PRACTICE ABSTRACT NO. 2

SEA2LAND

UVIC
UNIVERSITAT DE VIC
UNIVERSITAT CENTRAL DE CATALUNYA

Beta
Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària

Phosphorus extraction strategies from P-rich ashes coming from fish sludge-derived organic amendments

Main results / outcomes

Organic amendments coming from marine aquaculture sludge were demonstrated to be rich in phosphorus. Since the current regulation does not allow to use them as fertilizers, the thermal valorization could be an interesting option for aquaculture industry in terms of energy savings. Different strategies were followed to extract the P in the resulting ashes after the organic amendment combustion. First, a screening of different acids (sulfuric and citric acid) at different concentrations was conducted. Sulfuric acid at 1 M with a low acid-to-ash ratio (10 to 1) led to the maximum extraction efficiency of the P in the ashes (up to 85%). A cumulative two-round P extraction was then tested using 1 M H_2SO_4, which resulted in a very concentrated P product (4.57% of P_2O_5). Finally, alkaline-driven precipitation of the P-rich H_2SO_4 was performed to obtain two precipitates with a P-content up to 15% mainly in the form of calcium phosphates.

Practical recommendations

Cumulative extraction of the P from ashes is a good way to increase the P concentration in the final solution, despite decreasing the extraction efficiency in the second extraction round. The pH of the H_2SO_4 solution can be used as indicator of the capacity of the acid to continue extracting P from the ashes. If the pH is higher than 2.0, a decrease in the extraction efficiency is observed. Finally, despite alkaline-driven precipitation results in high concentrated P precipitates, the mass balance efficiency is very low, being able to recover as precipitated salt a minor part of the phosphorus in the extract. Further research in maximizing precipitation efficiency is needed. In the meantime, commercialization of the acidic P-rich extract obtained in a cumulative process would be recommended.

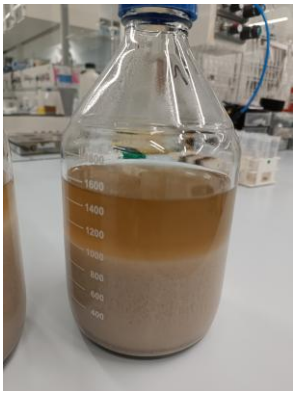

Figure 1. Lab-scale extraction of P with sulfuric acid from ashes

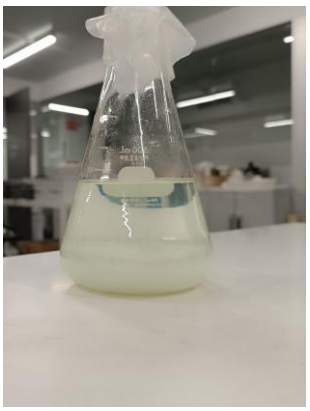

Figure 2. Alkaline-driven precipitation from P-rich sulfuric acid solution.

About this abstract

Authors: Miguel Martínez, Nagore Guerra – BETA-Technological Center (UVic-UCC)
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
Website: www.sea2landproject.eu

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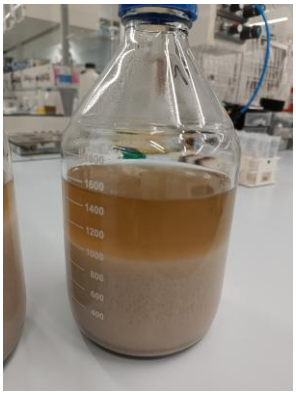
Estrategias de extracción de fósforo a partir de cenizas ricas en P provenientes de enmiendas orgánicas derivadas de lodos de pescado

Principales resultados

Las enmiendas orgánicas derivadas de lodos de acuicultura marina son ricas en fósforo, pero la normativa actual impide su uso directo como fertilizantes. La valorización térmica surge como una opción energética interesante para la industria acuícola. Tras la combustión de estas enmiendas, se evaluaron distintas estrategias para extraer el fósforo de las cenizas resultantes. Se compararon ácidos como el sulfúrico y cítrico a varias concentraciones, destacando el ácido sulfúrico 1 M con una relación ácido/ceniza de 10:1, que alcanzó hasta un 85% de eficiencia en la extracción. Además, se implementó una extracción acumulativa en dos etapas con H_2SO_4 1 M, logrando un extracto con alta concentración de fósforo (4,57% P_2O_5). Posteriormente, la precipitación alcalina del extracto permitió obtener precipitados con hasta un 15% de fósforo, principalmente como fosfatos cálcicos.

Recomendaciones prácticas

Aunque la extracción acumulativa aumenta la concentración de fósforo, la eficiencia disminuye en la segunda ronda y un pH superior a 2.0 indica menor capacidad extractiva. La precipitación alcalina, pese a producir concentrados ricos, tiene baja eficiencia en el balance de masa, recuperando solo una fracción del fósforo. Por ello, se recomienda profundizar en mejorar esta etapa, y mientras tanto, comercializar el extracto ácido acumulativo como producto rico en fósforo.



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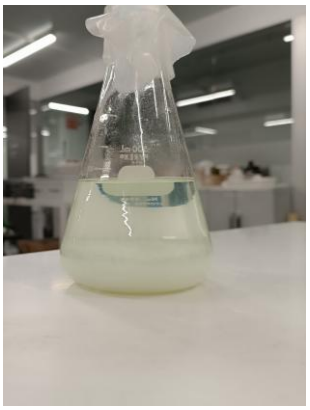

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Acerca de este resumen

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