

# Removal and recovery of phosphate from municipal wastewater by electrochemical method

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## Motivation

Phosphate is an essential nutrient for life, unfortunately phosphate ore reserves in the world are diminishing. On the other hand, excess phosphate in wastewater can lead to water pollution, i.e., eutrophication. Therefore, the removal and recovery of phosphate from wastewater would provide an excellent solution for both problems. The most common ways for removing phosphate are precipitation with iron/aluminum. They are effective but not sustainable, because phosphate in the iron and aluminum precipitates is hardly bio-available. Herein, an attempt to produce bio-available calcium phosphate by a novel electrochemical means is therefore suggested.

## Technological challenge

Electrochemical precipitation, as a promising method for removal of phosphate from waste streams, has received increased interest, because of the availability and low (chemicals consumption) costs of the technology, the low temperatures used which would lead to crystalline products, and also, the ability to control the thickness, composition and microstructure of deposition. In general, several processes, including acid-base reactions, a decrease in solubility by an increase in pH and a decrease in solubility by an increase of free constituent ions ( $\text{OH}^-$ ) are involved in the precipitation of  $\text{CaP}$  via the electrochemical system. Therefore, it is possible to harvest phosphate with the electrochemical precipitation system. But there are still many concerns that need to be investigated before it can be applied to treat real wastewater. At present, our challenges are to identify the influence of water constitutions and more importantly, how to collect the formed  $\text{CaP}$  precipitation in this system.

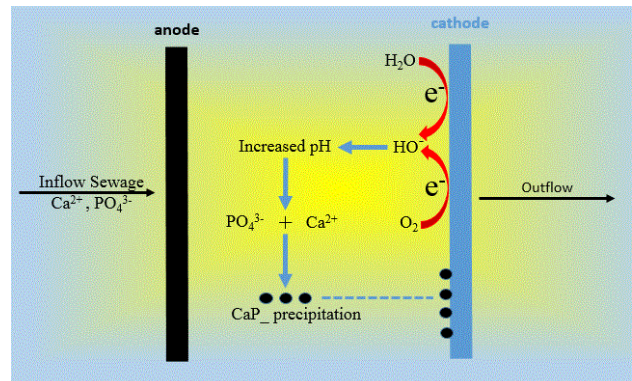


Fig. 1. Proposed mechanism of phosphate recovery in electrochemical system.

Accordingly, the main goal of this research will be to develop a WWTP integrated electro-precipitation system, for calcium phosphate removal and recovery. The detailed objectives are listed below:

- 1) Recover the  $\text{CaP}$  product, preferably on an electrode, or a template that would allow re-use (harvesting) of the  $\text{CaP}$ . On/near electrode: deposit the  $\text{CaP}$  with a reasonable thickness and/or density on electrode or template. A templated electrode may be considered, using coatings, seeds or activated polymers.
- 2) The solution chemistry and scaling tendencies in combination with  $\text{CaP}$  products will be investigated theoretically and experimentally. The % of phosphate that can be electrochemically recovered from low concentrated  $\text{PO}_4^{3-}$  waste streams needs to be determined as well as the waste water composition after electrochemical treatment.
- 3) Integrate electrochemical phosphate recovery in the WWTP.



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