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PII: S0959-6526(16)31963-1
DOI: 10.1016/j.jclepro.2016.11.111
Reference: JCLP 8500

To appear in: Journal of Cleaner Production

Received Date: 19 August 2016
Revised Date: 16 November 2016
Accepted Date: 17 November 2016


This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
A LIFE CYCLE ASSESSMENT OF A NEW LATERITE PROCESSING TECHNOLOGY

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ABSTRACT

This paper presents a life cycle assessment (LCA) study of three nickel laterite processing technologies. The main goal was to quantify selected environmental impact categories and to compare and analyse each impact category for three different nickel feedstock for stainless steel production. The nickel laterite processing routes were (1) high pressure acid leaching (HPAL), (2) ferronickel, and (3) the newly developed Direct Nickel (DNi Process) that involves atmospheric leaching of nickel laterite using nitric acid. A cradle to gate approach was adopted. A functional unit of one tonne stainless steel was chosen. The scope covered was from laterite ore mining to final metal production. All inventory data was expressed in units per tonne nickel-based feedstock. The flow sheets for each technology were developed and the system boundaries were clearly defined. It was found that Ferronickel has the highest global warming potential and non-renewable energy scores whereas HPAL has the highest water depletion score. Overall, the DNi Process is found to be a more sustainable processing route as it produces less airborne emissions compared to the other two routes. Nitric acid is also less toxic compared to sulphuric acid used in HPAL. The DNi Process is also able to process different types of laterite ores (from limonitic to saprolitic ores) which is an important feature for future nickel production.

KEYWORDS

Sustainable Development, Life Cycle Assessment, Metal Production, Environmental Impacts, Nickel Processing, Stainless Steel Production

INTRODUCTION

1.1 Nickel Processing Technology

Nickel plays an important role in over 300,000 products for consumer, industrial, military, transport, aerospace, marine and architectural applications (Nickel Institute, 2013). The most abundant sources of naturally occurring nickel are nickel laterites and nickel sulphides. About 60\% of nickel ore is found in the form of laterite deposits and the remaining 40\% are sulphides (Jessup and Mudd, 2008). Laterites are usually formed near the surface by the weathering of ultramafics which are iron and magnesium rich rocks. Thus, laterites can mostly be mined via the surface (open-pit) mining method. The principal nickel-containing minerals in laterites are
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