dalam mineral silika sehingga memiliki aksesibilitas rendah terhadap proses pelindian.

Hasil pengujian flotasi menunjukkan bahwa proses tersebut meningkatkan kadar logam yang berasosiasi dengan mineral sulfida, namun peningkatan perolehan emas relatif terbatas. Hasil pelindian selama 24 jam menunjukkan bahwa *fresh ore* menghasilkan

ekstraksi emas sebesar 54,83%, sedangkan konsentrat flotasi sebesar 45,35%. Analisis kinetika menunjukkan bahwa laju pelindian pada kedua sampel dikontrol oleh mekanisme *ash layer diffusion control*. Secara keseluruhan, pelindian langsung terhadap *fresh ore* memberikan kinerja yang lebih baik dibandingkan rute flotasi yang diikuti sianidasi, baik dari aspek teknis maupun ekonomi.

Kata kunci: Bijih emas kadar rendah, *low-sulfidation*, flotasi, sianidasi emas, kinetika pelindian.

ABSTRACT

COMPARATIVE STUDY OF GOLD LEACHING BEHAVIOR OF LOW SULFIDATION LOW-GRADE ORE USING FRESH ORE AND FLOTATION CONCENTRATE FEEDS

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Gold prices in the global market have shown a significant increasing trend in recent years, encouraging the mining industry to improve the efficiency of gold ore processing, particularly for low-grade ores that are increasingly being mined. One approach that can be undertaken is the evaluation of appropriate processing routes based on the mineralogical characteristics of the ore. In epithermal deposits of the low-sulfidation type, gold is generally associated with silica minerals, which may affect the effectiveness of the extraction process. This study aims to evaluate the performance of the flotation process in increasing gold grade, as well as to analyze the cyanide leaching behavior of fresh ore and flotation concentrate, and to compare the technical and economic efficiency of both processing routes.

The study was conducted through mineralogical characterization, flotation testing, and leaching experiments using the Intermittent Bottle Roll Test (IBRT) and Diagnostic Leach Test (DLT) methods. Leaching kinetics analysis was carried out using the Shrinking Core Model (SCM), while statistical analysis was performed using a 2² factorial experimental design with variations in NaCN concentration (300 ppm and 600 ppm) and solid percentage (35% and 45%). Mineralogical analysis results indicate that the ore is dominated by silica minerals at 81.4%, mainly quartz, with sulfide minerals of approximately 4%, suggesting that gold is mostly present as inclusions within silica minerals, resulting in relatively low accessibility to the leaching process.

The flotation test results show that the process increases the grade of metals associated with sulfide minerals; however, the improvement in gold recovery is relatively limited. The leaching results after 24 hours indicate that fresh ore achieved a gold extraction of 54.83%,

while the flotation concentrate achieved 45.35%. Kinetic analysis shows that the leaching rate in both samples is controlled by the ash layer diffusion control mechanism. Overall, direct leaching of fresh ore provides better performance than the flotation route followed by cyanidation, both in terms of technical and economic aspects.

Keywords: *Low-grade gold ore, low-sulfidation, flotation, gold cyanidation, leaching kinetics.*