10 years of Phosphorus Recovery at WWTP Amsterdam West

Enhanced sewage sludge treatment with struvite recovery

June 21, 2023

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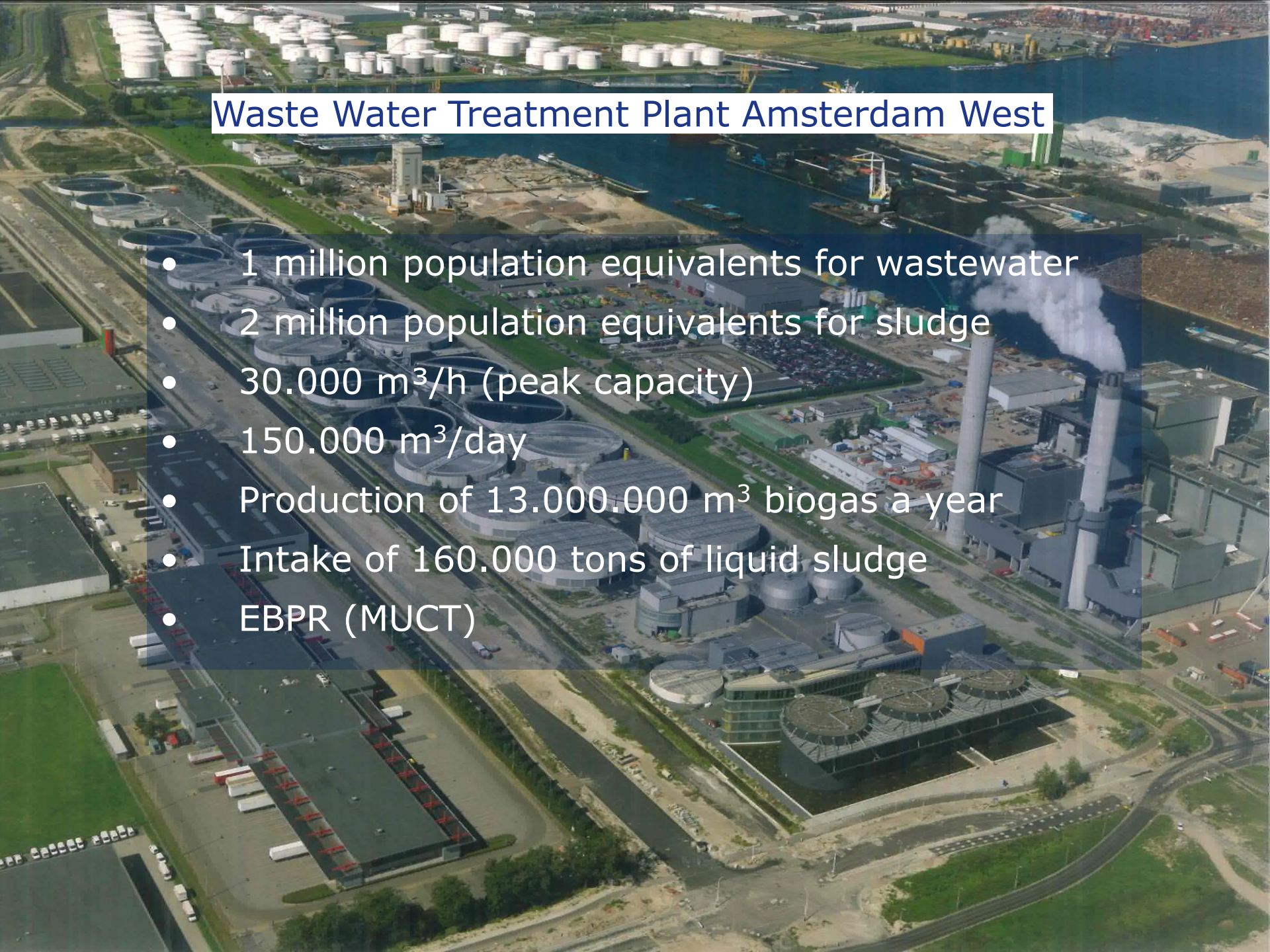
WWTP Amsterdam West recovery of phosphorus

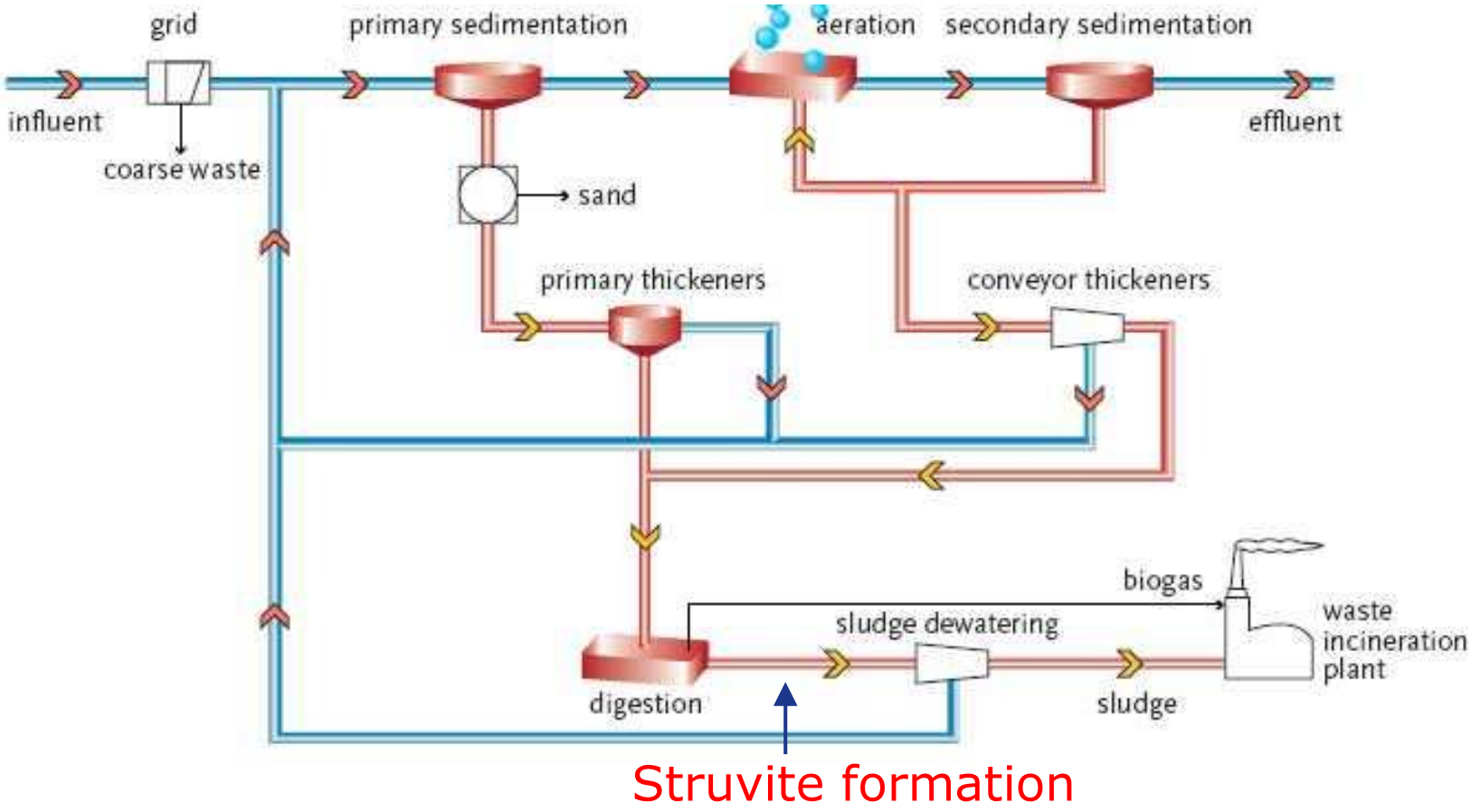
Phosphorus, problem or solution?



Waste Water Treatment Plant Amsterdam West

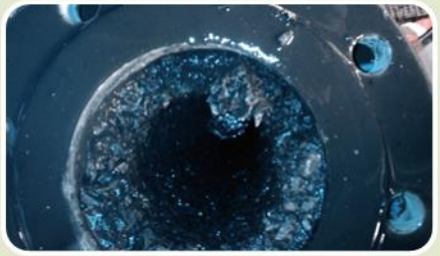
- 1 million population equivalents for wastewater
- 2 million population equivalents for sludge
- 30.000 m^3/h (peak capacity)
- 150.000 m^3/day
- Production of 13.000.000 m^3 biogas a year
- Intake of 160.000 tons of liquid sludge
- EBPR (MUCT)

Waste Water Treatment Plant Amsterdam West (process flow diagram)



Sludge treatment WWTP Amsterdam West

Primairy sludge WAS → digesters → buffer → dewatering



Scaling

Sedimen-tation

Wear and tear

Phosphorus problem

Problem definition:

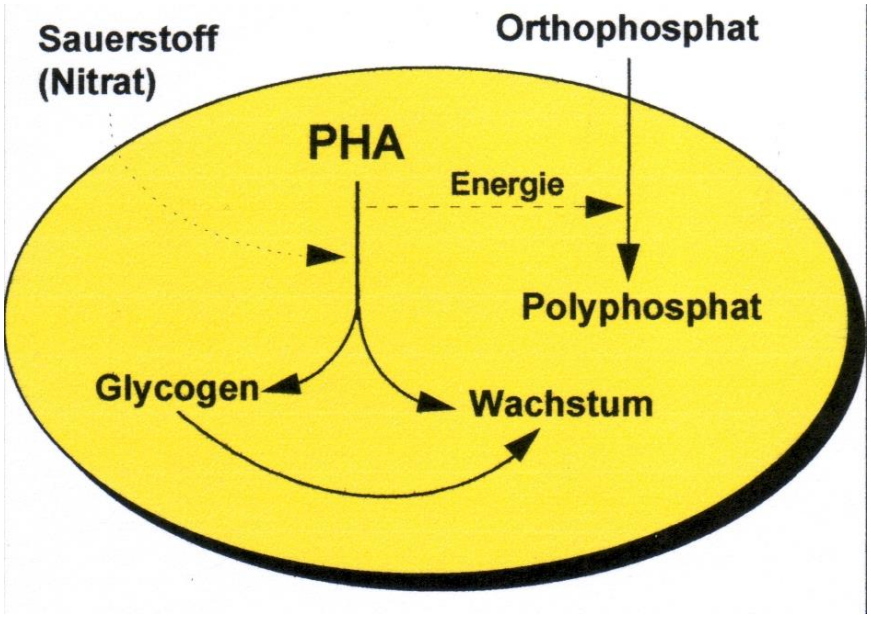
- Scaling in pipelines and dewatering equipment
- Massive build up of crystals in sludge holding tank
- Analysis show struvite

  $MgNH_4PO_4.6\ H_2O$ (N-P-K, 5-28-0)+ Mg 10 (as MgO)

Why struvite crystallization at WasteWater Treatment Plant (WWTP) Amsterdam West?

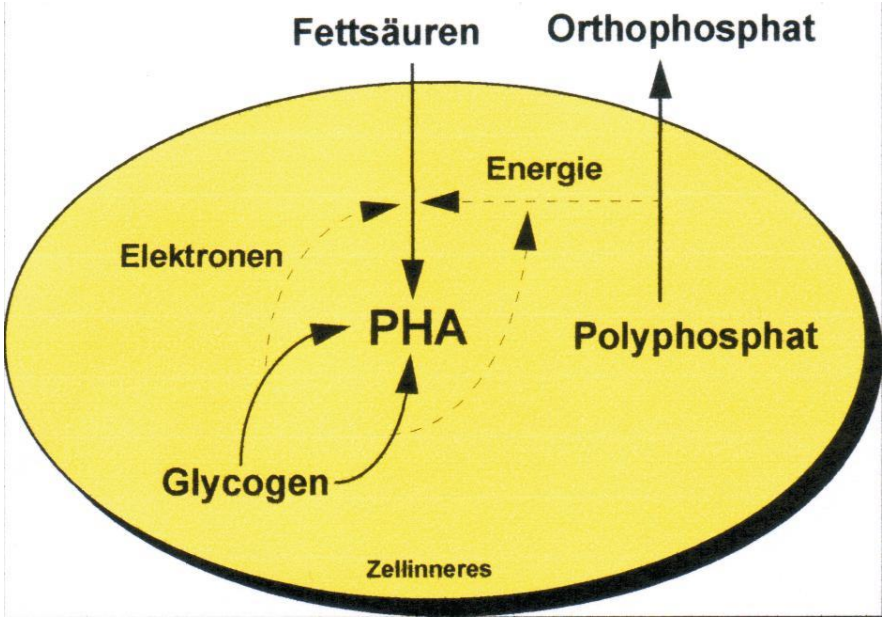
- Enhanced Biological Phosphorus Removal
- Construction Digester

Enhanced biological P- removal



Aerobic Zone
=
luxury P-uptake
by building polyphosphates

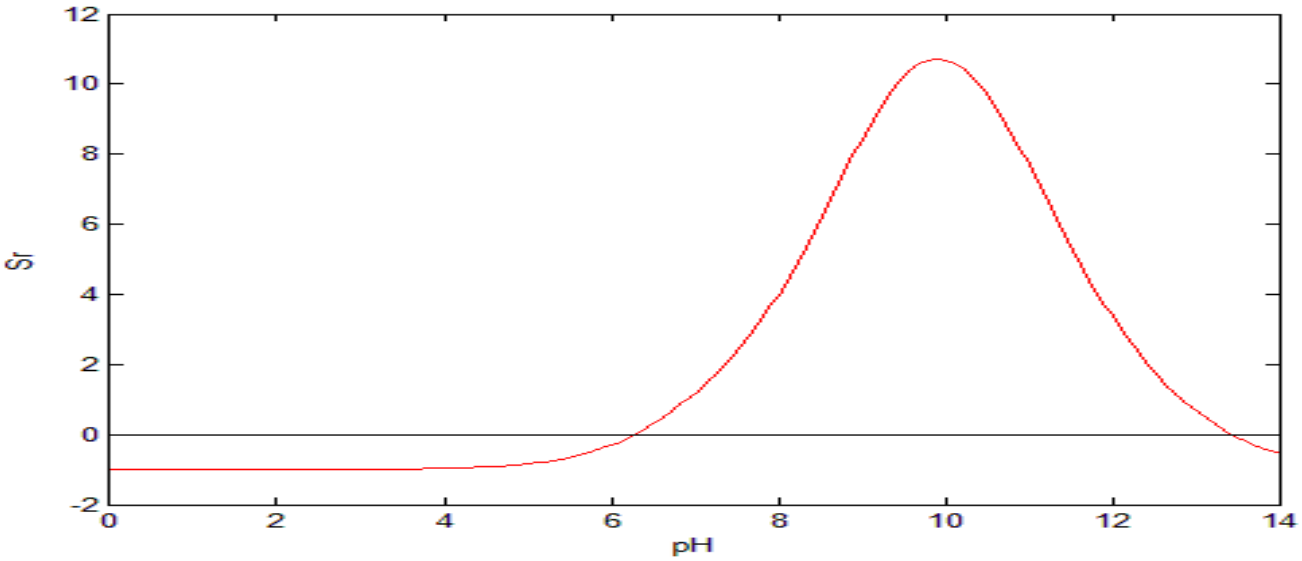
Digestion



Anaerobic Zone
=
P- release by
hydrolysis of polyphosphates

Digesters of WWTP Amsterdam West

Struvite crystallization



- pH rise ➔ Higher supersaturation
- $Mg^{2+} + NH_4^+ + PO_4^{3-} + 6\ H_2O$ ➔ $MgNH_4PO_4.6\ H_2O$ (MAP)

Research and LCA

- Research and LCA showed that removal of phosphorus in digested sludge was most promising

Process benefits

- Enhancement sludge dewaterability
- Less maintenance sludge handling
- Lowering phosphorus recycle to WWTP
- High quality struvite production

Pilot ‘Airprex’ & ‘NuReSys’

Results pilot scale experiments

Parameters	PO_4 –P (mg/L)	pH	NH_4 (mg/L)
Before crystallization	150	7,2	680
After crystallization	5	7,8-8,0	630

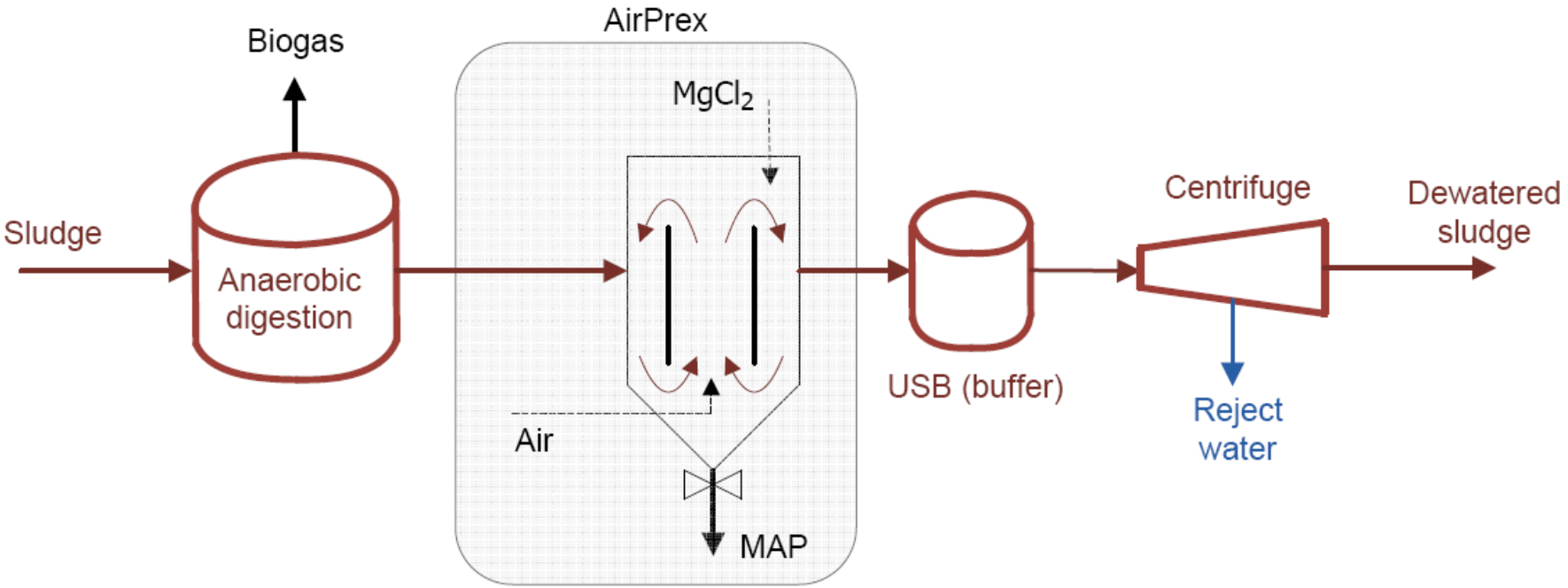
Parameter	Before crystallization	After crystallization
% DM	22	25-26
Polymer dosage kg/ t DM	14-16	11-13

Magnesium dosage Me/P~1,8-2,0

Conclusions

- Process is useful in combination with Biological phosphorus removal
- Solves dewaterability and scaling problems
- Produces a ready to use product

Airprex principle



Process description

- pH rise by CO2 stripping
- Adding MgCl2 (32 % solution) for struvite crystallization
- Separation is easy because struvite density is 1,7 kg/m3

Struvite quality

- Analysed and tested by ICL fertilizer
- “Useful product in production of tailor made fertilizers, especially when extra magnesium is needed”

Business case at WWTP Amsterdam West

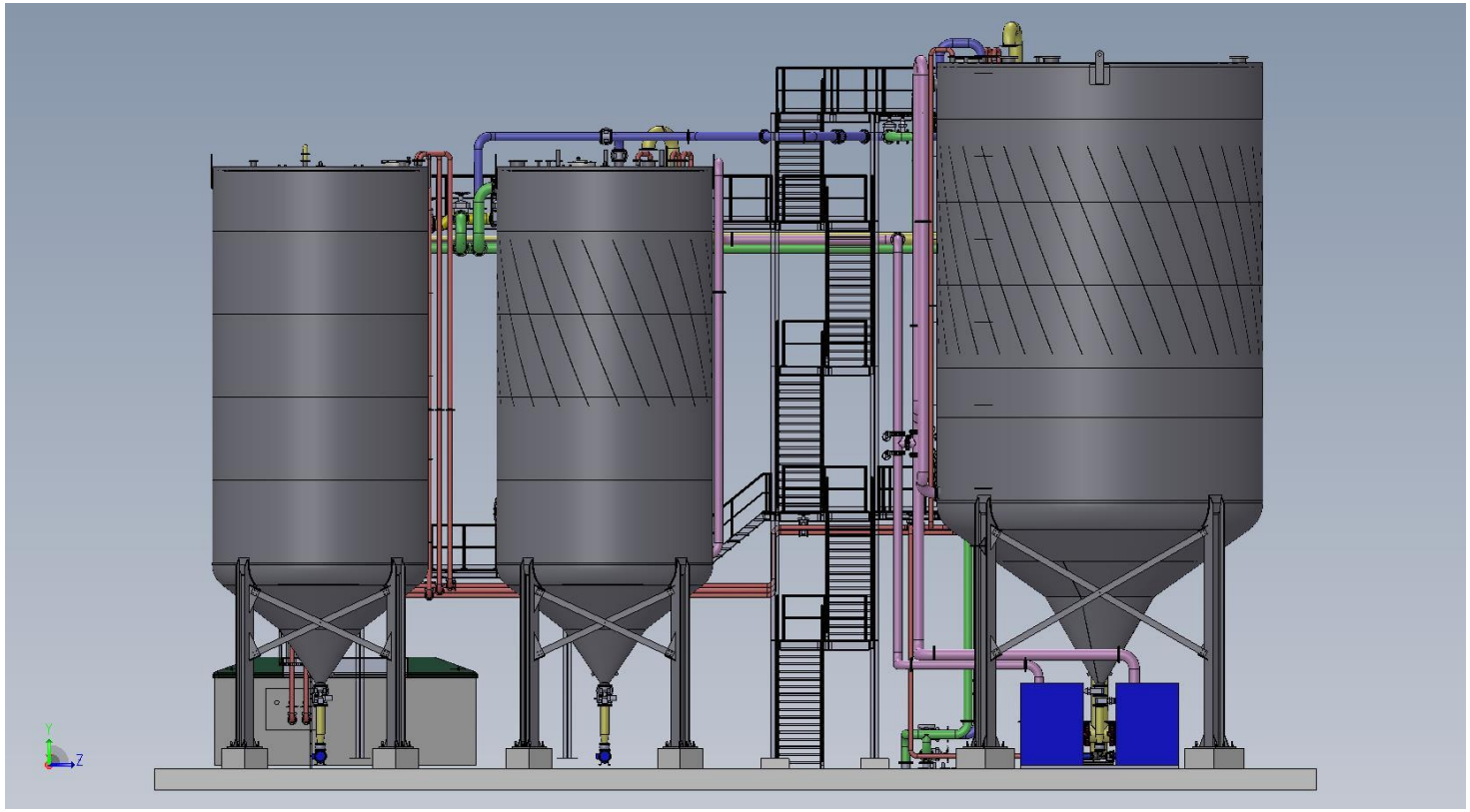
- Benefits ~ € 1.200.000/a (dewatering+struvite € 0)
- Costs ~ € 700.000/a

Annual savings ~ € 500.000

Investments costs ~ € 3.000.000

ROI ~ 6 years

Reactor design



Installation and Production, 2014

Maintenance and down time

- Cleaning of reactors every half year
- Cleaning of struvite discharge pumps takes a lot of maintenance
- Causing less production of struvite and downtime

Problem and solution

- Hair and struvite
- Discharge system without pumps installed 2018

Full scale results

- Dewaterability up from 21 % DM to 23,5 % DM
- Production of struvite is up from 200 ton in 2017 to 300 ton in 2018 ➔ 500 ton 2025
- Ortho-phosphate removal of 95 %
- Scaling is nearly absent or easy to remove
- Struvite sold to ICL (Fertilizer company)

"We may be able to substitute nuclear power for coal, plastic for wood, yeast for meat and friendliness for isolation…..but for phosphorus there is neither a substitute nor replacement"

Isaac Asimov, 1974

Thank you