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Beneficiation of pulp mill waste green liquor dregs: applications in treatment of acid mine drainage as new disposal solution in South Africa

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Abstract

Acid mine Drainage (AMD) is a low pH, sulphate and heavy metal rich leachate that is produced from oxidation of sulphide bearing minerals commonly found in the host rocks of some mineral ores. The pH augmentation, and sulphate and metal removal in AMD is often achieved by adding alkaline reagents in it. CaCO_3 and/or its derivatives are commonly used for this purpose due to their abundance and affordability as compared to other neutralizing reagents. The problems associated with the use of this naturally occurring reagent do not only include the emission of greenhouse gases and ecological disturbances but also include a disastrous implication of depleting their reserves. To avoid these predicaments, green liquor dregs (GLD) from two Kraft pulp manufactures in South Africa were used as alternative alkaline reagents to neutralize AMD originating from Witwatersrand goldfields in Johannesburg. These GLD samples were referred to as GLD A and B. CaCO_3 was used as a reference material. The GLD samples had neutralizing values that are comparable to that of CaCO_3 . Thus, CaCO_3 , GLD A, and GLD B had a neutralizing value of, 26.0, 21.2, and 21.0 % CaO respectively. Different dosages 1, 2, 6, 10, and 20 g/L of these neutralizing reagents were used to neutralize the AMD. Results of this study showed that raising the pH of AMD was possible even at a low dosages of 1 g/L. At this dosage, the acidity of the AMD sample changed from 183.36 to 21.7, 36.4, and 48.72 mg/L CaCO_3 , and changed the pH from 5.6 to 8.84, 8.21, and 8.0 respectively. However, the SO_4^{2-} and Ec had increased from 2093 to 2360, 2538, and 2407 mg/L and from 3.6 to 4.0, 4.3, 4.2 mS/cm respectively, indicating that caution should be taken to keep these values low by keeping the reagent dosage low and being cognizant of the carbonate mineral present in GLD. The x-ray diffraction patterns of the reacted samples confirmed the presence of metal oxides and Ca and Mg compounds that were depicted by SEM/EDX micrographs. In conclusion, the results from this study showed that the pH of AMD can be raised to optimum pH process value and reduce the acidity at a low dosage, a competitive advantage over commercial CaCO_3 . The proposed concept can be adopted by both the mining and pulp and paper industries, for the upscaling of co-disposing GLD and AMD contaminants as an eco-friendly alternative for the CaCO_3 .