

Electrodialytic process combined with gas permeable membrane for phosphorus and nitrogen recovery from municipal waste as biofertilizer

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Introduction

- P and N are two primary nutrients for plant growth. Although, production of mineral P and N fertilizers are highly material and energy consuming, respectively.
- MSW digestate may represent a secondary source of P and N. However, its directly use in agriculture poses a risk by the potential presence of contaminants.
- Electrodialytic (ED) process and gas permeable membrane (GPM) technology have been independently used to extract P and N from wastes, prior the precipitation of P and N as biofertilizer: struvite.

Objectives

- Development of an innovative lab-scale set-up that combines ED and GPM for the simultaneous extraction of N and P from MSW digestate
- Comparison of two different sources of materials when producing a fertilizer: materials recovered from wastes vs synthetic chemicals

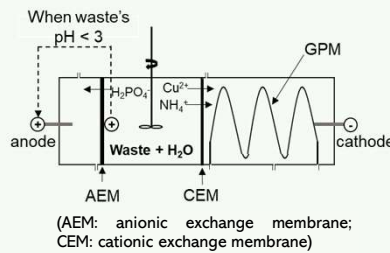
Methods

- Adaptation of the existing ED set-up to accommodate the GPM technology
- Performing 3 extraction experiments (A, B, C) varying i) length of the waste compartment (10cm, 15cm), ii) current intensity (50mA, 75mA and iii) operation time (9d, 12d)
- Performing 3 precipitation experiments i) STRUVITE-S: using synthetic N and Mg sources; ii) STRUVITE-SA: using alternative N (extracted from MSW digestate using ED + GPM) and synthetic Mg sources; iii) STRUVITE-A: using alternative N (extracted from MSW digestate using ED + GPM) and alternative Mg (obtained from seawater).

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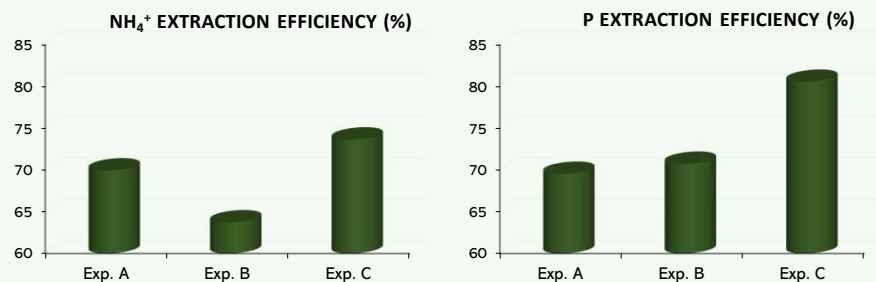
Results

A new lab-scale setup combining ED and GPM was developed comprising:

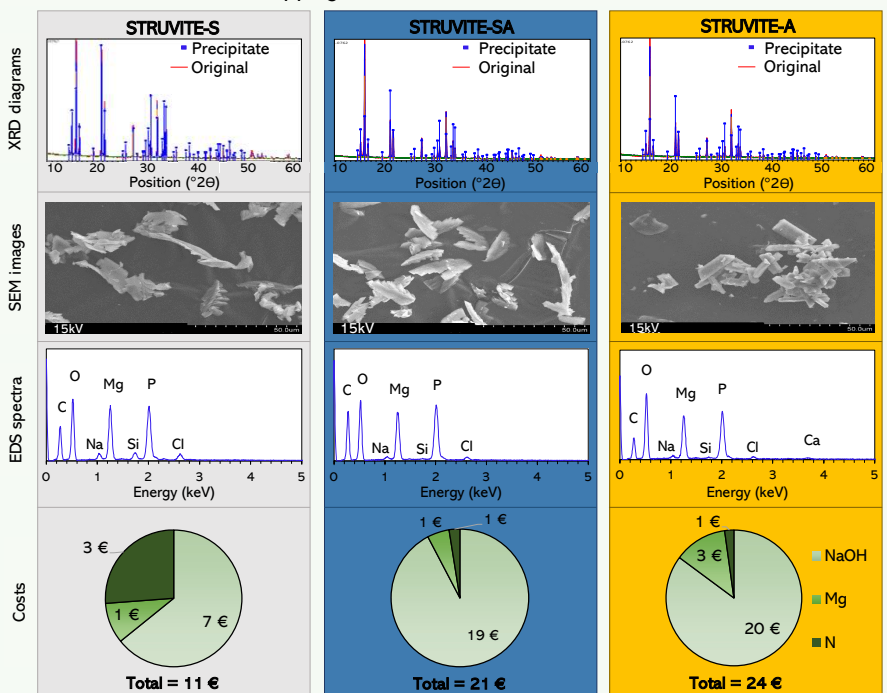


- Three compartments, in which GPM was placed in the cathode compartment. During ED, N is expectably present as NH_4^+ , a positively charged specie that theoretically moves to the cathode side.
- HCl as stripping solution. N is expected to be recovered as NH_4Cl (needed for struvite precipitation).
- An increase in the length of cathode compartment to integrate the GPM.

Novel ED plus GPM integrated process was successfully applied extracting 72% of N and 81% of P from MSW digestate.



The properties of the struvite synthesized using N and P recovered from the waste were similar to struvite formed using synthetic chemicals but the costs were higher due to the need to neutralize the acid-trapping solution.



Conclusions: The high recycling rates of P and N using novel ED plus GPM technology obtained in this study are encouraging and widen the possibility of replacing synthetic fertilizers by secondary biofertilizers produced using the nutrients extracted from wastes.