Recovery of phosphate

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Traditional P-cycle
Future P-cycle

- crops
- farm animals
- fertilizer animal feed food additives
- detergents industrial uses
- sewage works + treatment of animal wastes
- agriculture use in rural areas
- recovery and recycling of phosphates
Stimulating factors:

- EC Urban Waste Water Treatment Directive
- Limits to sludge spreading
- High sludge treatment costs (The Netherlands, Japan)
- P-recovery policy of industry (CEEP)
- P-recovery policy of government (Sweden, UK)
- Struvite deposit problems
- A demand for sustainable phosphorous resources
Drivers for the water industry

Potential for cost savings:
chemical addition and sludge handling costs

Potential for cost recovery:
sale of recovered phosphate product

Potential to enhance phosphorus removal:
achieve lower effluent phosphorus concentrations
Biological P-removal is a facilitating process

- Calcium phosphate formation (Crystallactor®)
- Struvite precipitation (Phosnix®)
- Precipitation as aluminium or iron phosphate
  ... But also ion exchange resins, magnetic separation, adsorption ...

And there are also different techniques for incinerated sewage sludge
Calcium phosphate (Crystallactor®)

- A few full scale reactors are in operation
- High quality product
- Can be used by fertiliser industry and phosphate industry

Crystallactor® at Geestmerambacht, The Netherlands
Struvite (Phosnix®)

- Good experience on full scale in Japan and Italy
- High quality product
- Can be used as fertiliser or in certain phosphate industry process routes

Ube Industries Sakai plant, Japan
Economic feasibility

Feasibility depends strongly on circumstances per country, determining factors are:

• P-concentration in influent
• sludge handling costs
• costs of the P-recovery technique
• market value of P-recovery products
Publicity on P-recovery

Several activities to reach all actors:

• SCOPE newsletter

• two special issues of Environmental Technology

• 1\textsuperscript{st} Int. Conf. in Warwick in 1998 (100 visitors)

• 2\textsuperscript{nd} Int. Conf. in Noordwijkerhout in 2001 (270 visitors)

Inventory study in The Netherlands

**Clients:** STOWA, Thermphos and CEEP

**Consultant:** Haskoning B.V.

**Objective:**

Which phosphate rich streams are available from wwtp’s that can be used for production of elementary phosphorus?
Base material: Phosphate ore (600,000 tons/year)

Phosphate usage: 190,000 tons P₂O₅ / year

Production: Elementary phosphorus

Aim: Replacement of 20% base material by phosphate rich streams within 5 years

Option: Usage of phosphate-rich sludge from wwtp’s
Requirements for P-rich streams

- **Dry solids:**  > 75%
- **P$_2$O$_5$:**  > 18% of dry solids
- **Iron (Fe):**  Maximum of 0.5% if P$_2$O$_5$=20%
  ≤ 2000 tons / year extra
- **Zinc (Zn):**  ≤ 20 tons / year extra
- **Cu / Cr / Ni / Co / V:**  ≤ 2 tons / year extra
Phosphate flow through WWTP’s

Pre-settler  Anaerobic  Anoxic  Aerobic  Settler

FeCl₃

Sludge processing
(350,000 tons d.s. / year)

24,000 tons P₂O₅ / year

63%  9%  3%  24%  1%

Ashes  Compost  Wet oxidation  Thermally dried  Other

Euro-CASE Workshop: "Wastewater sludge as a challenge", June 25, 2001
Phosphate flow through WWTP's

Pre-settler Anaerobic Anoxic Aerobic Settler

FeCl₃

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Ashes Compost Wet oxidation Thermally dried Other

24.000 tons P₂O₅ / year

63% 9% 3% 24% 1%

Solutions

Metal concentration too high:

- dosing of aluminium chemicals at wwtp’s
- implementation of side-stream processes
  - e.g. with the Crystallactor®

$P_2O_5$ concentration too low:

- implementation of side-stream processes
  - e.g. with the Crystallactor®
Side-stream implementation

Pre-settler  Anaerobic  Anoxic  Aerobic  Settler

Sludge separation

Precipitation

Crystallactor®

Thermphos
Qualification of side-stream sludge

Precipitation

D.s.% = 2%
P$_2$O$_5$% = 29%
Cu/Zn/Fe = <<<

Crystallactor®

D.s.% = 75%
P$_2$O$_5$% = 24%
Cu/Zn/Fe = <<<

Further research

Feasible!
Current: 72 wwtp’s with Bio-P removal
Within 2010: 29 to be built with Bio-P removal

Max. 5% of Thermphos base material
Conclusions of the inventory

• Yearly amount of $P_2O_5$ from wwtp’s: 24,000 tons

• Main bottlenecks for usage by Thermphos B.V.:
  - Too low dry solids concentration
  - Too low $P_2O_5$ concentration
  - Too high metal concentration (Fe / Cu / Zn)

• Direct usage of wwtp-sludge: Not feasible

Solution: implementation of Crystallactor®
Covers all bottlenecks
About 5% of Thermphos base material can be made available within 2010
For the situation in the Netherlands

• Besides Thermphos, also the fertilizer industry became interested

• Therefore the Crystallactor® is not the only option, also struvite and iron precipitation can be applied

• A working group will be formed with all actors in the industrial column of P-recovery, also animal waste, waste processing and different industries

• The P-recovery working group will start a lobby towards the regulators

For more information:

visit the P-recovery website on

http://www.nhm.ac.uk/mineralogy/phos
Thank you for your attention