

carbon | nitrogen | phosphorus

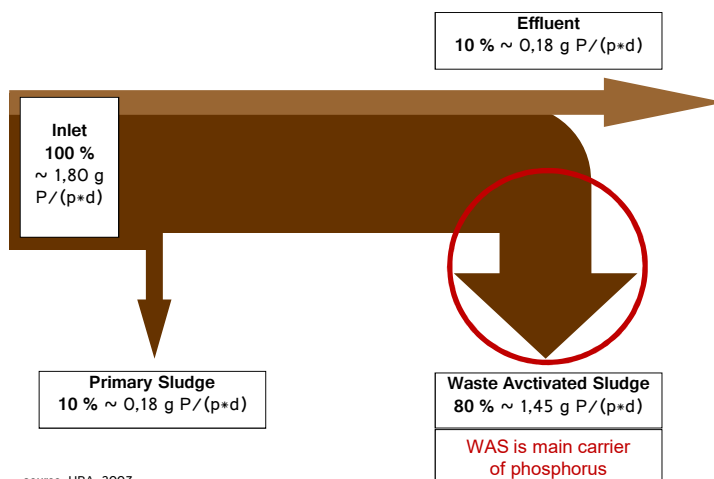


P Recovery

- Brief Introduction of new Requirements and appropriate Solutions -

CNP-Technology Water and Biosolids GmbH
May 2018

Phosphorous Removal and Recovery Mass Balance and New German Law (AbfKlärV 2017)



source: UBA, 2007

Effluent

The German Water Resources Act (**WHG, 2010**) was adapted to the requirements of the European Water Framework Directive. As a result, the water immission control legislation in each federal state has to be adapted (**OGewV**). In some cases, smaller STPs (<10.000 PE) have now to comply with phosphorus thresholds, whereas medium (>10.000 P.E.) and large (>100.000 PE) size STPs have to comply with stricter regulations than those laid down in the Wastewater Ordinance (**AbwV, 2017**).

Sludge

The new Sewage Sludge Ordinance (**AbfKlärV, 2017**) is strictly targeting Phosphorous recovery.

Larger STPs (>50.000 PE) having >20g P/kg DS in residual sludge must meet following requirements:

- > <20g P/kg DS in sludge after P recovery, or
- > <50% P recovery efficiency from sludge, or
- > <80% P recovery efficiency from dry ash

Smaller STPs (<50.000 PE) must also meet these requirements, unless their sewage sludge is fully used as a fertilizer in agriculture.

CNP's Product Portfolio: Specialist Supplier of Biosolids Recovery Technologies



§	Technology	Application of CNP Technology in Sludge Treatment Line	Achievements
<20 g P per kg DS in sludge	AirPrex® Macro Post-Digestion Struvite (MAP) Macro Crystallization		<ul style="list-style-type: none"> improved dewatering reduced pipe scaling 95% reduced P load in chargeback 30-50% P recovery P depleted sludge
>50% P recovery from sludge	CalPrex™ Pre-Digestion Brushite (DCP) Crystallization		<ul style="list-style-type: none"> improved dewatering reduced pipe scaling 95% reduced P load in chargeback >50% P recovery P depleted sludge
>80% P recovery from dry ash	AirPrex® Micro Post-Digestion Struvite (MAP) Micro Crystallization		<ul style="list-style-type: none"> improved dewatering reduced pipe scaling 95% reduced P load in chargeback P stabilized in sludge P recovery from ash

P Biosolids Recovery Plant AirPrex® Patented P-Removal Process



Principle

AirPrex® removes struvite, which tends to encrust surfaces (pipes, walls, aggregates) of wastewater treatment plants. It is a complete sludge optimization and phosphorus recovery system, installed **between** anaerobic digestion and dewatering. Easy retrofitting possible.

Applications

WWTP with EBPR (Bio-P):

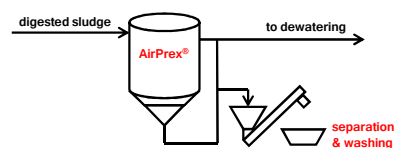
- Digested sludge
- Filtrate / Centrate

Benefits

Reduction of

- disposal costs by up to 20%
- polymer consumption for dewatering
- phosphorus recycle load over 90%
- maintenance costs (=> significant)

Additional revenue from fertilizer reselling



P Biosolids Recovery Plant AirPrex® Micro and AirPrex® Macro Process



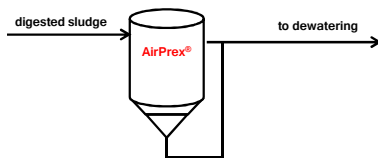
AirPrex® Micro

Principle

The AirPrex® Micro Process has no struvite recovery, microcrystals remain in sludge for targeting $\geq 80\%$ P recovery from ash*.

Benefits

- Increase of cake dryness up to 4%
- Less polymer consumption (15-25%)
- Reduction of Phosphorus by $> 90\%$ in the filtrate (internal recycling)
- Prevention of crystallization in the sludge and centrate area



* In accordance with German Regulations

AirPrex® Macro

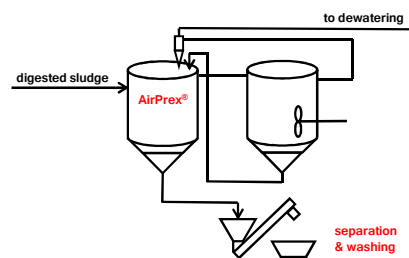
Principle

AirPrex® Macro Process, besides struvite harvesting, includes further P release into the second mixing tank where enhanced struvite growth and sedimentation occurs, enabling micro crystals recovery.

Benefits

The same benefits as AirPrex® Micro plus

- Enhanced P-release out of sludge
- Macro crystals of struvite
- Higher direct recovery rates (up to 50%) targeting $P < 20\text{g/kgDS}^*$



P Biosolids Recovery Plant CalPrex™ Phosphorous Recovery



Function

Pre-digestion high-rate phosphorus recovery technology from anaerobic acid digesters. The phosphate contained in sludge dry solid and sludge liquor is separated and converted into a valuable fertilizer. Target is a high total Phosphorus recovery.

Applications

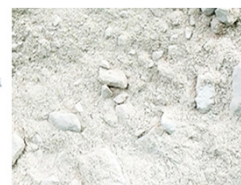
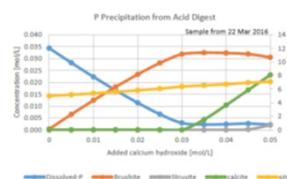
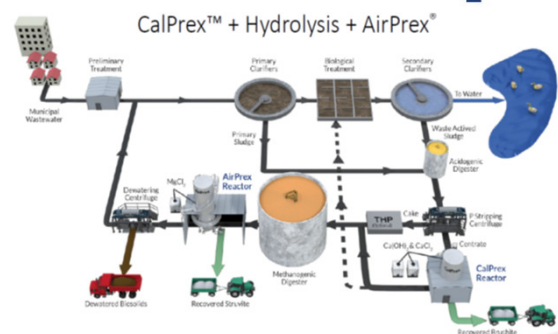
- A mesophilic anaerobic acid digester produces a lower pH environment where P is solubilized. The centrate, which contains the bulk of the soluble phosphate, is reacted in slightly acidic conditions to Brushite.
- After the Brushite removal the depleted centrate is recombined with cake and sent to the methane digester or, if available, to a hydrolysis process.

Design sizes and performances

- Anaerobic acid digester HRT $\approx 1,5$ days
- $\text{Ca}(\text{OH})_2 / \text{CaCl}_2$ dosing target pH 6.5
- Valuable fertilizer product Brushite ($\text{CaH}[\text{PO}_4] \cdot 2\text{H}_2\text{O}$)

Benefits

- Reduction of the P load in the filtrate, which is recycled to the headworks
- Struvite control pre and post digestion and dewatering efficiency
- Brushite formed in acid conditions is a valuable high-grade fertilizer
- Improvement of the N-to-P ratio in biosolids that are land applied
- Low processing volume and high total P recovery ($>50\%$)



**P Biosolids Recovery Plants
AirPrex® Installations**



	<p>Niersverband - Mönchengladbach-Neuwerk</p> <p>WWTP MG-Neuwerk Capacity AirPrex®: 995.000 P.E. MAP-Recovery: 1.500m³ sludge/d Commissioning: ca. 1.500kg/d 2010</p>		<p>Abwasserzweckverband Uelzen</p> <p>WWTP Uelzen Capacity AirPrex®: 83.000 P.E. Commissioning: 120 m³ sludge/d May 2015 No Struvite recovery</p>
	<p>Berliner Wasserbetriebe</p> <p>WWTP Berlin-Waßmannsdorf Capacity AirPrex®: 1.000.000 P.E. MAP-Recovery: 2.000m³ sludge/d Commissioning: ca. 2.500kg/d 2011</p>		<p>Abwasserentsorgung Salzgitter GmbH</p> <p>WWTP ASG Salzgitter Capacity AirPrex®: 175.000 P.E. Commissioning: 240 m³ sludge/d July 2015</p>
	<p>Reest & Wieden, NL</p> <p>RWZI Echten Capacity AirPrex®: 190.000 P.E. MAP-Recovery: 400m³ sludge/d Commissioning: ca. 500kg/d 2013</p>		<p>Wolfsburger Entwässerungsbetriebe WEB</p> <p>WWTP Wolfsburg Capacity AirPrex®: 175.000 P.E. Commissioning: 280m³ sludge/d May 2017</p>
	<p>Waternet, NL</p> <p>RWZI Amsterdam-West Capacity AirPrex®: 1.000.000 P.E. MAP-Recovery: 2.500m³ sludge/d Commissioning: ca. 4.000 – 5.000kg/d 2013/2014</p>		<p>Medina County, OH – Liverpool WWTP Capacity AirPrex®: ca. 155m³ sludge/d Commissioning: end of 2018</p> <p>HOWARD COUNTY, MD - Little Patuxent WRP Capacity AirPrex®: ca. 800m³ sludge/d Commissioning: estim. 2018/2019</p>



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