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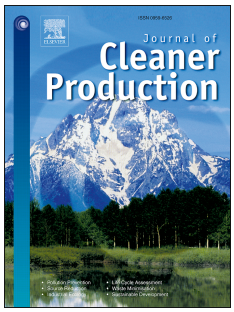

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PII: S0959-6526(18)30997-1

DOI: 10.1016/j.jclepro.2018.03.309

Reference: JCLP 12567

To appear in: *Journal of Cleaner Production*

Received Date: 2 December 2017

Revised Date: 29 March 2018

Accepted Date: 30 March 2018

Please cite this article as: Mohammed F, Biswas W, Yao H, Tadé M, Sustainability assessment of symbiotic processes for the reuse of phosphogypsum, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.03.309.

Sustainability Assessment of Symbiotic Processes for the Reuse of Phosphogypsum

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ABSTRACT

The conversion of by-products to resources is a novel approach for enhancing circular economy through increasing the lifecycle of resources, however, it does not always achieve sustainability outcomes. A life cycle assessment has been conducted to assess the economic and environmental implications of the conversion of phosphogypsum, which is a by-product from phosphoric acid manufacture, to useful resources such as paper and fertilizer. The current research found that the phosphogypsum based paper and fertilizer are neither environmentally nor economically better than conventional products due to the raw materials used that leads to higher environmental impact and economic cost. However, phosphogypsum based products offers some social benefits such as additional employment creation and enhanced intergenerational equity. Further investigation into chemical process design in terms of reagent selection for precipitation reactions is needed to achieve the economic and environmental feasibility of the products based on these by-products.

Keywords: Solid by-products, industrial symbiosis, triple bottom line analysis

1. INTRODUCTION

Phosphoric acid is mainly utilised in the production of phosphate fertilisers, which means it is vital for crop production and of key economic importance. More than 90% of phosphoric acid produced worldwide is derived from the wet acid process (Tayibi et al., 2009) the phosphate rock digestion by sulphuric acid. However, the major by-product from phosphate rock digestion by sulphuric acid is phosphogypsum ($Ca_2SO_4.2H_2O$) as described through Equation 1.

$$Ca_5F(PO_4)_3 + 5H_2SO_4 + 10H_2O \rightarrow 3H_3PO_4 + 5CaSO_4.2H_2O + HF \quad (1)$$