Electrodialytic recovery of phosphorus from chemically precipitated sewage sludge ashes

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Aim: Phosphorus

- Phosphorus 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.

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.

  Anolyte liquid:
  - P-rich
  - Acidic (H+ generated in the anode)
  - Low in heavy metals

  Bulk ash: can be reused in construction industry

  Catholyte liquid:
  - Mostly Ca and heavy metals

- 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.

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

References

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