

carbon | nitrogen | phosphorus

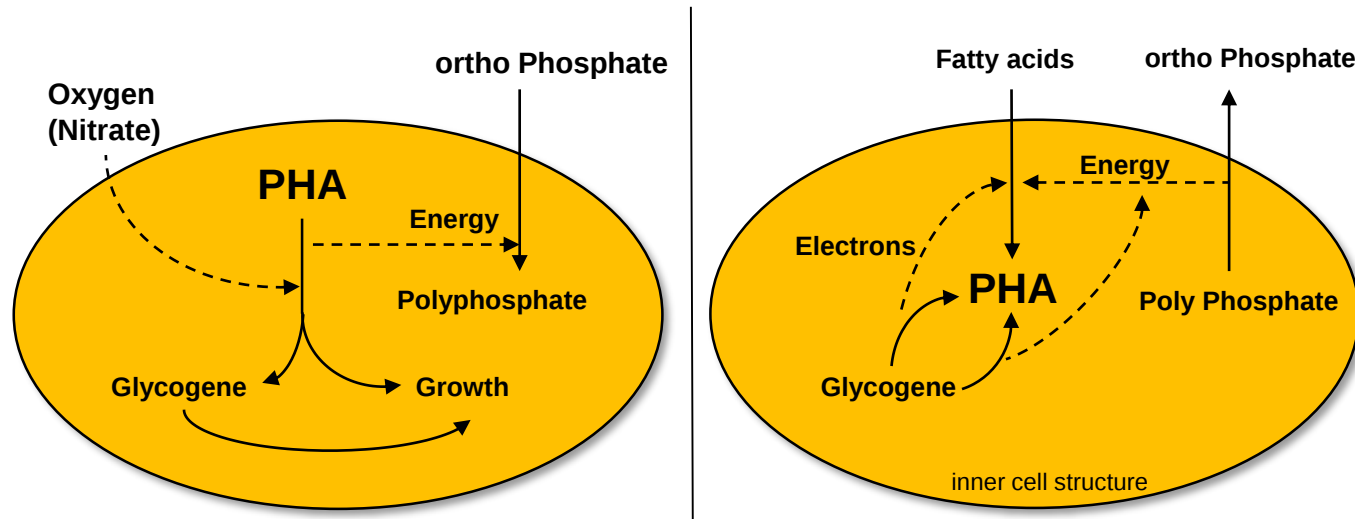


AirPrex™:
Process for Optimization of
Biosolids Treatment with the
option of Phosphate
Recovery

July 2015

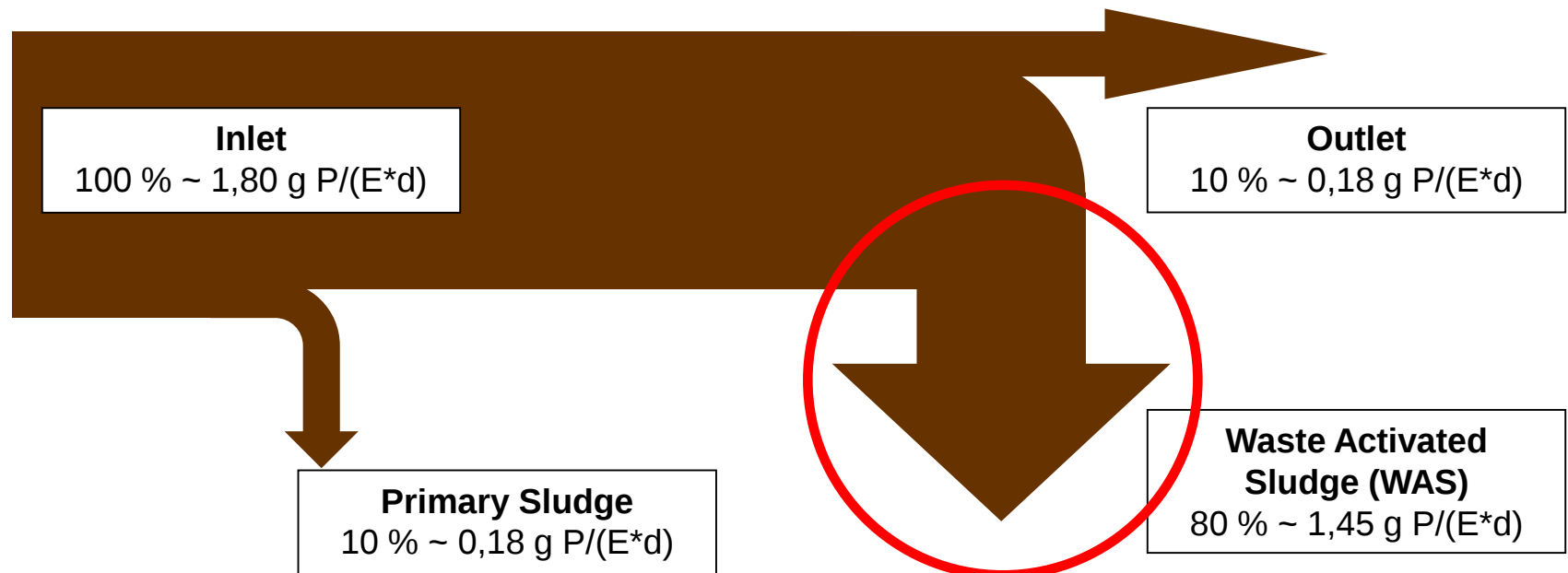
- Biological Phosphate-Removal
- Influence of Phosphate on
 - Magnesium-Ammonium-Phosphate (MAP/ Struvite) crystallization
 - Sludge properties / Sludge dewatering
 - P- Recovery
- Phosphate precipitation as Struvite
- AirPrexTM- Installations → References
- Use of Struvite
- Summary and Outlook

Enhanced Biological Phosphate Removal



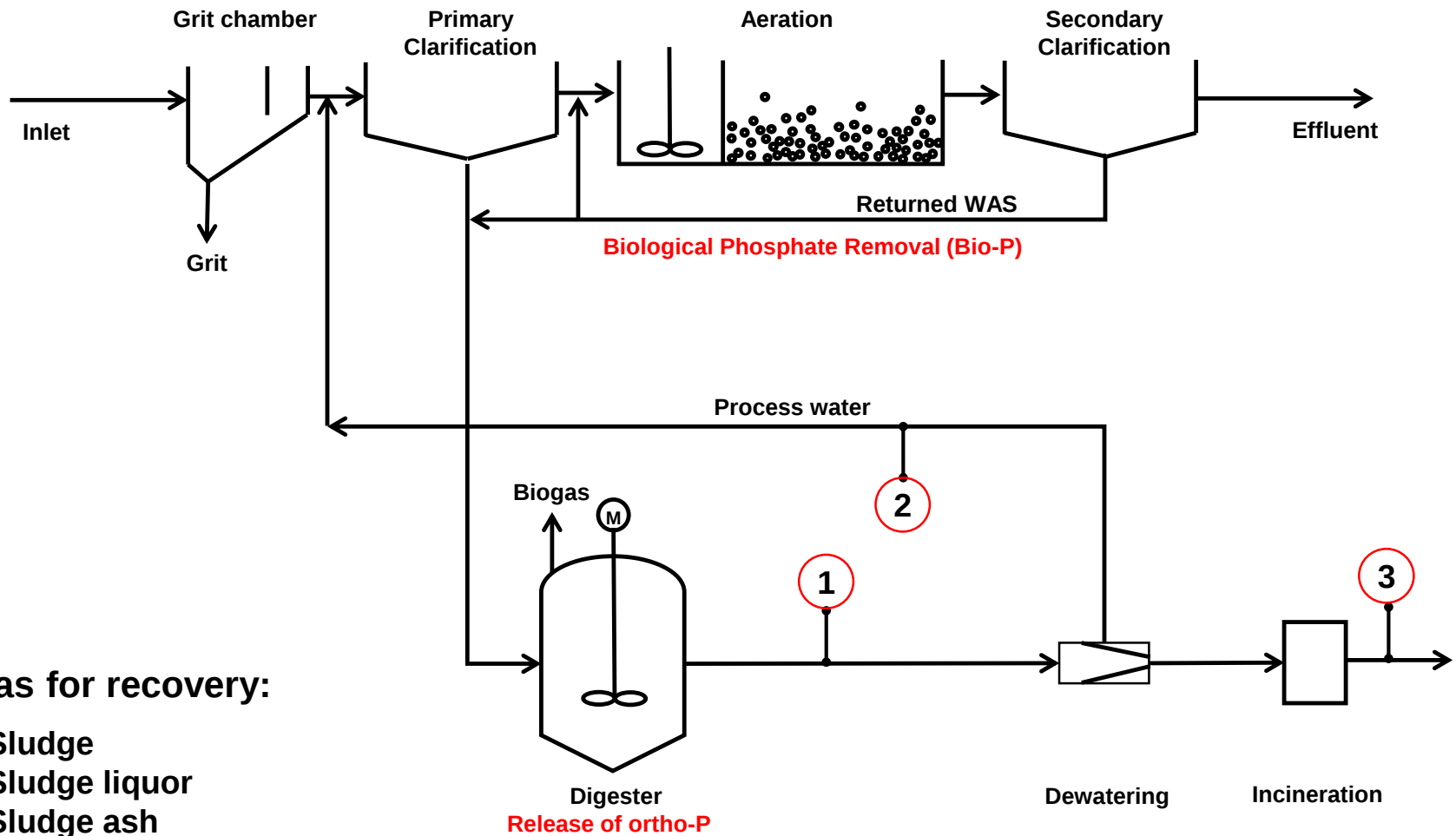
Aerobic Biological Zone	Anaerobic Zone / Digester
=	=
increased PO_4 intake	PO_4 release
due to the	due to the
formation of polyphosphates	hydrolysis of polyphosphates

Phosphorus flow and –concentrations in the WWTP

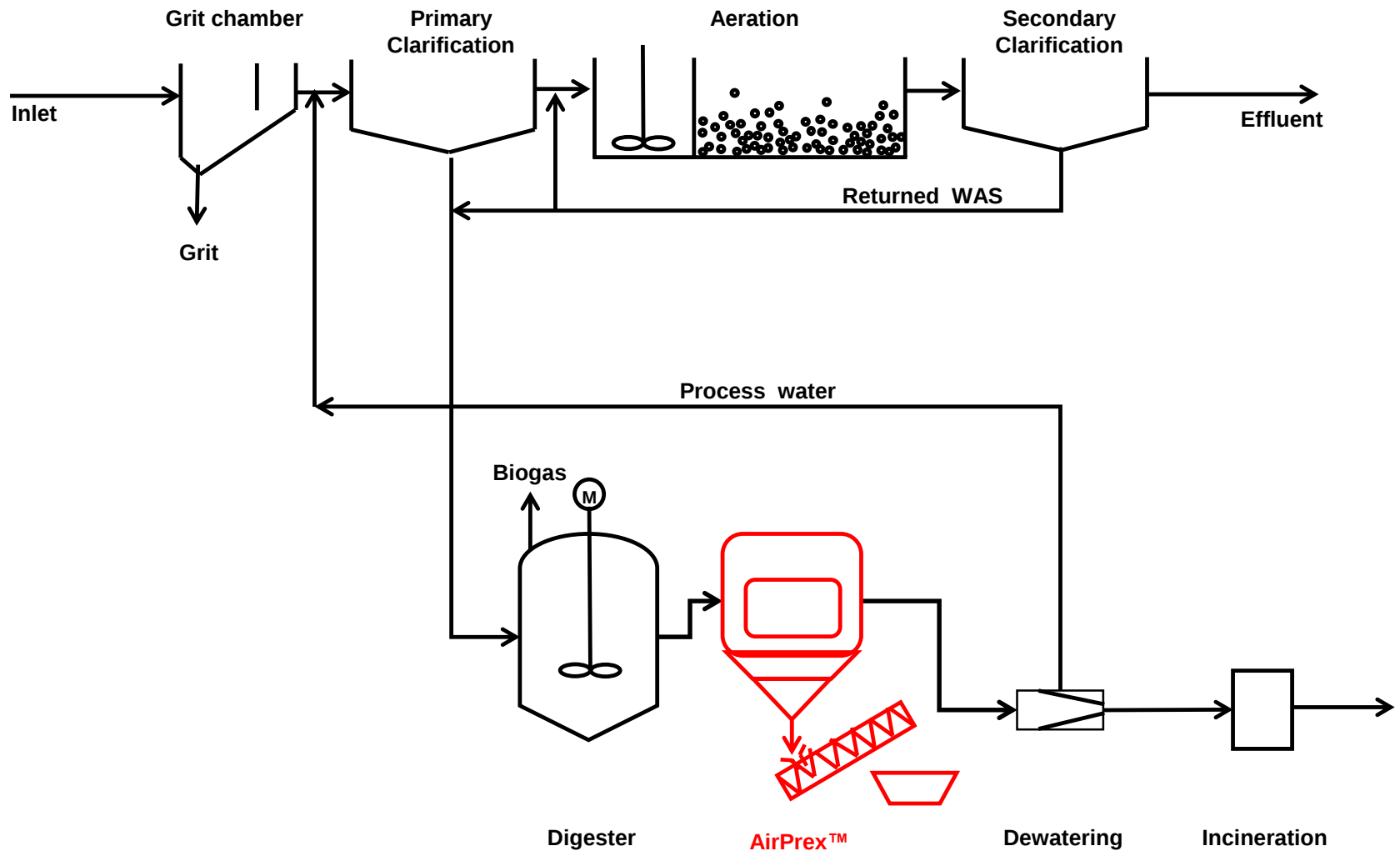


WAS is main
carrier for
phosphate

Possible areas for P-Recovery



Integration of the AirPrex[®] Process



Biological Phosphate Elimination in the Water phase Summary



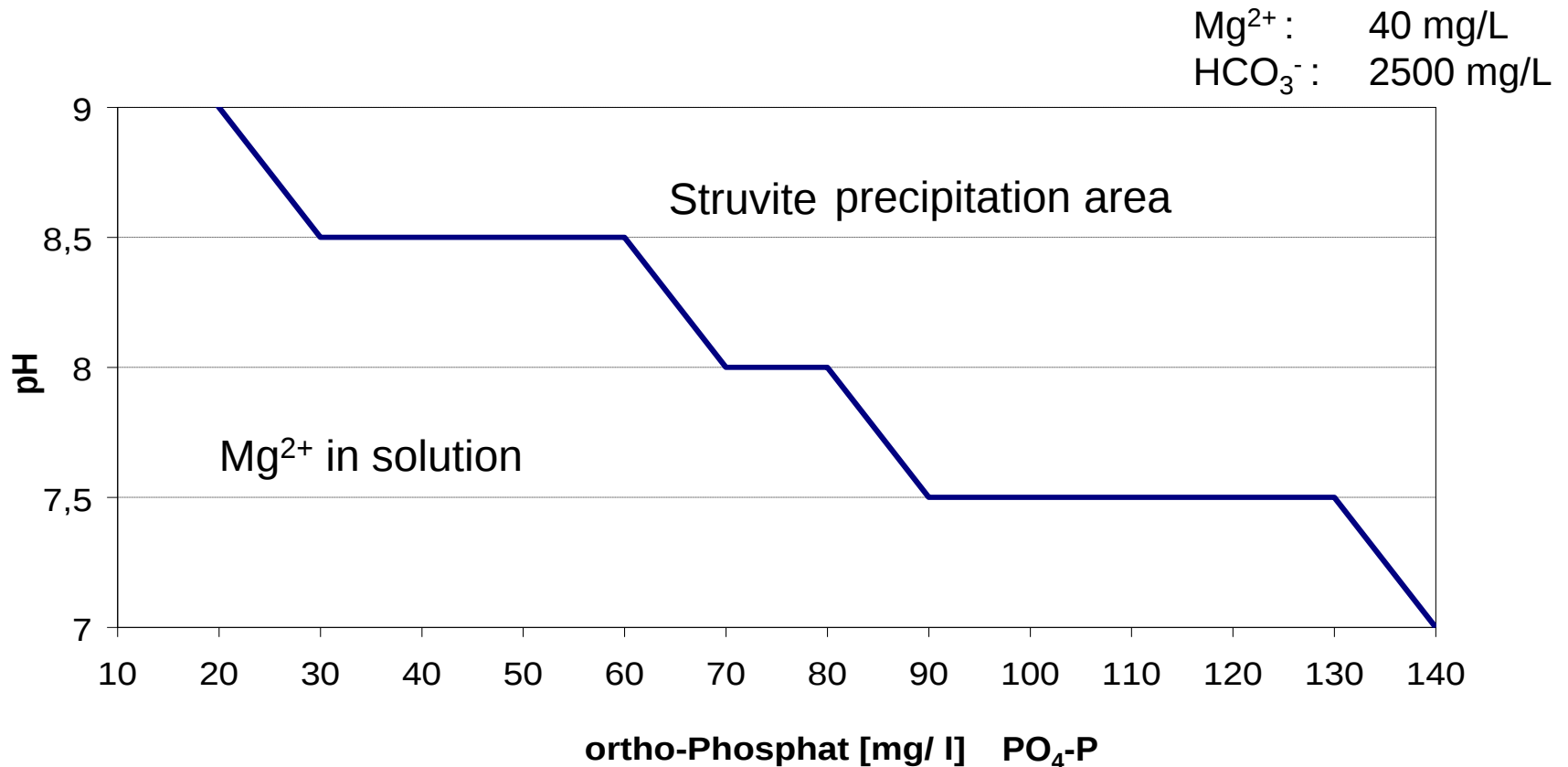
- Internal recycling of ortho-phosphate ($\text{PO}_4\text{-P}$)
- Uncontrolled Struvite crystallization and deposits
- Negative influence on the sludge dewatering (lower DS and / or higher Polymer usage)
- High internal P-recycling by sludge liquor

Formation of Magnesium-Ammonium-Phosphate (MAP/Struvite)



Chemical equation:	$\text{Mg}^{2+} + \text{NH}_4^+ + \text{HPO}_4^{2-} + 6\text{H}_2\text{O} = \text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O} + \text{H}^+$			
	Mg	NH ₄	PO ₄	6 H ₂ O
Molar weights [g/mol]: Struvite: 245	24.3	18.0	95.0	108.0
Share in per cent [%]:	9.9	7.3	39.0	43.8

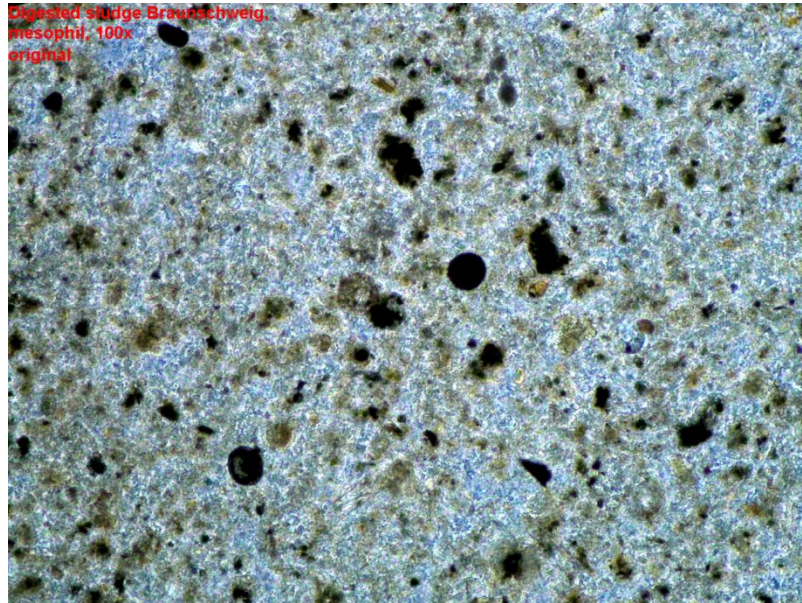
Struvite Crystallisation Relation P-content and pH



Uncontrolled Struvite precipitations



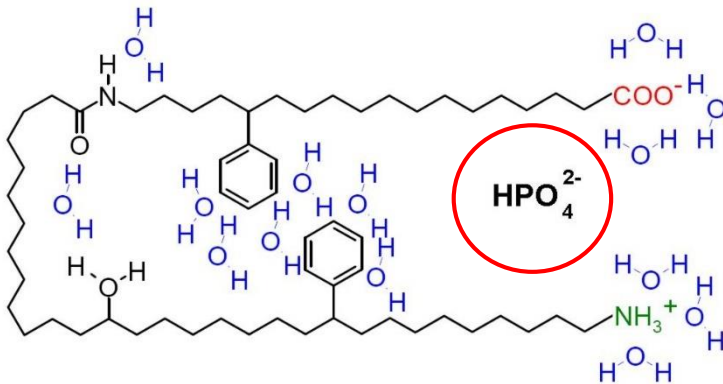
Influence of Ortho-Phosphates on the water absorption capacities of digested sludge



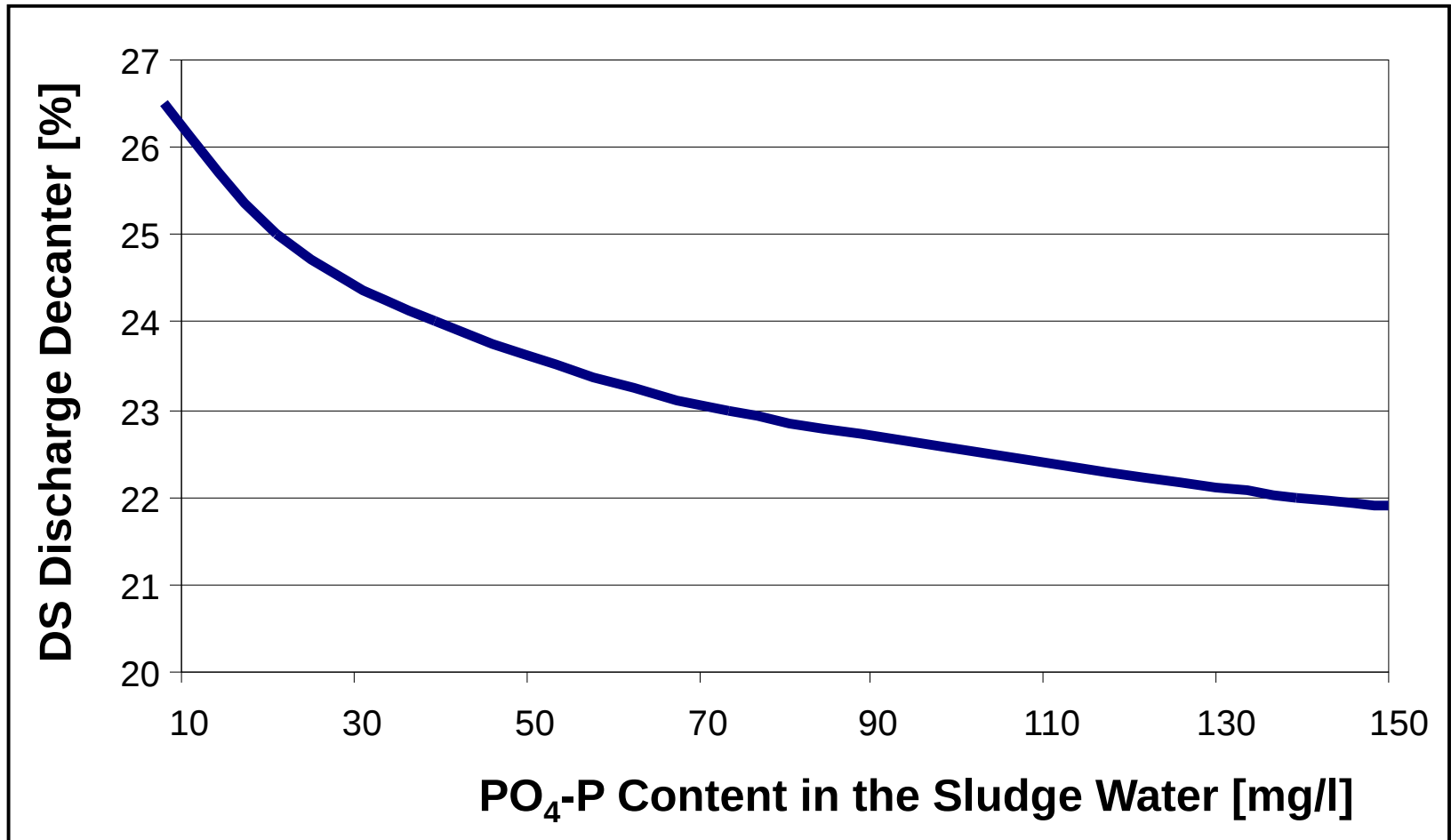
Water absorption by hydrogels (EPS), shown with polysaccharides, proteins, etc.

Stabilisation due to phosphates and increased pH values

Consequence:
Increased water absorption capacity
AND
therefore decreasing sludge dewatering efficiency (less cake dryness and higher Polymer consumption)



Influence of the PO₄-P concentration on the dry solid content during dewatering

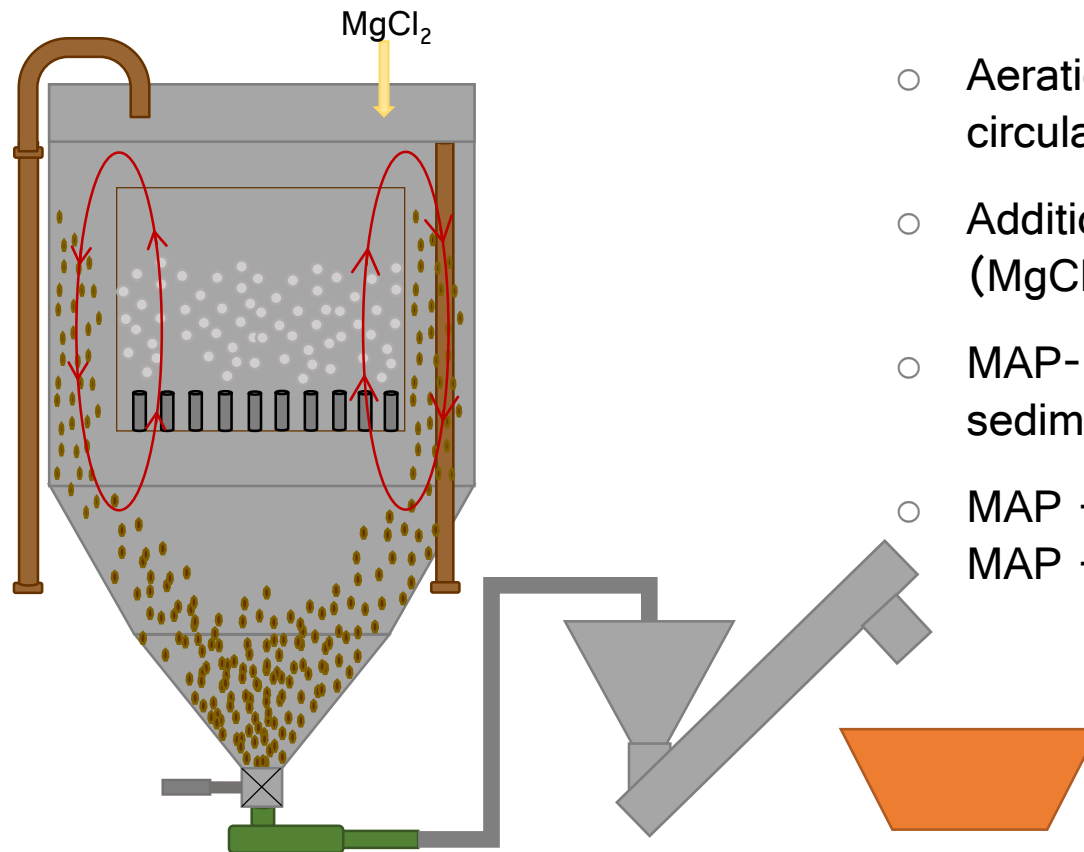


AirPrex® Process for the targeted Struvite precipitation



- CO_2 stripping by aeration
- Increase of pH to 7.8 – 8.2
- Addition of Magnesium chloride (MgCl_2)
- Growing and sedimentation of Struvite
- Struvite separation and cleaning

AirPrex[®] Process for selective MAP - Precipitation



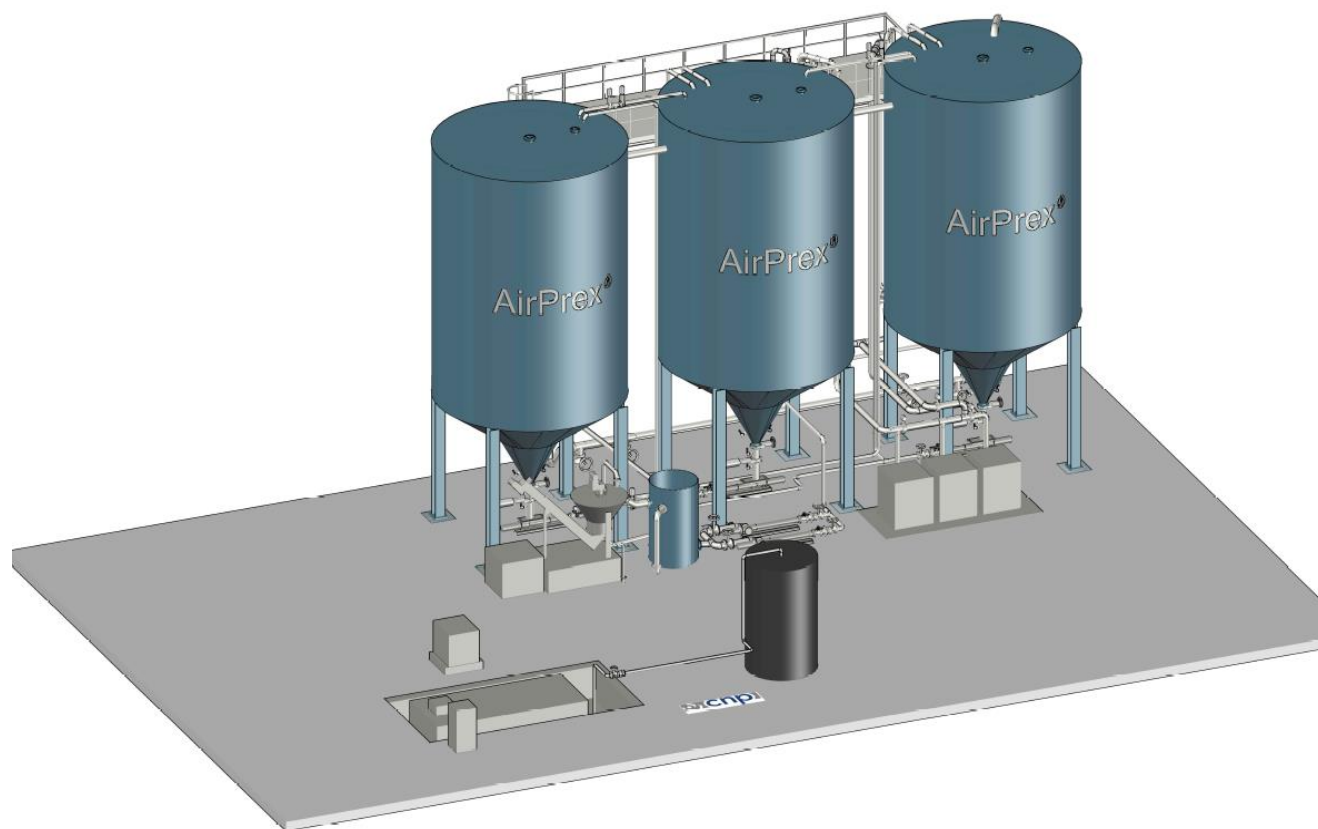
- Aeration for CO_2 stripping and circulation
- Addition of Magnesiumchloride ($MgCl_2$)
- MAP- crystal growth and sedimentation
- MAP - Separation and
MAP - Cleaning



AirPrex[®] Process for selective MAP - Precipitation



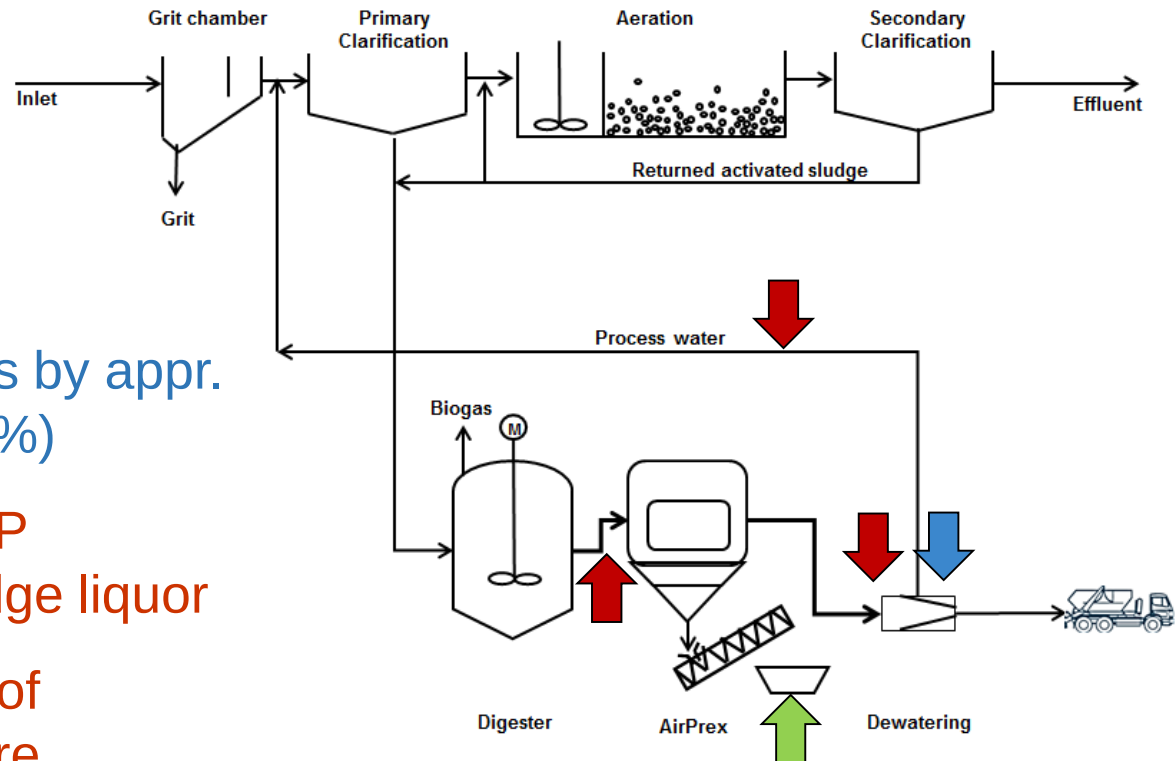
AirPrex® Process for selective MAP - Precipitation



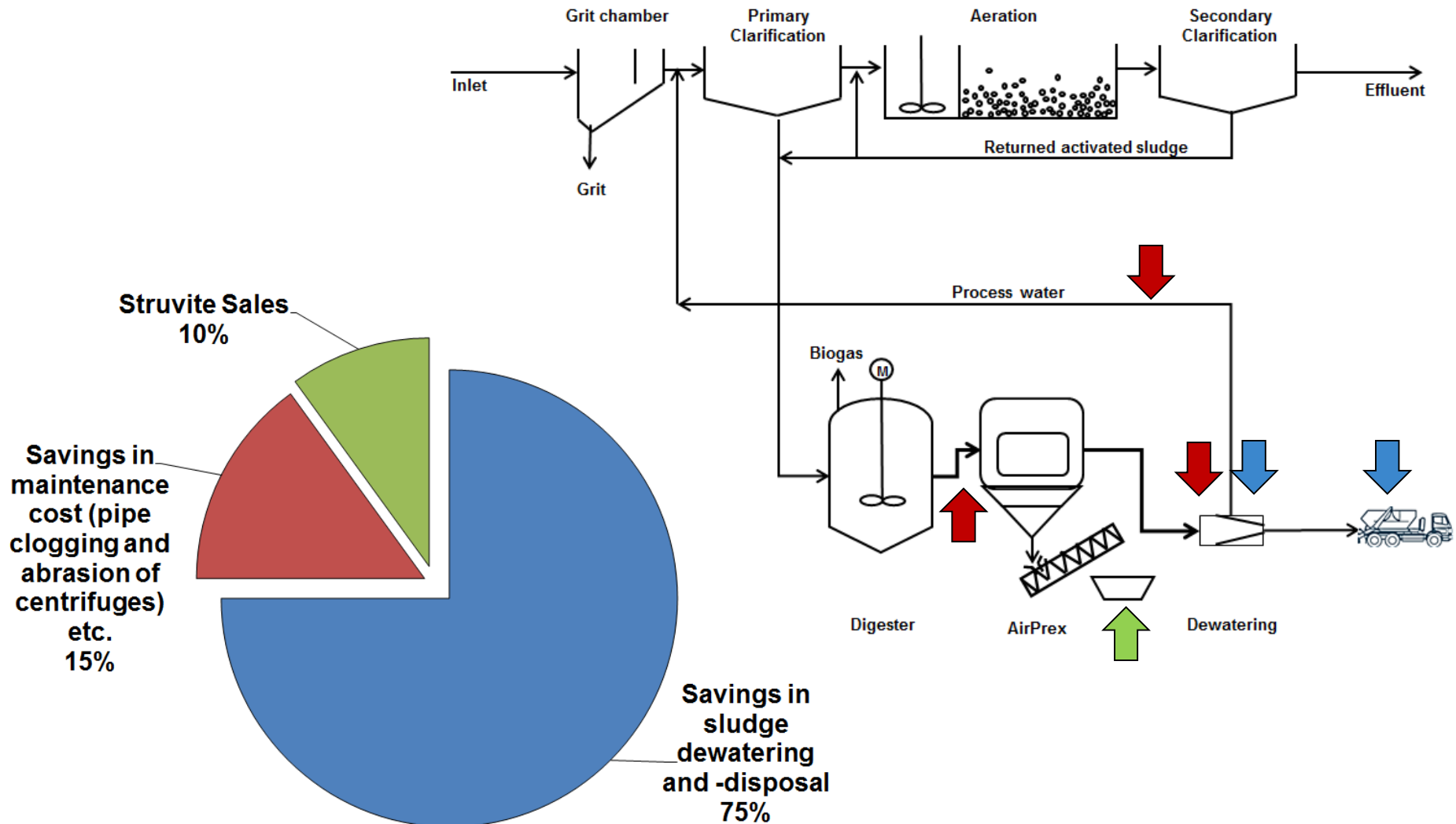
Economic drivers for AirPrex®



1. Increase of cake dryness by appr. 3 to 4% (e.g. 22% → 26%)
2. 95% reduction of Ortho-P concentration in the sludge liquor
3. Elimination / prevention of crystallization in the entire sludge- and centrate area
4. Production of Struvite



AirPrex® Process - The perfect location for maximum savings



The following WWTP already use an AirPrex® System:

- ❖ Berlin Waßmansdorf (Germany), 1.200.000 P.E. (2010)
- ❖ Mönchengladbach Neuwerk (Germany), 650.000 P.E. (2010)
- ❖ Wieden-Echten (Netherlands), 190.000 P.E. (2013)
- ❖ Amsterdam-West (Waternet, Netherlands), 1.000.000 P.E. (2013)
- ❖ Uelzen (Germany), 83.000 P.E. (since March 2015)
- ❖ ASG Salzgitter Nord (Germany), 120.000 P.E. (since April 2015)
- ❖ Tianjin (China), 1.000.000 P.E. (Start-up Nov. 2015)
- ❖ Wolfsburg (Germany), 120.000 P.E (Start up July 2016)

AirPrex® Installation Berlin-Wassmannsdorf WWTP (Germany)



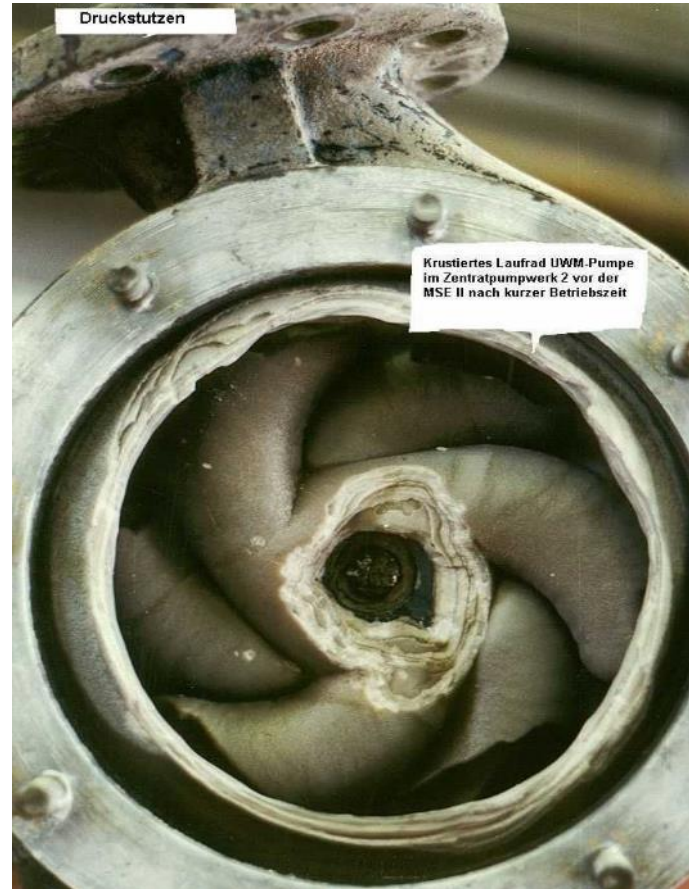
Berliner Wasserbetriebe (BWB), Germany
Berlin-Wassmannsdorf WWTP (1,000,000 P.E. or People Equivalent)

Capacity AirPrex®: 2,000 m³/d anaerobically digested (AD) sludge
Struvite production: approx. 2,500 kg/d
Start-up: 2010

AirPrex® Installation Berlin-Wassmannsdorf WWTP (Germany)



Problem:
uncontrolled Struvite precipitation



Quelle: A.Lengemann, BWB

AirPrex® Installation Berlin-Wassmannsdorf WWTP (Germany)



Struvite as bulk delivery

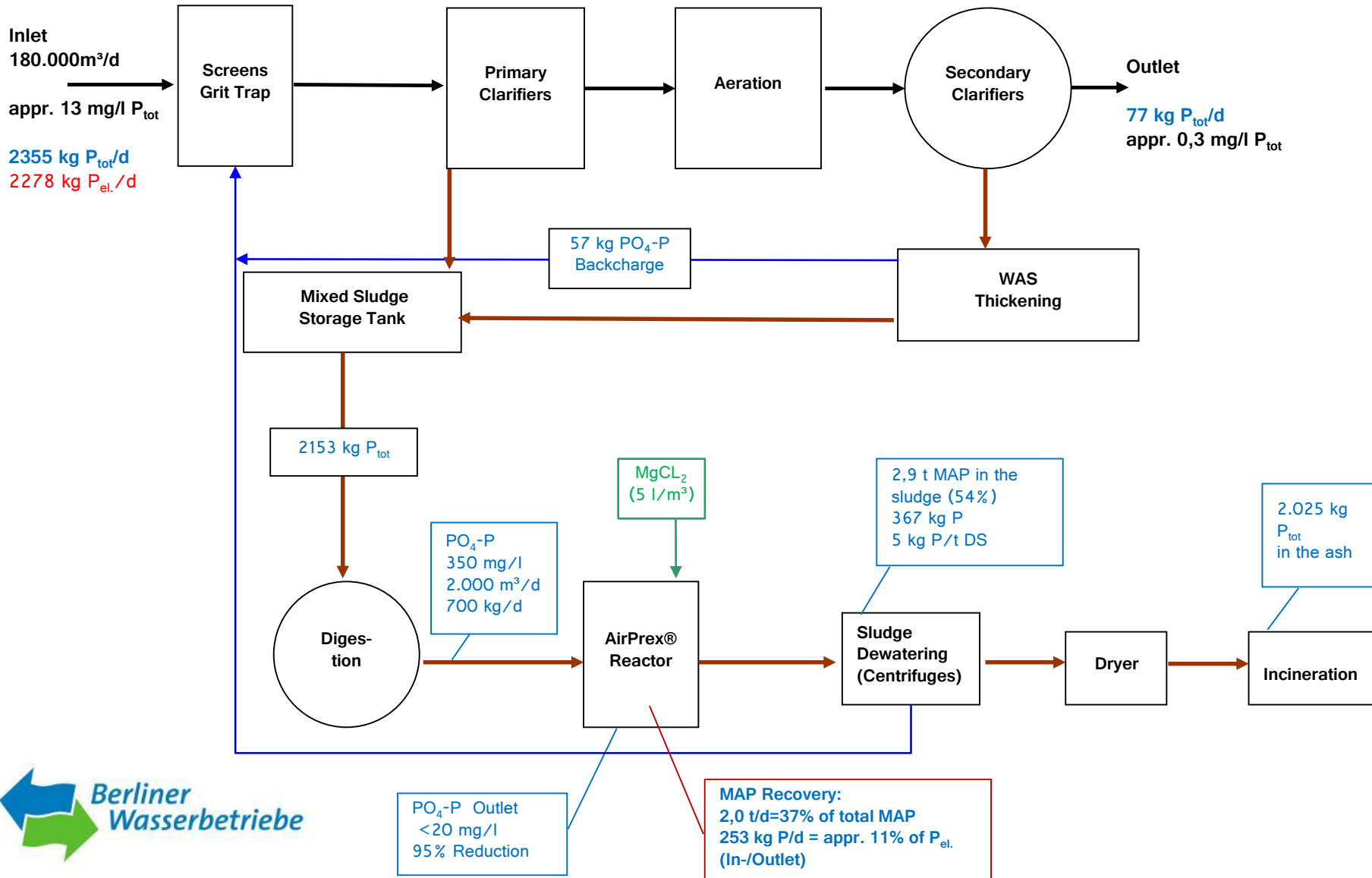


Berliner Pflanze - Produktverpackungen

Quelle: Berliner Wasserbetriebe, 2013

Struvite packaged for sale to public

Daily Phosphorus Balance of Berlin Wassmannsdorf WWTP



AirPrex® Installation Moenchengladbach-Neuwerk WWTP (Germany)



Quelle: Niersverband



AirPrex® Installation Moenchengladbach-Neuwerk WWTP (Germany)



Dewatering

Digester



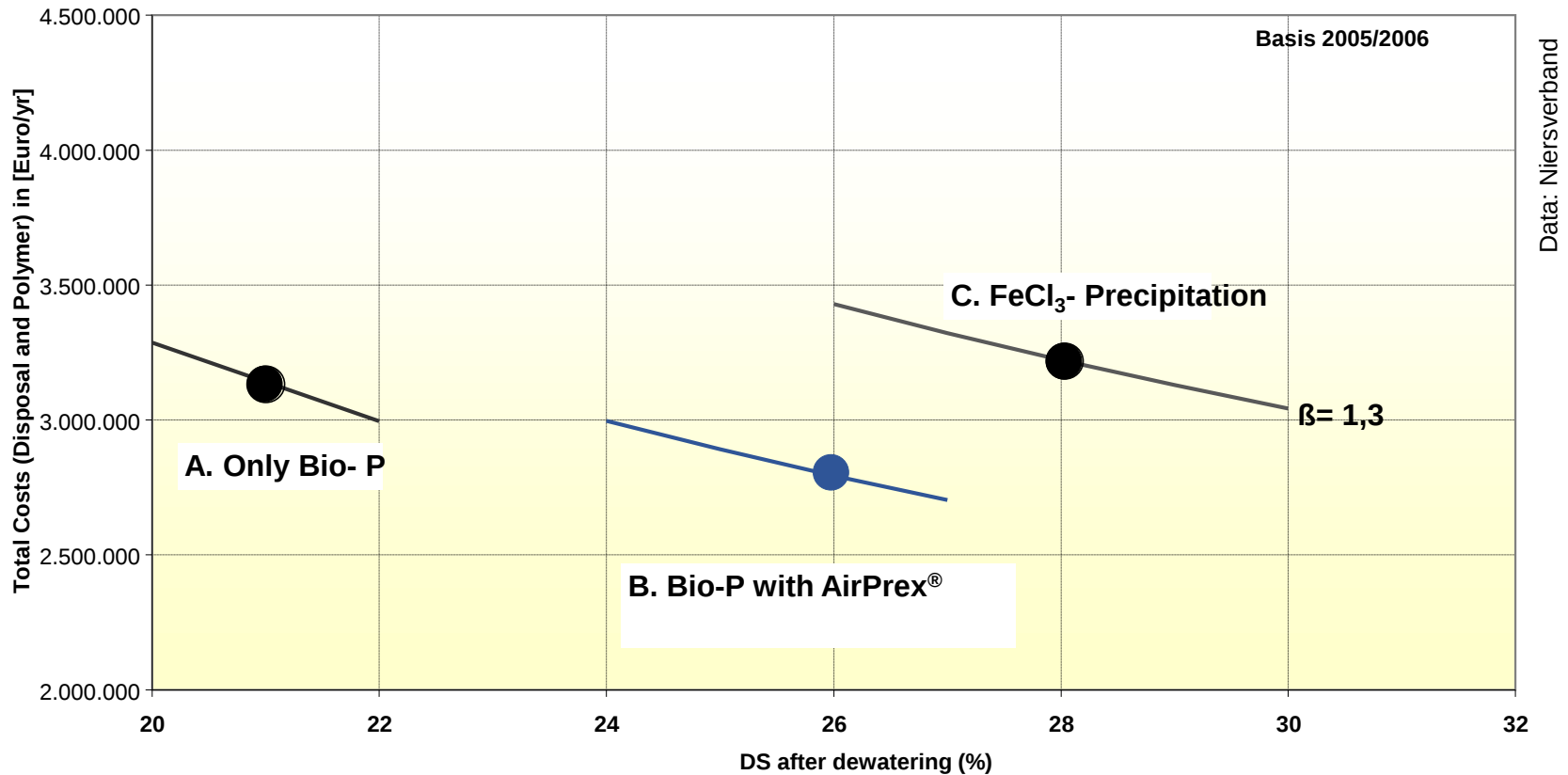
AirPrex® Installation Moenchengladbach-Neuwerk WWTP (Germany)



Niersverband, Germany
MG-Neuwerk WWTP (995,000 P.E.)

Capacity AirPrex®: 1,500 m³/d digested sludge
Struvite production: 1,500 kg/d
Start-up: 2009

AirPrex® Process M'gladbach-Neuwerk Economy



A. Only Bio-P:	3.150.000 € p.a.
B. Bio-P plus AirPrex®:	2.600.000 € p.a.
C. chem. P-Precipitation (FeCl ₂):	3.200.000 € p.a.

AirPrex® Installation Echten WWTP (Netherlands)



Reest & Wieden, NL
Echten WWTP (190,000 P.E.)

Capacity AirPrex®: 400 m³/d AD sludge
Struvite production: appr. 500 kg/d
Start-up: 2013

AirPrex® Installation Amsterdam WWTP (Netherlands)

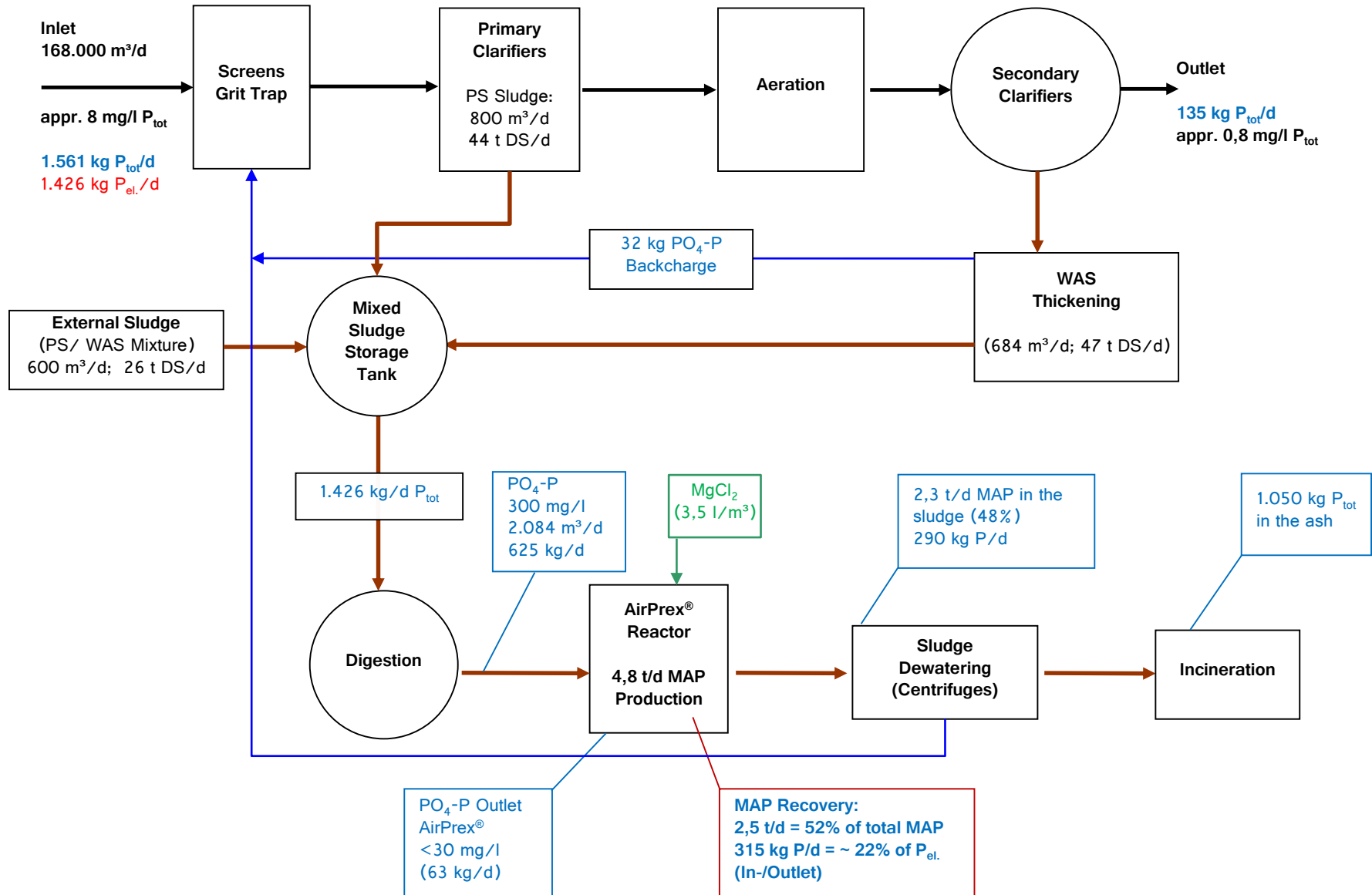


Waternet, NL
Amsterdam-West WWTP (1,000,000 P.E.)

Capacity AirPrex®: 2,500 m³/d AD sludge
Struvite production: 4,000 – 5,000 kg/d
Start-up: 2014



Daily Phosphorus Balance of Amsterdam West WWTP



AirPrex® Installation Uelzen WWTP (Germany)



Uelzen WWTP, Germany (83,000 P.E.)

Capacity AirPrex®: 120 m³/d AD sludge

Struvite production: no MAP recovery

Start-up: April 2015

AirPrex® Installation Salzgitter WWTP (Germany)



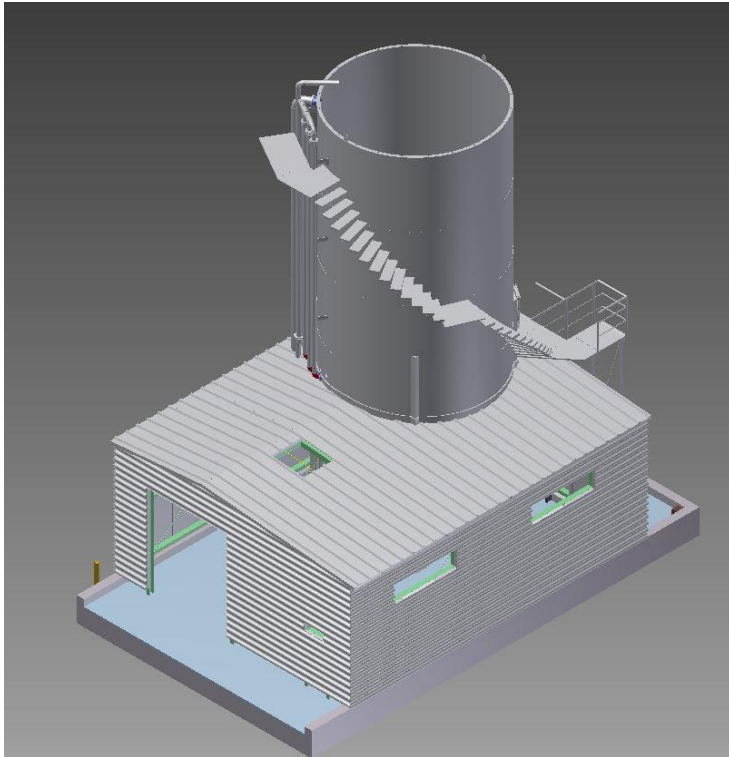
Salzgitter WWTP, Germany (120,000 P.E.)

Capacity AirPrex®: 240 m³/d AD sludge

Struvite production:

Start-up: July 2015

AirPrex® Installation Wolfsburg WWTP (Germany)



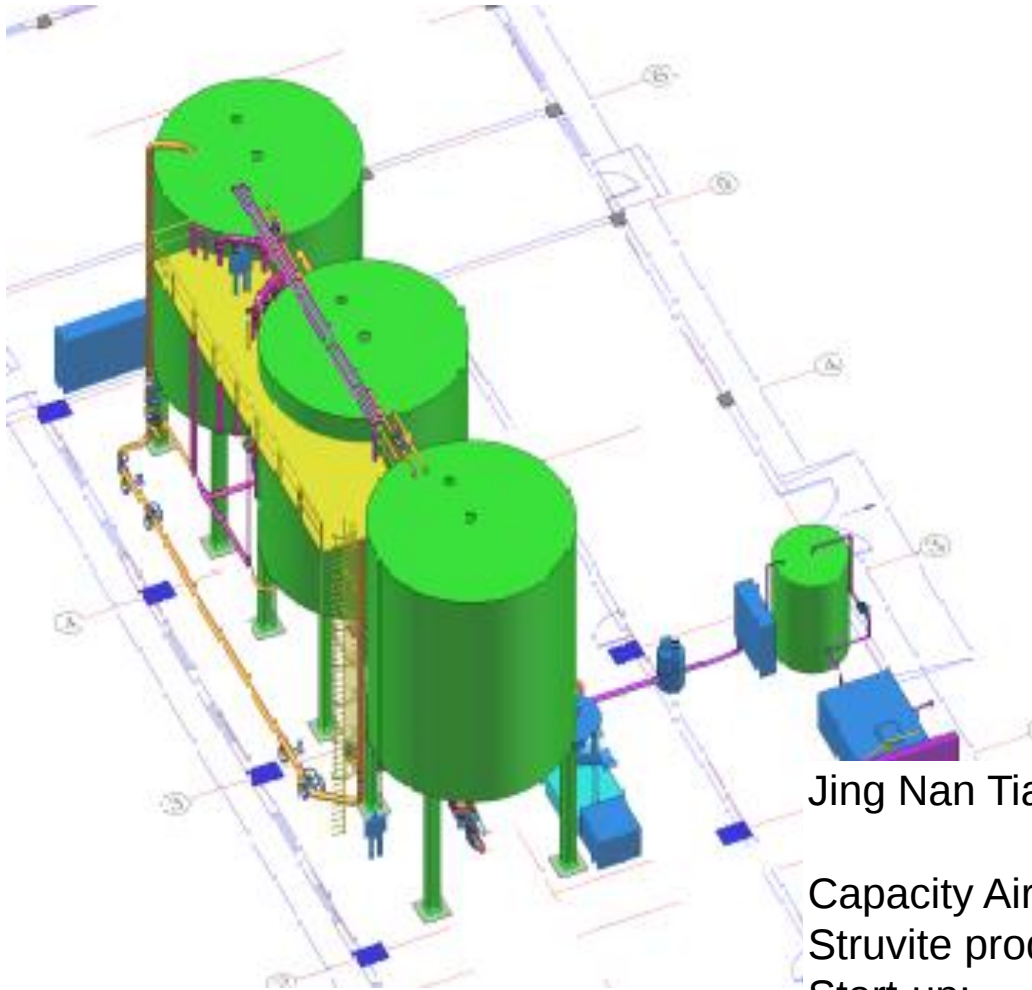
Wolfsburg WWTP, Germany (185,000 P.E.)

Capacity AirPrex®: 280 m³/d AD sludge

Struvite production:

Start-up: November 2015

AirPrex® Installation Jing Nan Tianjin WWTP (China)



Jing Nan Tianjin WWTP, China (1,000,000 P.E.)

Capacity AirPrex®: 1,608 m³/d AD sludge

Struvite production:

Start-up:

Nov. 2015

Use of Struvite



- Struvite:
By-product with a good use as a fertilizer
- Nutrients have been proven in accordance with the German law (certified as fertilizer)
 - low heavy-metal content
 - slow release of nutrients
(no wash-away effect)
- REACH certified



- The specific phosphate precipitation by Struvite crystallization (AirPrex®) leads to the following advantages
 - **Minimize the crystallization** potential
 - **Positive impact on the sludge dewatering** by a constant P-Elimination rate between 90 and 95%
 - AirPrex® is an **approved and reliable technology** with large-scale references
 - Good quality **fertilizer** as a by-product



Thank you for
your attention
and interest!