Phosphorus recovery from wastewater by Crystallization

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Background

Nutrients such as phosphorus (P) and nitrogen (N) in the wastewater resulted in water pollution and cause eutrophication problem. Moreover, as Phosphorous is the crucial ingredient for food chain, the demand of P is increasing in agriculture and industrial sectors with the increase of urban population. All P products in the market are manufacture from mining of phosphate rock, which is a limited resource. According to an estimate, P removal from wastewater can meet around 20% global phosphorus demand (Yang Wu, 2019). Many different processes/approaches have already been developed including physical, chemical, biological to recover phosphorus from wastewater treatment plants, but they still face a challenge of low product purity, high cost and operational complexity (Lukas Egle, 2015).

Crystallization is an extensively researched approach with less environmental risks and economically viable. It can produce phosphate products such as struvite, calcium phosphates (e.g., hydroxyapatite (HAp)) and vivianite (Lihong Peng, 2018) (Liubov Vasenko, 2018) (Yang Wu, 2019). However, much efforts are needed to develop and to optimize the crystallization processes as the major challenges include the complexity of the process that leads to the high operating costs, and the market value of the recovered P products. The P fertilizers manufacture process in the industries are designed with phosphoric acid as the feeding materials. Therefore, effective P recycle requires the development of P recovery process that is optimized with respect to the composition of the incoming wastewater streams and furthermore the recovered P products match the market expectations to balance supply and demand. In this PhD project, we will develop a multi-stage process with optimized operation parameters to minimize the operating costs, the recovered P products will be chosen based on the composition of the wastewater stream, post-processes to convert the recovered P product into marketable chemicals will also be included.

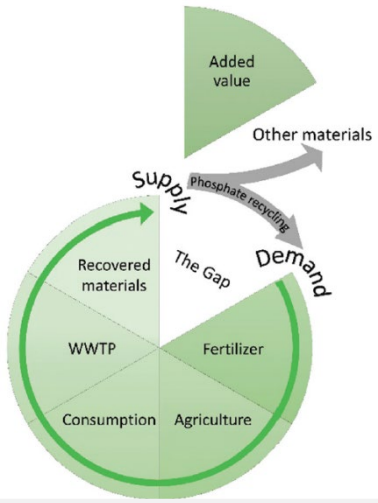


Fig.1. Gap between supply and demand (Jupp, 2021)

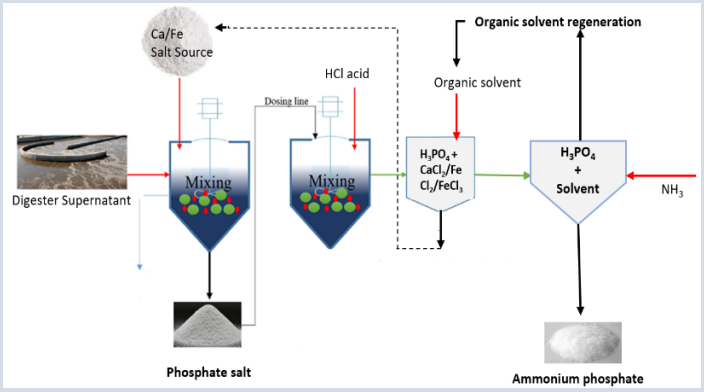
Aim of Study

Development of processes that can recover Phosphorus from wastewater as market-valuable product.

Objectives

1. Develop a process to separate and recover P from wastewater i.e., digester supernatant (DS) with high purity. The process will be optimized with respect to the composition of DS and the recovered P products will be selected based on the operating costs of the process.
2. Develop a post process that can convert the recovered P product into market preferred chemicals and enable maximized recycle of the reagents used in the process (e.g., dosing chemicals, solvents).

Methodology



References

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