Technical Factsheet | February 2015

P-REX
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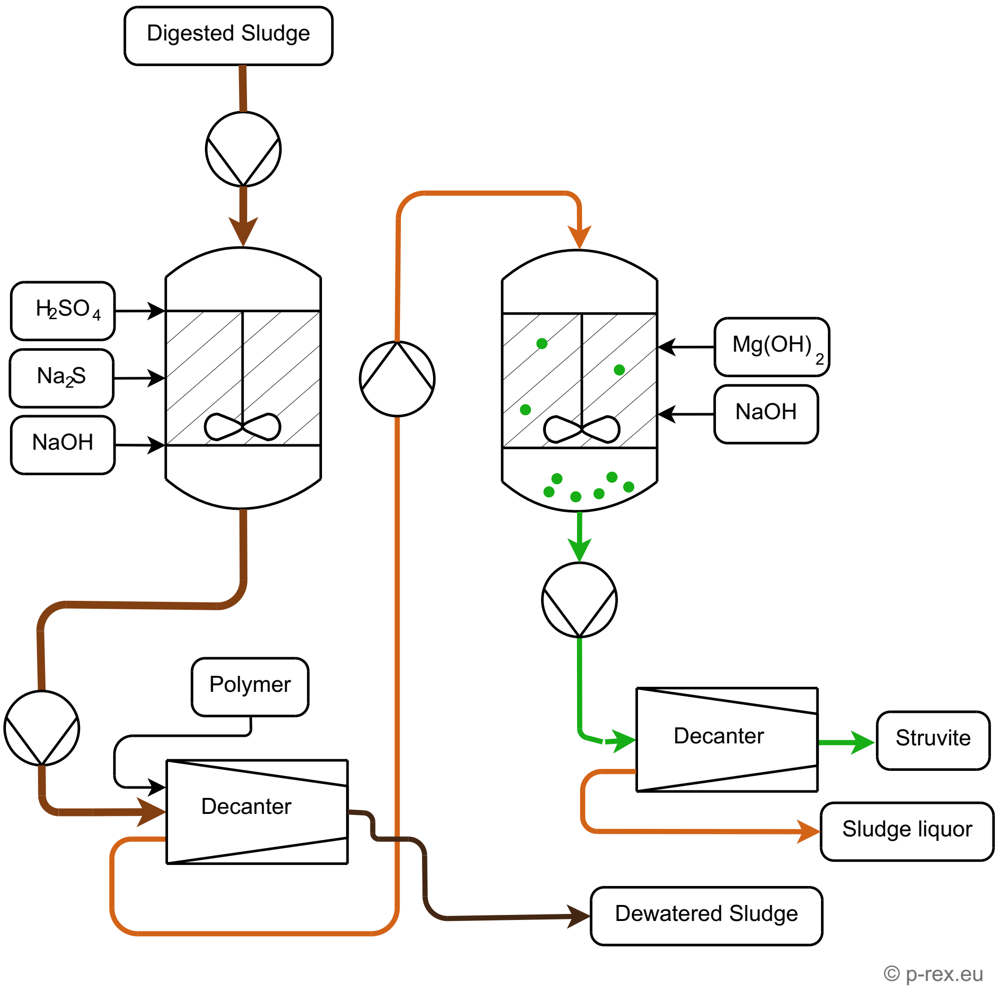
Gifhorn *Sludge leaching*

Short description

The basic concept of this process was originally developed in 2000 by Seaborne Environmental Laboratory AG (Germany) in order to recover nutrients from liquid manure. Since then, the Seaborne process was modified, optimized and implemented in full scale at WWTP Gifhorn, which gave the current name of this process ("Gifhorn process").
The phosphorus bound in the biomass is extracted at low pH = 4.5 from the solid phase of digested sewage sludge by addition of sulphuric acid (H_2SO_4). In a second step, the dissolved heavy metals are precipitated as sulfides (dosing of Na_2S) at pH 5.6 which is adjusted with NaOH. After solid/liquid separation with a decanter, dosing of $Mg(OH)_2$ initiates precipitation of phosphorus as mix of struvite/calcium phosphate at high pH = 9 (adjusted with NaOH). Mg is dosed below stoichiometric ratio to provoke complete calcium precipitation. This prevents scaling in the stripping reactor but produces a major fraction of hydroxylapatite next to struvite.
The P product is harvested by a second solid/liquid separation. The Gifhorn process can also be extended by an optional nitrogen recovery step (air stripping at pH = 10.5, recovery of NH3 in sulfuric acid as diammonium sulfate).

Process scheme



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General Data

Type of Process	acidic dissolution and precipitation
Type of Plant	precipitation reactor
Input Material	sewage sludge
Product	mix of struvite and hydroxylapatite
P-concentration	28 % P_2O_5 of DM
P recovery performance[1]	49 % of P in sludge input

Supply

Average total electricity demand[1]	6.9 [kWh/kg $P_{recovered}$]
Average chemical demand[1] (as 100% concentrate)	8.2 [kg H_2SO_4/kg $P_{recovered}$] 2.9 [kg NaOH/kg $P_{recovered}$] 0.2 [kg $Mg(OH)_2$/kg $P_{recovered}$] 0.1 [molar ratio Mg:$P_{recovered}$] 0.1 [molar ratio Mg:$P_{dissolved}$] 0.8 [kg Na_2S/kg $P_{recovered}$]

Advantages

- Process can be applied with EBPR or Chem-P sludge (acid demand calculated with 4% Fe)
- Separate heavy metal precipitation as sulfides
- Proportional reduction of phosphorus and nitrogen return load from sludge liquor
- Downstream recovery of nitrogen possible (air stripping) in the form of diammonium sulfate

Remarks

- Al coagulants in WWTP reduce P recovery rate. Higher rates of P recovery are possible at pH < 4.5, but with reduced dewaterability and increased chemical consumption. High Fe content in sludge leads to an increase in Na_2S dosing (FeS precipitation).
- Product contains small fractions of iron phosphate and larger fractions of hydroxylapatite.

Patents and Licenses

Patent held by	Seaborne EPM AG
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References

Owschlag (pilot)

Start of operation	2000
Scale	10.000 p.e., 50 kg struvite/d

Gifhorn (full scale)

Start of operation	2007
Scale	50.000 p.e., 270 kg struvite/d *(currently limited performance due to economic reasons)*

[1]Process data related to reference sludge line defined in P-REX (digested sludge of wastewater treatment plant for 1 Mio inhabitant equivalents, dry matter (DM) content: 3%, P content: 4.2% of DM, PO_4-P in liquor: 200 mg/L (EBPR) or 10 mg/L (ChemP), Fe content: 2% (EBPR) or 6.6% (ChemP)).More information on modelling can be found in P-REX LCA report.

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