

ABSTRAK

PENGARUH *OXYGEN SHEAR REACTOR* (OSR) TERHADAP KINETIKA DAN PERSEN EKSTRAKSI EMAS PADA PROSES SIANIDASI DENGAN METODE UJI AGITASI

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Kenaikan harga emas global sebesar 44% dalam satu tahun terakhir (USD 2.324/*troy ounce* pada 2024 menjadi USD 3.345/*troy ounce* per Juni 2025) mendorong industri pertambangan untuk meningkatkan efisiensi pengolahan bijih emas, termasuk pada bijih dengan karakteristik refraktori. Sebagai bagian dari upaya tersebut, dilakukan peningkatan sistem pemberian oksigen dari *sparger lance* menjadi *oxygen shear reactor* (OSR) untuk mengoptimalkan pelindian berbasis sianida. Penelitian ini bertujuan untuk mengevaluasi pengaruh teknologi OSR terhadap persen perolehan emas dan karakteristik kinetika pelindian dibandingkan *sparger lance* dengan metode semi-laboratorium *plant* di PT Meares Sopotan Mining. Analisis dilakukan menggunakan pendekatan *Shrinking Core Model* (SCM) dan model Crundwell, Ling, Andrade de Lima, Mintek, KBK Model, Loveday, serta validasi statistik melalui nilai R^2 , RMSE, dan MAE. Hasil menunjukkan bahwa OSR memberikan perolehan emas rata-rata 89,58% setelah 24 jam pelindian, lebih tinggi dibandingkan *sparger lance* sebesar 86,47%, namun secara statistik ($p = 0,315$) memiliki perbedaan tidak signifikan. Pengendali laju reaksi menggunakan SCM dikontrol pada *rate diffusion control* baik pada *sparger lance* maupun OSR. Model Crundwell menunjukkan kecocokan tertinggi dengan nilai $R^2 > 0,99$, RMSE sebesar 0,012, dan MAE sebesar 0,009. Analisis korelasi menunjukkan bahwa OSR memiliki hubungan positif terhadap kandungan emas dalam sulfida baik pada *residence time* ($r = 0,30$) maupun 24 jam pelindian ($r = 0,45$), sedangkan *sparger lance* menunjukkan korelasi lebih tinggi pada tahap awal ($r = 0,52$) namun negatif pada pelindian lanjutan ($r = -0,36$). Dengan demikian, Teknologi *oxygen shear reactor* (OSR) menunjukkan keunggulan teknis dibandingkan *sparger lance* dalam pelindian jangka panjang terhadap bijih bersulfida tinggi

Kata kunci: Kinetika Pelindian, *Oxygen Shear Reactor*, Sianidasi Emas, *Sparger Lance*

ABSTRACT

THE EFFECT OF OXYGEN SHEAR REACTOR (OSR) ON GOLD LEACHING KINETICS AND EXTRACTION PERCENTAGE IN CYANIDATION PROCESS USING AGITATION TEST METHOD

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The global gold price has increased by 44% over the past year, rising from USD 2,324/troy ounce in 2024 to USD 3,345/troy ounce by June 2025. This surge has prompted the mining industry to enhance processing efficiency, particularly for refractory gold ores. As part of this effort, the oxygen delivery system at PT Meares Soputan Mining was upgraded from sparger lance to oxygen shear reactor (OSR) to optimize cyanide-based leaching. This study aims to evaluate the impact of OSR technology on gold recovery and leaching kinetics compared to sparger lance under real operational conditions. Kinetic analysis was conducted using the Shrinking Core Model (SCM) and six mathematical models (Crundwell, Ling, Andrade de Lima, Mintek, KBK, and Loveday) with statistical validation through R^2 , RMSE, and MAE. Results showed that OSR achieved an average gold recovery of 89.58% after 24 hours, higher than sparger lance at 86.47%, although the difference was statistically insignificant ($p = 0.315$). SCM analysis indicated that the reaction rate for both systems was controlled by diffusion. Crundwell's model provided the best fit, with $R^2 > 0.99$, RMSE of 0.012, and MAE of 0.009. Correlation analysis revealed that OSR exhibited a positive relationship with gold content in sulfide minerals at both residence time ($r = 0.30$) and 24-hour leaching ($r = 0.45$), while sparger lance showed a stronger correlation at the initial stage ($r = 0.52$) but a negative correlation during extended leaching ($r = -0.36$). These findings demonstrate that OSR is technically superior in processing sulfide-rich ores due to its high shear forces and enhanced oxidation of passivation layers, offering greater stability across varying mineralogical conditions.

Keywords: Cyanidation, Gold Leaching Kinetics, Oxygen Shear Reactor, Sparger Lance