Electrodialytic recovery of phosphorus from chemically precipitated sewage sludge ashes

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Electrodialytic separation of phosphorus and heavy metals from sewage sludge ash

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Aim: Phosphorus

• Phosphorous is a limited resource and an essential nutrient.

• Phosphate rock (P-rock) reserves are foreseen to be depleted in 300-400 years [1].

• In the last decade, the EU imported around 90% of the P-rock that it consumed (IFA).

• In the EU there is a flow of 182,000 t of non-recycled P yearly in sewage sludge, around 20% of the EU P-rock consumption (Van Dijk et al. (submitted)).

• A common practice in some countries (AT, BE, CH, DE, DK, NL, US, JP, HK) is incineration of sewage sludge. In recent years, gasification has gained attention.

Low-temperature gasification technology

• Due to the low temperature it is possible to use high alkaline fuels. Examples: straw, sewage sludge, etc.

• The resulting ashes, might have a high content in heavy metals or have a poor P-plant availability

Electrodialysis: a technology to recover P from sewage sludge ashes

• A patent has been filed from DTU (WO 2015/032903) for the 2-compartment Electrodialytic (ED) cell.

• With this setup (Figure 1), it is possible to recover up to 90% of P from incineration sewage sludge ashes, in the anolyte liquid with low content in heavy metals (Cd, Cr, Cu, Ni, Pb, Zn) [2].

• Only 26% of P was recovered with the same setup at the same conditions (liquid-to-solid ratio, current density and experimental time) with gasification sewage sludge ashes [3]. Most likely, due to the presence of Fe-P bindings (Figure 2). Poor results were previously observed for ashes with high Al content [4].

• Up to 70% of P was eventually recovered for the same ashes with an innovative ED setup. The recovered P-liquid has a content in heavy metals comparable to the one of wet phosphoric acid (Figure 3). The new setup is currently being drafted for a patent filing.

• Further work will focus on sewage sludge ashes containing both high content of both Fe and Al.

References


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Figure 1. Two-compartment ED cell

Figure 2. Solubility of Al-P, Ca-P and Fe-P compounds

Figure 3. Heavy metal to P ratio of the ash, anolyte liquid (final product) and wet phosphoric acid

Figure 4. Different sewage sludge ashes