

Environmental Performance Comparison of Wet and Thermal Routes for Phosphate Fertilizer Production Using LCI – A Brazilian Experience

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Phosphorous plays a fundamental role in any crop's growth. Therefore this element's main use is for fertilizer production. The most frequently used raw material for phosphate fertilizer manufacture is phosphate rock which main mineral is fluorapatite - $\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$. In this form phosphorous is not available for ready absorption by vegetals requiring further industrial processing to make it accessible for them. The processes used for this transformation can be divided into two major groups: the thermal route and the wet sulfuric route. In the thermal route, fluorapatite's crystalline structure is modified by a thermal action, producing soluble phosphate compounds known as Fused Magnesium Phosphate (FMP).

FMP has an alkaline characteristic very adequate for acid soils (which is the case in most of the Brazilian agriculturable areas). Their slow nutrient release is also favorable for many crops grown in this country. Nevertheless the thermal route presents a major disadvantage being very energy intensive.

In the wet sulfuric route, the phosphate rock is digested by sulfuric acid yielding as main products Single Superphosphate (SSP) or phosphoric acid, an intermediate used for the manufacture of Triple Superphosphate (TSP) and Ammonium Phosphates.

Environmentally speaking, the sulfuric route's main disadvantages are the consumption of elemental sulfur - a non-renewable natural resource used for the sulfuric acid production - and in the phosphoric acid production, the generation of phosphogypsum - a solid residue - whose disposal may cause, as environmental impacts, underground waters contamination and intensive land use.

In this context, this work intends to compare the environmental performance of the wet sulfuric route and the thermal route.

LCA was the methodology selected for this comparison as it is the most powerful tool for environmental comparison of products that fulfill the same function.

To perform this comparison, the environmental impact profiles were established using a "cradle to gate" LCA approach for TSP and FMP chosen as reference products respectively for wet and thermal routes.