# Phosphate recovery from Iron Coated Sand granules by alkaline desorption

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**Abstract:** In general, phosphorus (P) is considered as an essential and limiting source of which reuse should be promoted. Agriculture water flows, e.g., drainage water, contain phosphate amounts of unused fertilisers above the standard limits for surface water sources. As end-of-pipe technology, adsorption processes have already showed high potential and efficiency to retain phosphate before discharge. In this study, both regeneration of the saturated sorbents and recovery of phosphorus are the main objectives. A desorption process using alkaline solutions is proposed without harming the sorbent grains. Alkalinity and contact time were varied to obtain optimal process conditions. Considering the investigated process conditions, the highest desorption efficiency, i.e., 60%, was achieved by using a NaOH-solution of 0.1M and a contact time of 48h. In a further stage, the recovery of the phosphate as a precipitate will be investigated.

**Keywords**: Phosphate adsorption; Iron coated sand; Drainage water

## 1. Introduction

Despite preventive measures and a strict policy, regions with intensive agriculture still have high concentrations of nitrogen (N) and phosphorus (P) in surface water. This leads to algal blooms in our streams, streams and rivers and even off our coasts. Curative steps are needed to improve the situation. This can be done, for example, by applying filter technology to agricultural water flows (e.g. discharge and drainage water). The stricter legislation on fertilisation has not ensured that the water quality in Flanders meets the European standards of 11.3 mg N/L and 0.1 mg P/L.

To capture the phosphorus in the drainage water, an adsorption technology using Iron Coated Sand grains is proposed. These grains are a side product of the local drinking water company Pidpa and produced during the deferrization of groundwater. The potential of the ICS granules to adsorb phosphate from municipal wastewater on laboratory scale was already demonstrated by Moelants et al. (2010). Since P is a critical raw material for which supply security is at risk and economic importance is high, it is essential to recover and reuse the P adsorbed on the filter materials.

The main objective of this study is to integrate the filter granules in a circular process. The desorption process of the 'captured' phosphates from the grains is investigated. Ideally, the desorption process should be achieved without damaging the pellets, so that the filter material can also be reused as adsorption material. Therefore, an alkaline desorption solution based on NaOH is used to recover P. Process parameters such as the concentration of NaOH and contact time were varied and the purity of the obtained phosphate solution was evaluated. In a further stage, the precipitation of the phosphorus as a phosphate salt will be investigated. The possible presence of impurities can hinder the precipitation process.

## 2. Material and Methods

The ICS granules are derived from rapid sand filters used for the deferrization in the production of drinking water from groundwater. 5g of pre-dried saturated adsorption material is contacted with 100 mL NaOH-solution (1M, 0.1M, 0.01M & 0.001M) in stoppered sample flasks, resulting in a S/X ratio of 1/20. The desorption experiments are performed at room temperature under constant motion by a horizontal shaker at 100 movements per minute. Afterwards, the solution is separated by the solid materials by decantation and filtered on a .45 µm filter prior to phosphate analysis. The residual concentration of phosphate after extraction is determined by ion chromatography.
Also, the release of iron or other impurities, as well as the grain structure (SEM), are investigated.

## 3. Results

The influence of the NaOH concentration and the desorption time on the release of phosphorus is shown in Figure 3.1. By increasing the contact time between the desorption solution and the saturated sorbent, more phosphorus was released from the sorbents. The increased P release at longer desorption times was observed for all investigated NaOH concentrations. However, significant higher P release was noticed by increasing the NaOH concentration. After a contact time of 48 hours, a P release of 0.01, 0.31 and 3.59 mgP/g sorbent was measured at 0.001M, 0.01M and 0.1M NaOH-solution, respectively. Knowing the saturation concentration, i.e., 6 mgP/g sorbent, approximately 60% of the adsorbed P was desorbed at 0.1M NaOH-solution.

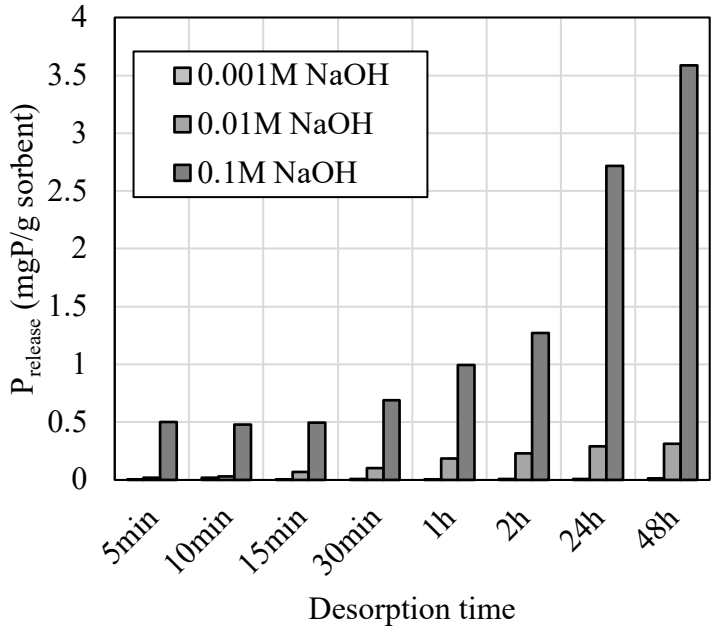


**Figure 3.1** Effect of intermediate rest periods on the adsorption capacity of $PO_4$-P on the iron granules.

## REFERENCES

Moelants, N., Smets, I.Y., Van Impe, J.F. 2011 The potential of an iron rich substrate for phosphorus removal in decentralized wastewater treatment systems. *Sep. Purif. Technol.*, **77**, 40-45.