Struvite - a technique for P recovery

Malmö October 28, 2016
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EKOBALANS

EkoBalans in brief

- Sustainable solutions for the recycling of plant nutrients from wastewater treatment, biogas production, and food industry
- Recycled nutrients are refined into high quality fertilizers and returned to agriculture or other plant production
- EkoBalans solutions are based on research on plant nutrition, nutrient balances in cropping systems, and nutrient recycling at Lund University

EkoBalans combines qualified expertise in plant ecology, chemical engineering, agriculture and forestry

Artificial fertilizer

↓

Agriculture

↓

Agricultural waste
Food waste
Sewage sludge

↓

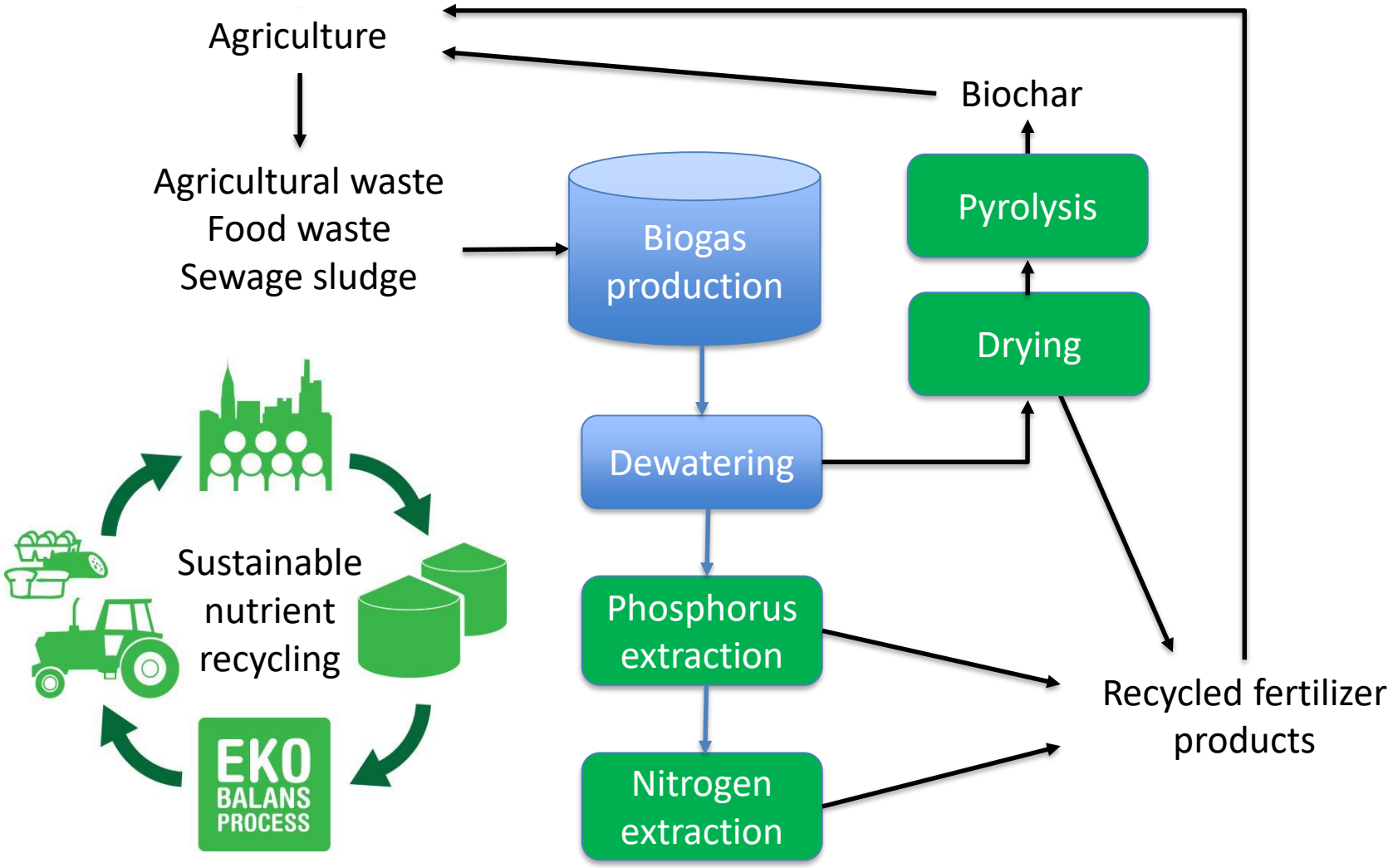
Landfill
Incineration + landfill
Overdosing in agriculture

↓

Ocean

Today's handling of plants nutrients and organic reidues is largely unsustainable and inefficient: One-way high-consumption of finite resources, lack of recycling, and eutrophication of soil and water.

Our goal


Agriculture
Biochar
Agricultural waste
Food waste
Sewage sludge
Biogas production
Pyrolysis
Drying
Dewatering
Phosphorus extraction
Nitrogen extraction
Recycled fertilizer products
Sustainable nutrient recycling
EKO BALANS PROCESS

EkoBalans' technologies

- Phosphorus extraction as struvite
- Short retention time *and* high recovery rate = small footprint / low CAPEX

- Nitrogen extraction as solid ammonium sulfate by stripping and crystallization
- Combines existing proven technologies

- Sludge detoxification by pyrolysis
- Cadmium reduced by 90 %, pathogens and organic pollutants destroyed

Struvite: $MgNH_4PO_4*6H_2O$

Struvite from the eco:P-process

- 12,6 % P; 5,7 % N; 9,9 % Mg
- Sometimes termed MAP
- <u>One</u> mineral - Ca-phosphates many minerals
- Crystalline, non water soluble but highly plant available P
- Specific density: 1,7 kg/dm^3
- Good adhesive and settling properties

Most often recognized as this……

… or as ”sand” in digesters

Digester sediment
70 % DS,12 % LOI

The same sediment after drying
Struvite 70 % of DS

Controlled struvite precipitation – several alternatives

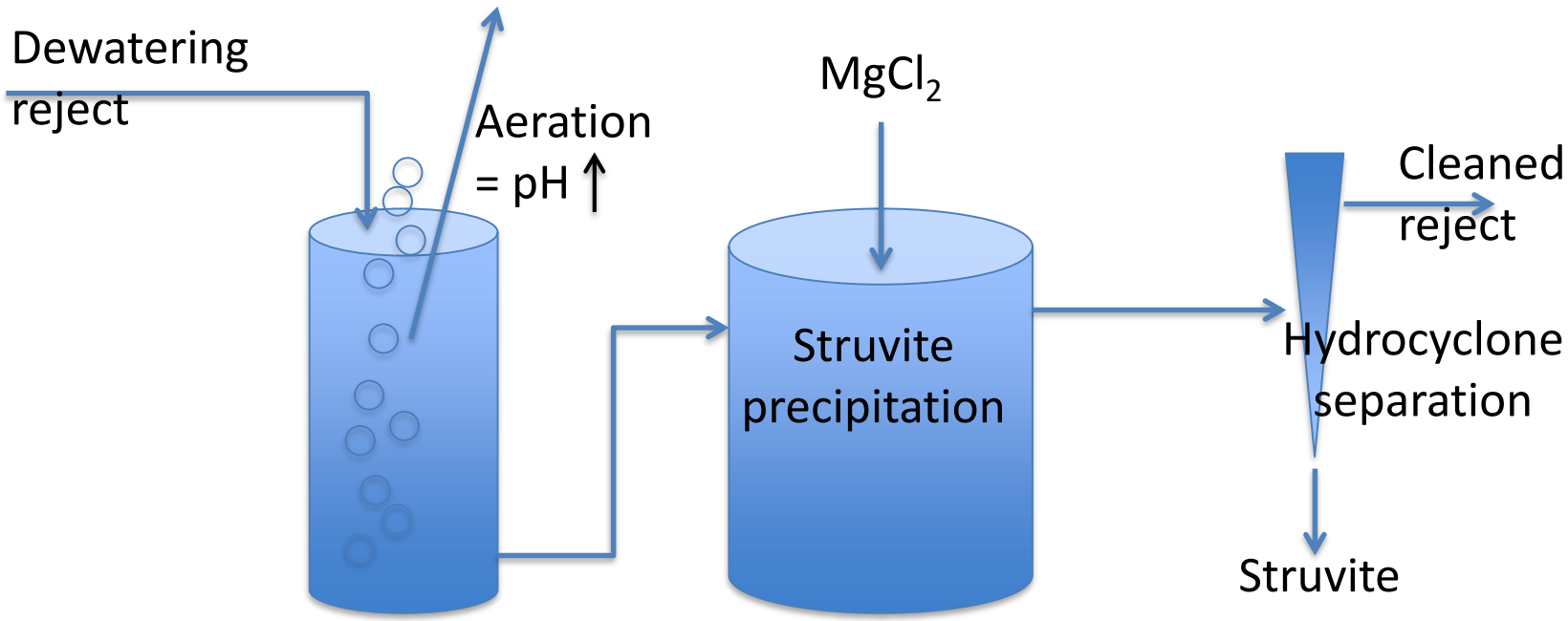
Source

- Directly on digestate, manure etc
- On dewatering reject (centrate, sludge liquor)
- On biosludge dewatering reject before digestion at WWTPs with Bio-P
- After chemical treatment to maximize P release

Technology

- Continuous flow in and out of precipitation tank, build and harvest large crystalls
- Batch based system and harvest microcrystalls – EkoBalans

The eco:P process



EKOBALANS

eco:P process data

- pH 7,5 80 % P reduction, pH 8 >90 % P reduction
- Retention time shortened from 60 to 20 min
- Capacity increased from 2 to 5 m3/h with shortened retention time
- pH-varitation does not affect struvite quality
- pH-increase by aeration
- Aeration lowers Mg consumption (less $MgCO_3$-formation)
- Hydrocyclone: efficient separation

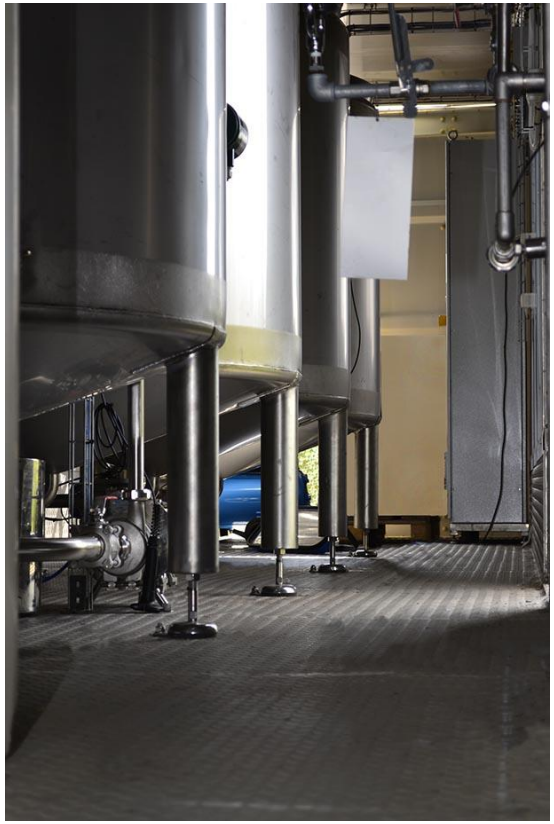
eco:P struvite

Struvite from the eco:P-process

- Microcrystalline powder
- Spreadable as is or raw material for fertilizer production
- 12,5 % P; 5,5 % N; 9,5 % Mg
- High nutrient plant availability
- Organic content usually <1 %
- Cd below detection limit
- Other heavy metals in lower concentrations than in artificial fertilizers

eco:P characteristics

- Simple, robust process, not sensitive to variations in pH, works at high and low P concentration
- High phosphorus recovery rate AND short retention time = small footprint
- Microcrystalls = short retention time
- pH increased by aeration, no NaOH
- Cost efficient solution
- Microcrystalls = suitable for mixing with N, K, etc
- Microcrystalls = high plant availability

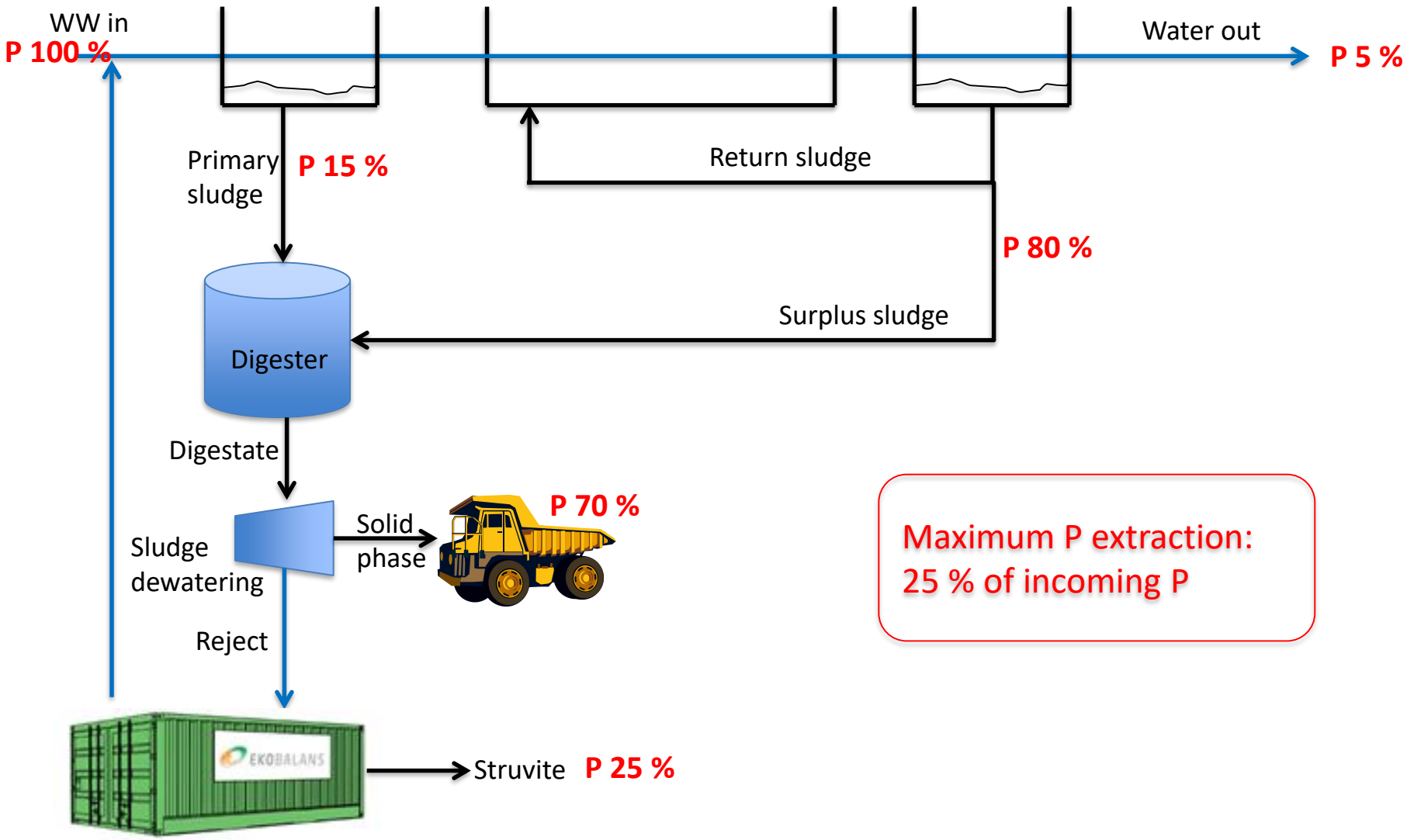


Interior of eco:P-plant

EkoBalans fertilizer products

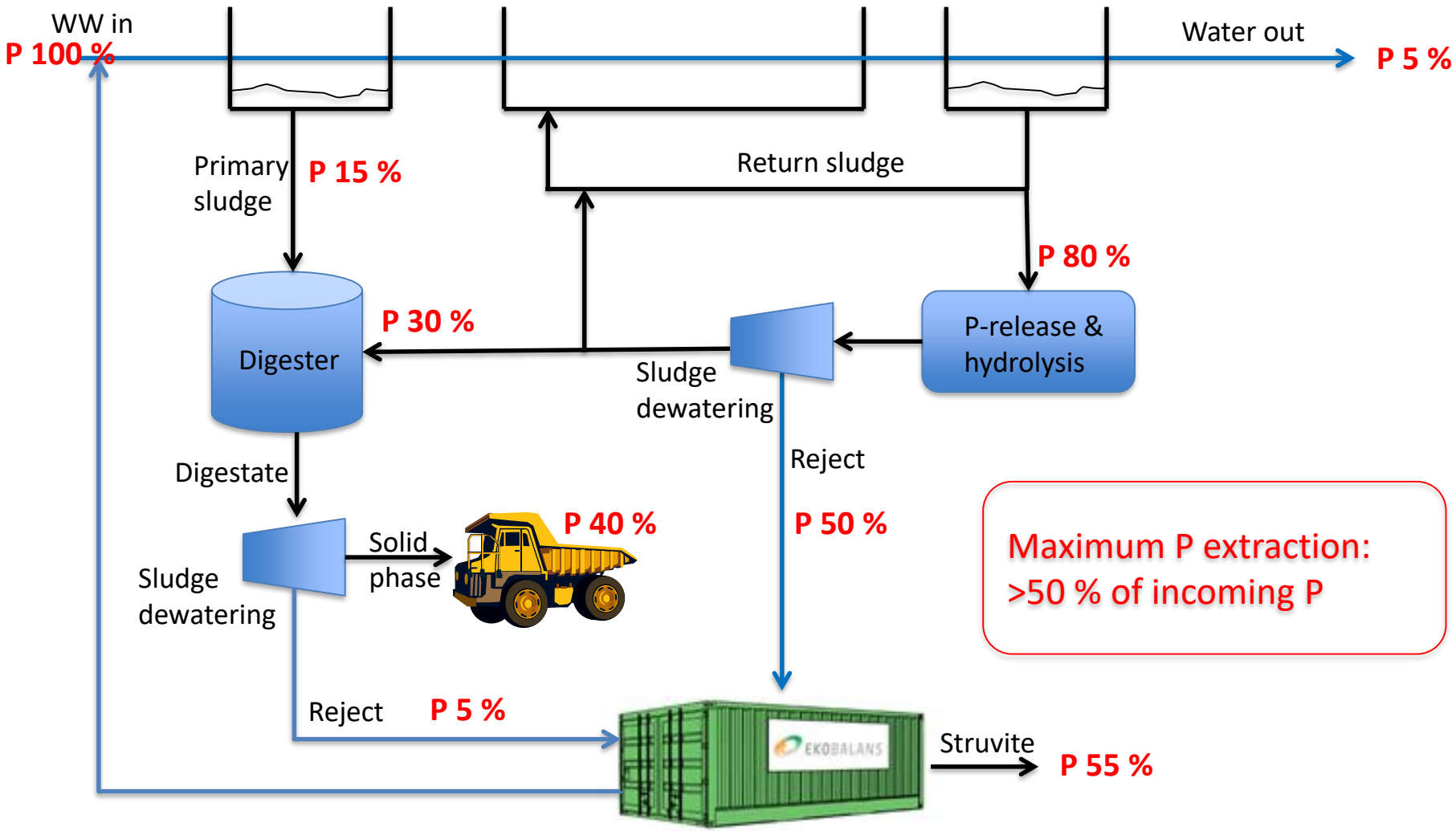
- Recycled phosphorus and nitrogen from the eco:P and eco:N processes
- NPK-mix can be customized
- Artificial fertilizer quality
- No contaminants

Struvite precipitation on final sludge dewatering reject at WWTPs with Bio-P



Maximum P extraction:
25 % of incoming P

Integrated system: struvite precipitation on biosludge dewatering reject before digestion



Maximum P extraction: >50 % of incoming P

Economy

Economy at conversion from chemical to biological phosphorus removal and eco:P installation at a 100.000 p.e. WWTP

OPEX struvite extraction	€/yr	15 000
Revenue for sold struvite	€/yr	30 000
<u>Cost reduction</u>		
- Chemicals	€/yr	130 000
- Sludge disposal	€/yr	100 000
- Energy savings	€/yr	70 000
- Nitrogen removal	€/yr	55 000
Net improvement	€/yr	370 000
Investment eco:P	€	900 000
ROI	yrs	2,4

Economy

Economy when installing eco:P at a WWTP for 100.000 p.e. with biological phosphorus removal

OPEX struvite extraction	€/yr	15 000
<u>Revenue</u>		
- Sold struvite	€/yr	30 000
- Increased gas production	€/yr	70 000
<u>Cost reduction</u>		
- Sludge disposal	€/yr	80 000
- Less struvite clogging	€/yr	60 000
- Nitrogen removal	€/yr	55 000
Net improvement	€/yr	280 000
Investment eco:P	€	900 000
ROI	yrs	3,2

What is needed for widespread implementation of sustainable P recycling?

INCENTIVES

Thank you for your attention!

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