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Beneficiation of Recycled Process Water at DRDGOLD's ERGO Brakpan Plant and Evaluating its Effect on Gold Recovery

MSc Thesis

by

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EXECUTIVE SUMMARY

In January 2019, DRDGOLD had implemented a 38 % decrease in externally sourced water, produced by Rand Water, resulting in the amplified utilisation of process water. ERGO Brakpan's Metallurgical Laboratory has however shown improved gold recoveries when utilising potable water over process water in laboratory test work. The overall impact of utilising process water is twofold; a reduction in gold recovery due to an accumulation of contaminants within the process water, as well as penalties imposed due to effluent water and tails discharge streams exceeding allowable contaminant concentrations. To improve the understanding of the effect of water quality on gold leaching and gold recovery, strategies for the beneficiation of the process water at the ERGO Brakpan gold mine operations are presented.

Laboratory scale leach test work showed a significant improvement in gold recoveries between the use of potable water, used as a benchmark, and untreated process water. A two-sample t-test undertaken on the respective leach results confirmed a significant difference in gold recoveries between the use of potable water and untreated process water.

Atomic absorption analysis of ERGO Brakpan's process water, confirmed the presence of appreciable concentrations of heavy metals identified as iron (Fe), nickel (Ni), zinc (Zn) and manganese (Mn). A study of the effect of these identified contaminants on gold recovery was undertaken by spiking potable water with a known concentration of the respective contaminant. Leach tests showed that iron, nickel and zinc have the largest negative effect on gold recovery, with iron and nickel having a greater detrimental effect on gold recovery than zinc.

Other contaminants present within ERGO Brakpan's process water were sulfate and calcium (Ca). Sulfates were shown to have a possible passivation effect, which negatively influenced gold recoveries; however, this was to a lesser extent than that caused by the heavy metals. Calcium, when found in excess, showed an increase in gold recovery indicating the possible formation of a calcium aurocyanide complex.

Lime softening was shown as efficient in the reduction of heavy metal concentration by metal hydroxide precipitation as well as showing a reduction in sulfate concentration by the precipitation of gypsum. Lime softened process water was shown to produce similar gold recoveries as potable water and was an attractive beneficiation option as it is readily available at the ERGO Brakpan plant.

The effect of lime treated process water at elevated temperatures showed improved gold recoveries; however, the heating requirement for the plants daily consumption of 60 Ml/day would not be economically viable.

An economic study for the potential full-scale installation of a lime treatment process and gypsum crystallization for treatment of 20 Ml/day of process water showed an estimated CAPEX of R49 085 809 and an estimated monthly OPEX of R1 521 408. A discounted cash flow analysis showed a Net Present Value of approximately R330 000 000 within the project life with an internal rate of return of 76 %, which far exceeded the project's discount rate of 10%.