Electrodialytic separation of phosphorus and heavy metals from sewage sludge ash

Pares Viader, Raimon; Jensen, Pernille Erland; Ottosen, Lisbeth M.; Ahrenfeldt, Jesper; Hauggaard-Nielsen, Henrik

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Phosphorous – Some facts

- 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 from sewage sludge, around 20% of the EU P-rock consumption (Van Dijk et al. submitted).
- A common practice in some countries (DE, NL, BE, AT, CH, 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, 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. 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. The new setup is currently being drafted for a patent filing.
- Further work will focus on sewage sludge ashes containing both high content of 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


*Corresponding author. Tel.: + 45 45 25 21 63
E-mail address: rapv@byg.dtu.dk