PHORWater
Integral Management Model for Phosphorus recovery and reuse from Urban Wastewater
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DAM Depuración de Aguas del Mediterráneo · Universitat de València · Calagua · Université Claude Bernard Lyon 1 · LAGEP

Phosphorus management and recovery from wastewater as struvite

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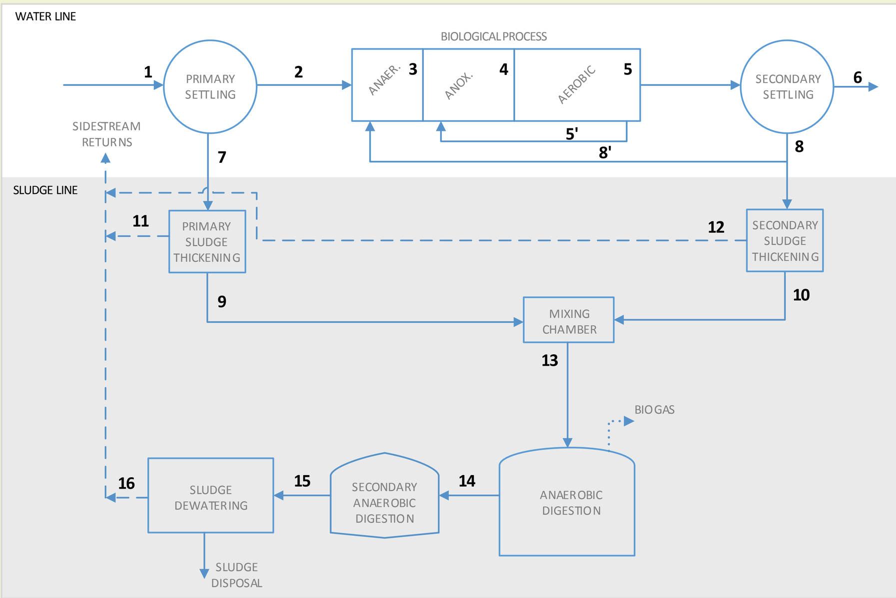
INTRODUCTION

The scarcity of phosphorus (P) (essential resource for life) as well as the problems associated to its presence in wastewater requires the development of a sustainable management (social, economic and environmental) of this resource in the WWTPs. In this context, the consortium formed by DAM, CALAGUA, and LAGEP are performing the PHORWater project which suggests P recovery as struvite ($MgNH_4PO_4 \cdot 6H_2O$) using the sludge supernatants' flows. The project will provide an integrated solution that involves the application of techniques of P management in those WWTPs that have enhance biological phosphorus removal (EBPR) and anaerobic digestion for sludge stability. The main objective of PHORWater is to demonstrate, at pre-industrial scale, the viability and sustainability of the correct management of the P in a WWTP obtaining struvite by crystallization.

METHODOLOGY

The project takes place at El Cidacos WWTP (Calahorra, La Rioja, SPAIN) with 23.000 m^3/d capacity, which has an activated sludge process (A2O configuration) and anaerobic digestion of the primary and secondary sludge (see Figure 1).


(a)



(b)

Figure 1. Aerial view of El Cidacos WWTP (a). Flowchart of the WWTP (b).

The project is based on five major technical actions:

- Integral management of the WWTP for optimal recovery of P.
  - ✓ Maximize the concentration of P in the supernatants.
  - ✓ Minimize the uncontrolled precipitation of P.
- Design and construction of the **crystallization** reactor to treat 20 m^3/d of supernatants.

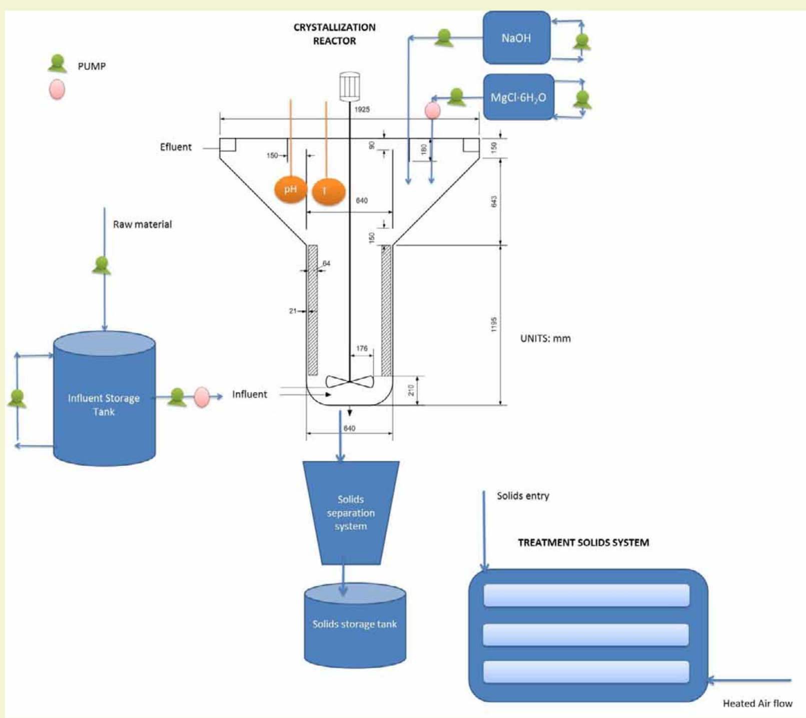


Figure 2. Proposed crystallization reactor scheme.

- Implementation, control and continuous operation of the proposed process:
  - ✓ Optimization of the EBPR process.
  - ✓ Minimization of P entering to anaerobic digestion in order to reduce its precipitation.
  - ✓ P recovery by crystallization as struvite.
- Validation of the obtained struvite as fertilizer.
- Economical and feasibility study.

RESULTS

Between November 2013 and February 2014 took place the "Integral management of the WWTP for the optimal phosphorus recovery" action by 5 exhaustive sampling campaigns on 16 points along the water and sludge lines (Figure 1b). The main results are:

- ✓ Development of a "Manual of characterization of WWTP" which identifies minimum sampling points and the required parameters to be analyzed in each one of them.
- ✓ The water line of the WWTP presents good yields of phosphorus removal.
  - ➢ Between 81 and 95%.
- ✓ The main P loss point at the WWTP is the anaerobic digester.
  - ➢ Between 8 and 12 g of P precipitated by kg of treated sludge.
  - ➢ Around 60-80% of the P entering this unit precipitates.
- ✓ The maximum availability of P (phosphate to be recovered) is placed in the mixing chamber.
  - ➢ P available in the mixing chamber over triples the incoming P.

CONCLUSION

The main outcomes during the analysis of the current management of the wastewater treatment plant are:

- There are good yields of P removal in the water line, which is key to ensure its recovery.
- The loss of P in the digester, associated with precipitation processes, is assumed between 8 and 12 g of P per kg of treated sludge.
- Only between 20 and 32% of P reaching the sludge line could be available to be recovered.
- Phosphorus recovery has to go through the optimization of the extraction of phosphate released into the mixing chamber

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