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Characterization of crystallized struvite on wastewater treatment equipment: Prospects for crystal fertilizer production

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ABSTRACT

With over-mining of the natural rock-P, food production will plummet sooner than we envisage since they are essential in agro-industry but are non-renewable. Hence, phosphate fertilizers are going to be limited in future. Struvite is a crystalline mineral substance containing equimolar amount (1:1:1) of magnesium and ammonium phosphate(V) ($MgNH_4PO_4 \cdot 6H_2O$), a good source of phosphorus and a slow-release fertilizer. In this study, a sample of the struvite formed in the wastewater treatment equipment of Kilang Kelapa Sawit, Sri Senggora (Palm Oil Mill at Pahang, Malaysia) was collected and characterized to determine its suitability for use as a slow-release fertilizer for agricultural purposes. The formation of struvite in the sewage pipes of wastewater treatment facility causes bottlenecks in the operation of the plant and results in reduced pumping efficiencies and high cost of overall plant maintenance. Due to the P, N and Mg content in the palm oil wastewater streams, struvite formation is triggered, and the treatment equipment are clogged as the struvite precipitates and builds up. The results of the characterization of the struvite through SEM-EDX, FTIR, XRD and TG-DTA/DSC analyses give the morphology and atomic percentage of the different elemental composition, the absorption pattern of the different functional groups, the orthorhombic crystal structure arrangement and the loss of mass against temperature respectively. The results indicate that high quality and large quantity struvite can be recovered from the palm oil wastewater streams. The recovery of struvite will reduce the BOD and COD of the wastewater stream resulting in plant size reduction, small land space requirements and reduced cost. This phenomenon being eco-recycling of phosphorus will serve as a sustainable approach towards food security and can help mitigate the problem of eutrophication.

Keywords: Struvite; Phosphorus; eco-recycling; crystal fertilizer; POME; Renewable

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