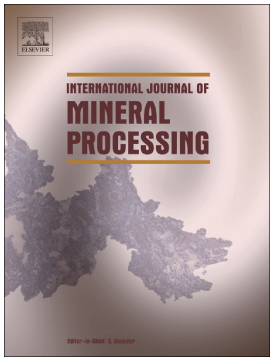

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PROCESS SIMULATION AND EXERGY ANALYSIS OF TWO NICKEL LATERITE PROCESSING TECHNOLOGIES

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ABSTRACT

The results have been presented for the process simulation and exergy analysis on two different nickel laterite processing routes. These are ferronickel production and high pressure acid leaching (HPAL). An exergy analysis undertaken using the simulation results. The process simulation was carried out by Aspen Plus with inputs from thermodynamic simulation of selective sub-processes using Factsage software. The exergy analysis includes the overall processing circuit as well as individual sub-processes. Furthermore, the exergy efficiency for the Ferronickel processing route was determined for the case of having a heat recovery steam generator (HRSG) and one without. The combination of performing overall process simulations, thermodynamic simulation of sub-processes and performing an exergy analysis is a new way to integrate these three approaches and knowledge that will benefit especially those working in mineral processing. It was found that the HPAL unit processes are relatively high in efficiency except for ammonium sulphate recovery (58.1% and 71.4%) due to heat required to concentrate and recrystallize the compound. The efficiencies of the Ferronickel unit processes are affected by the operating temperature. HRSGs are added to the downstream unit processes to recover waste heat generated from the flare and slag/matte cooling, giving a higher exergy efficiency of 91.2% and 94% respectively.

KEYWORDS

Exergy Analysis, Metal Production, Nickel, Process Modelling, Energy Efficiency

1. INTRODUCTION

1.1 The Nickel Industry

The production of nickel has increased over the past decade due to increase in demand for nickel and stainless steel for architectural applications and technology advancement. According to McDonald and Whittington (2008), there is an average growth rate of 4% per annum in the demand for nickel from 1950 up to recent years. Nickel was mostly extracted from nickel sulphides though it was the lesser reserve (40%) of nickel ores as sulphides were easier to process (Jessup and Mudd, 2008). However, as these sulphide based reserves are slowly depleting, there is an increasing interest towards processing abundant nickel laterite deposits (Agatzini-Leonardou et al., 2009).

Even though mining laterite ores are generally low cost using open pit mining techniques (Stopic and Friedrich, 2004), the processing of laterites tends to be more energy intensive due to the complexity of processing steps and mineralogy of the laterite ore (Mishra, 2001). Therefore, this paper aims to study the efficiency of nickel laterite processing routes through the means of exergy analysis. The exergy concept will be explained in section 1.2.

Two nickel laterite processing routes were chosen (Ferronickel and HPAL). Low grade laterite ores, normally limonitic ores, are mostly processed through hydrometallurgical means as