

Sewage sludge ash recycling

Sewage sludge ashes for agricultural application in Germany



EUROPEAN
REGIONAL
DEVELOPMENT
FUND

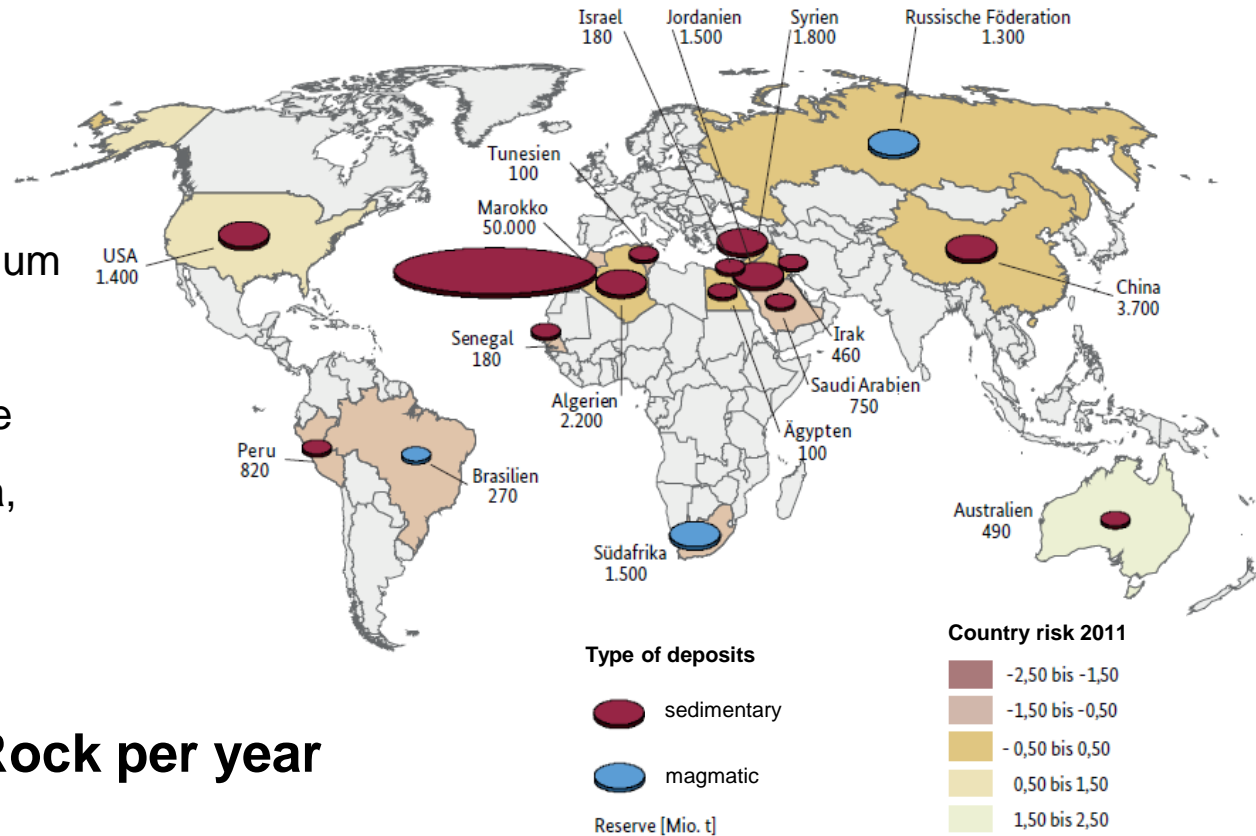
Harald Plank



Phosphorus recovery

- World reserves of Phosphate Rock -

- Phosphate Rock reserves will be available for the next 300 years
- Increasing contamination of phosphate with cadmium and uranium
- 85 to 90% of world's remaining reserves are controlled by only five countries (Morocco, China, Algeria, Syria and Jordan)



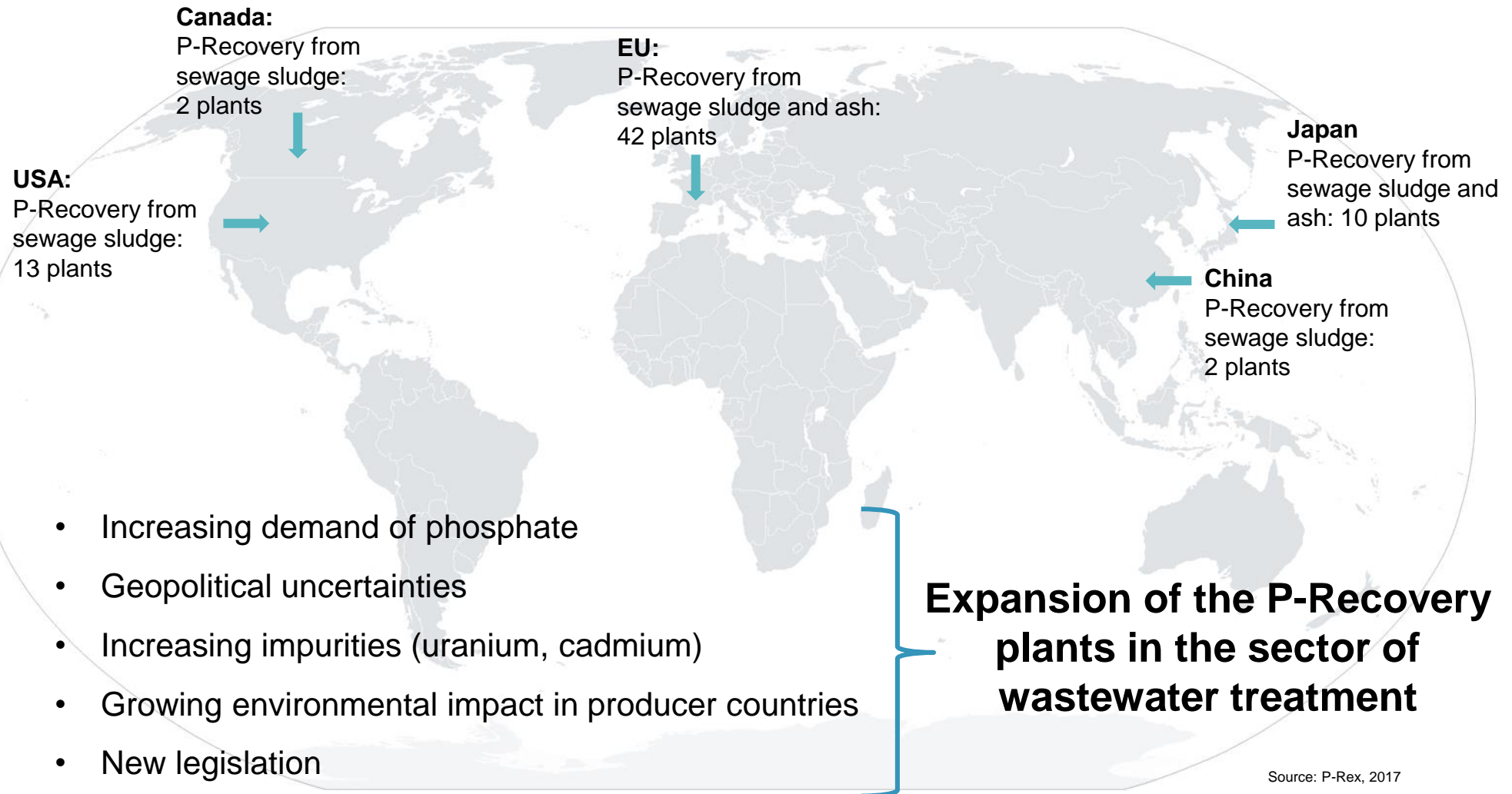
Source: BGR, 2013

Global consumption: 220 Mio. tons of Phosphate Rock per year

- 6 % Food and animal feed
- 83 % Fertilizer
- 11 % further industrial application

Phosphorus recovery

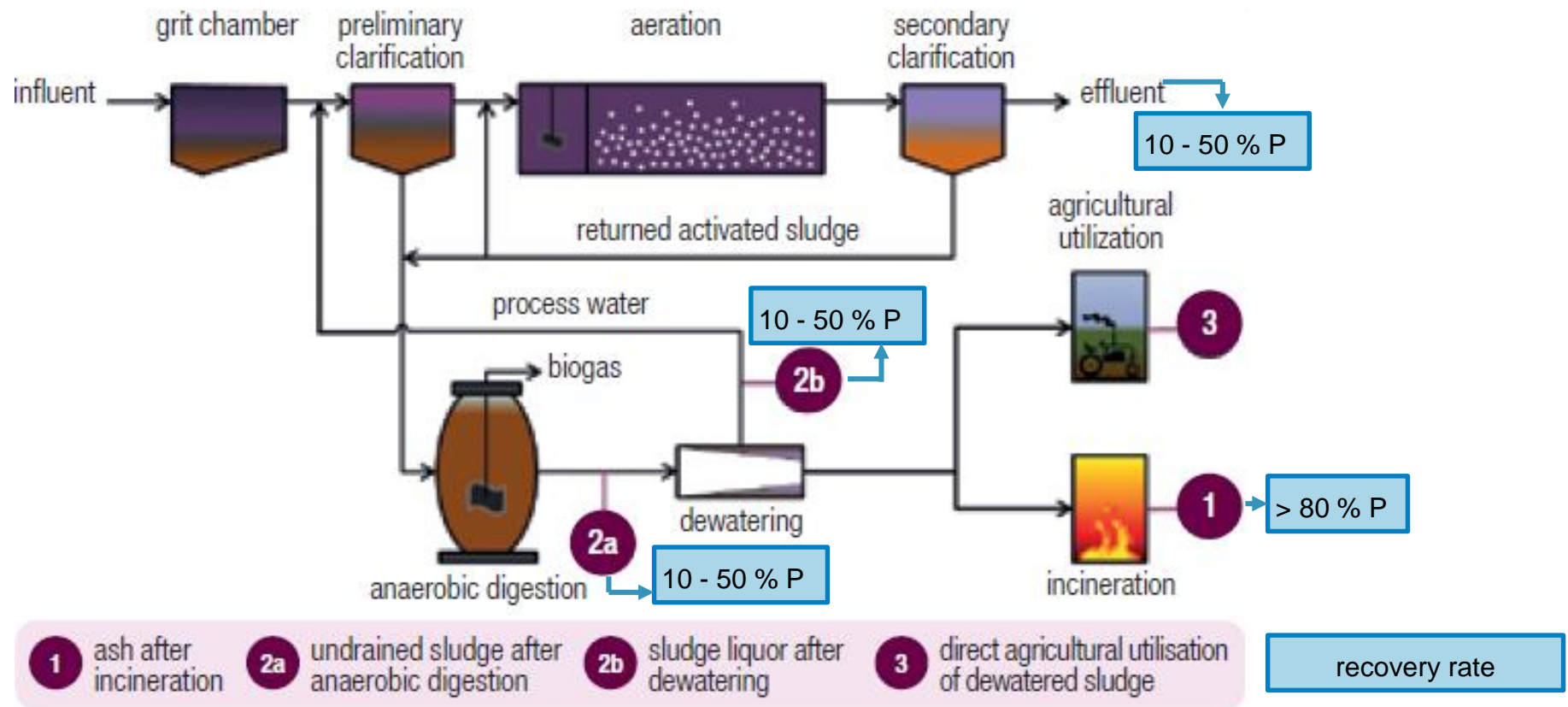
- Worldwide phosphorus recovery situation -



Source: P-Rex, 2017

Phosphorus recovery

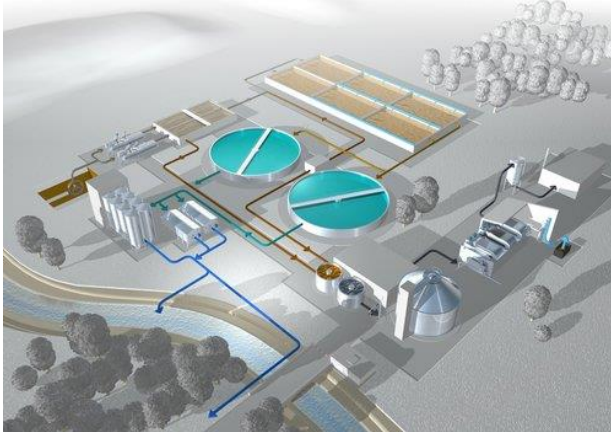
- Hot spot for P-recovery from municipal wastewater-



Source: Kabbe, 2017

Phosphorus recovery

- Potential for P-Recycling from sewage sludge ash in Germany -



Waste water treatment in Germany

- 9.600 waste water treatment plants
 - 10 billion m³/a wastewater containing 73.000 t/a P
 - 1.8 million tons sewage sludge containing 65.000 t/a P
 - 26 mono-incineration facilities for sewage sludge
 - approx. 300,000 t/a sewage sludge ash containing 21.000 t/a P
-
- 2016: 8.408 tons of sewage sludge ash were used for fertilizer production (approx. 600 t/a P)



The German sewage sludge ordinance was entered into force by the 3rd of October 2018!

- Significant restriction of the agricultural use of sewage sludge
- Obligation to recover phosphorus from sewage sludge and ash

Phosphorus recovery in Germany

- Demonstration Project Straubing -



General data:

Capacity:	200.000 PE
Inflow:	average 600 l/s (1.100 l/s)
Treatment process:	biological process with N & P removal
Sludge digestion:	mesophilic, 2 x 3000 m ³ tank´s
Biogas utilization:	2 CHP unit´s with 530 kW

Phosphorus recovery in Germany

- Demonstration Project Straubing -



General data sludge treatment:

Amount of co-substrate: 130 m³/day

Amount of septic sludge: 30 m³/day

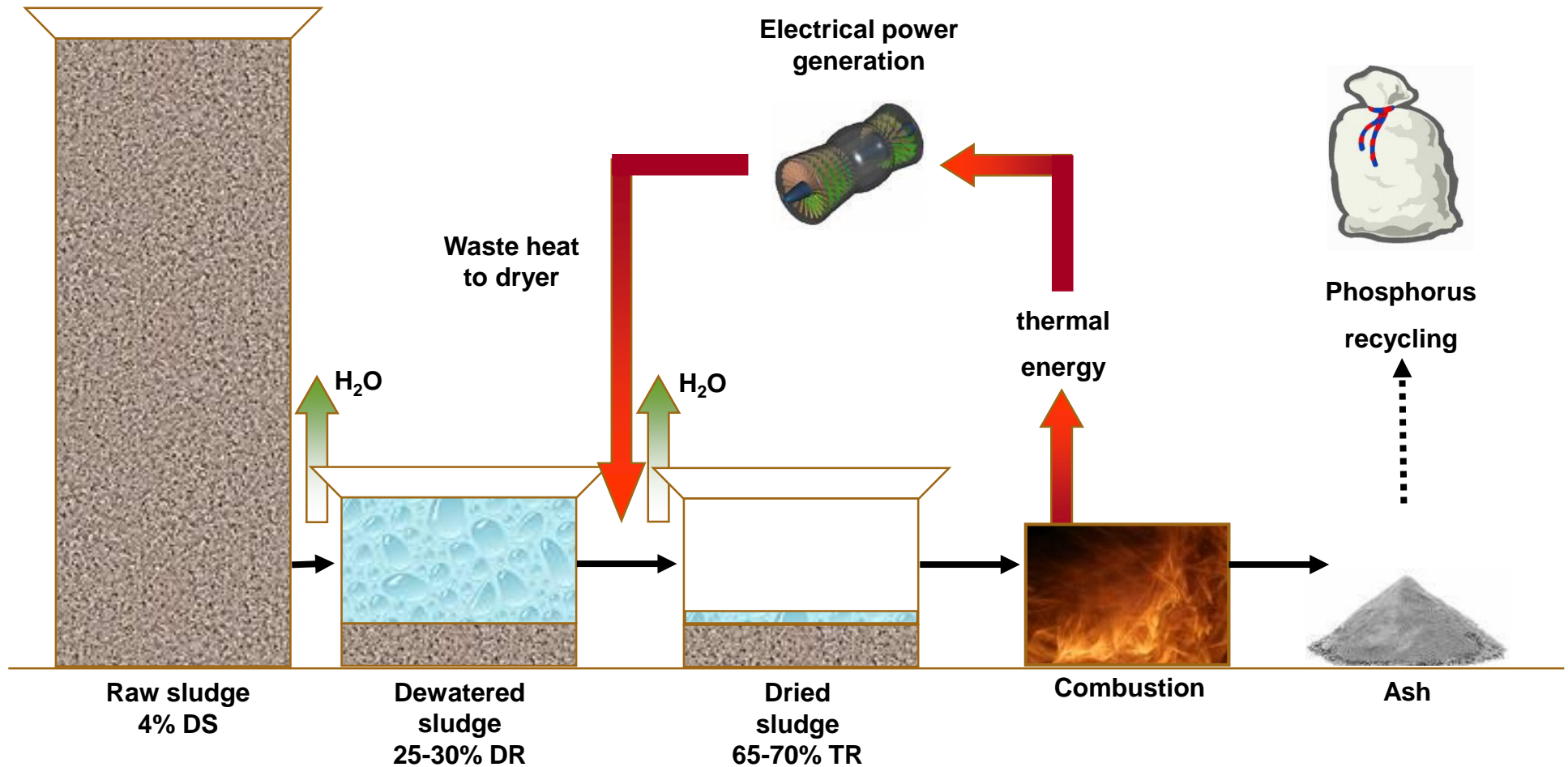
Amount of raw sludge: 150 m³/day

Biogas production: up to 12000 m³/day with 65 % methane content

Electrical power production: 6 – 6,5 Mio kWh/a (consumption of STP 3,8 – 4,0 Mio kWh/a)

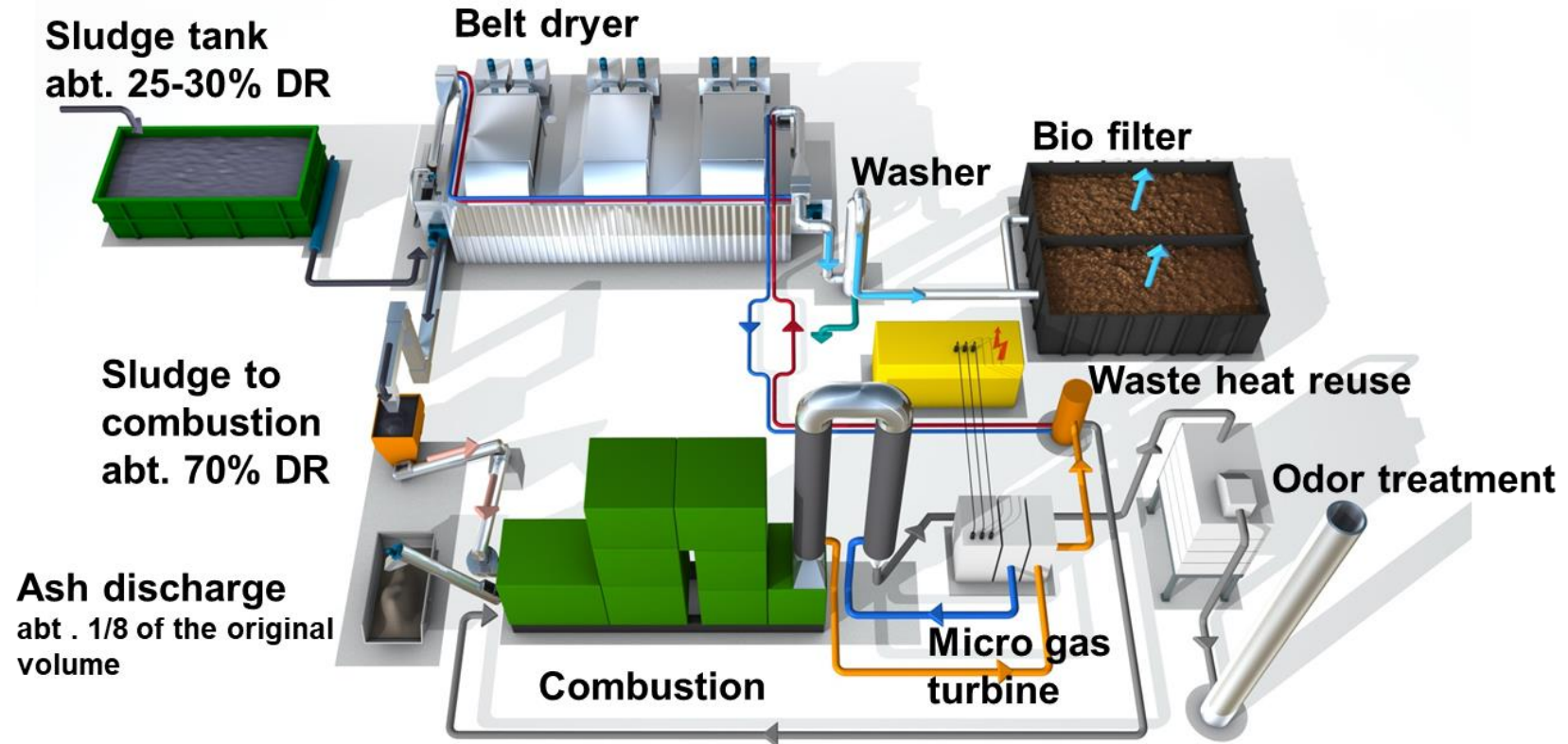
Phosphorus recovery in Germany

- Demonstration Project Straubing -



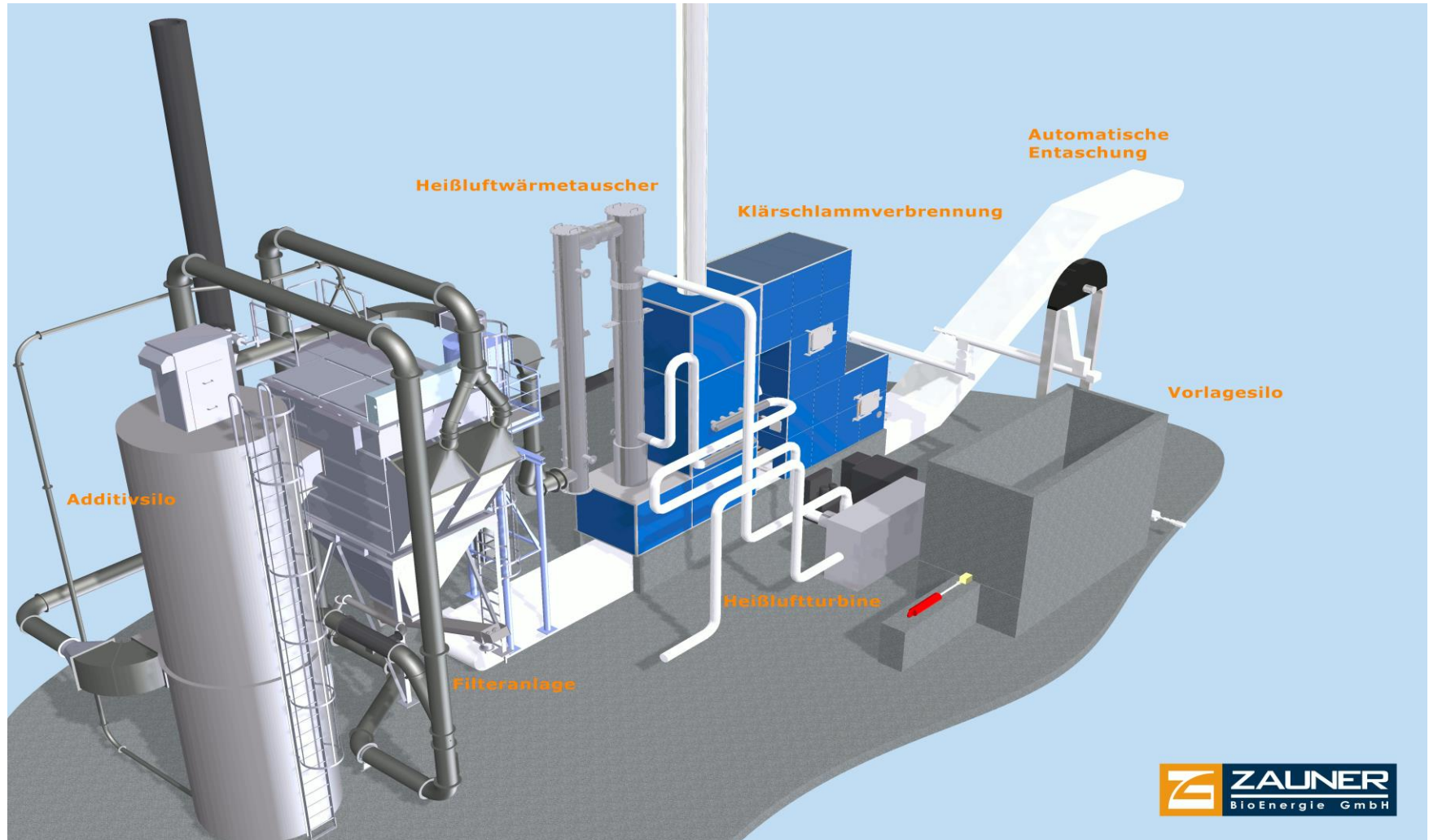
Phosphorus recovery in Germany

- Demonstration Project Straubing -



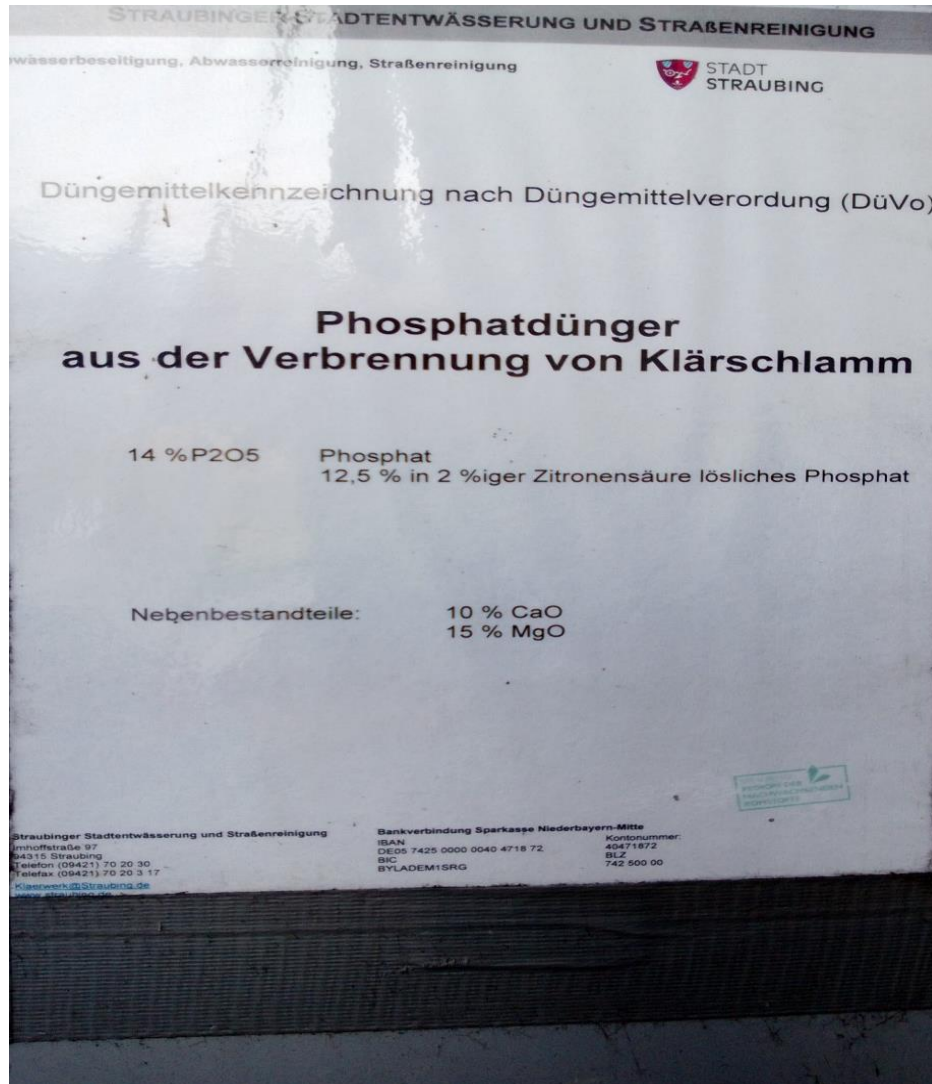
Phosphorus recovery in Germany

- Demonstration Project Straubing -



Phosphorus recovery in Germany

- Demonstration Project Straubing -



<http://www.dueka.de/content/kalke/dolophos-8/>

DüKa - Germany

- Addition from lime to the low-pollutant ash
- Production of P-rich lime fertilizer DOLOPHOS®

DOLOPHOS 6

KOHELESAURER MAGNESIUMKALK MIT PHOSPHAT 70 (+6)

Phosphorus recovery in Germany

- Phosphorus recovery from ash WWTP Straubing -

Contaminants in the sludge ash compared with the limit values set by German DüMV:

Contaminant	Ash WWTP Steinhäule [mg/kg DM]	DüMV limit [mg/kg DM]	DüMV limit for declaration [mg/kg DM]
As	8 - 11	40	20
Pb	63 - 76	150	100
Cd for fertilizer with > 5 % P₂O₅ in mgCd/kg P₂O₅	7 - 8	50	20
Cr total	66 - 138	No limit value	
Cr VI	0.5 - 1	2	1.2
Ni	38 - 49	80	40
Hg	0.4 – 0.7	1.0	0.5
Tl	< 0.3	1.0	0.5
Polyfluorinated tensides	n.m.	0.1	0.05
Dioxins and dl-PCB, ng/kg ash	0,1	30 ng WHO-TEQ/kg	8

n.m. = below detection limit



Uranium in Fertilizer: 284 mg U/ kg P₂O₅

Contaminant	mg Cd/ kg P ₂ O ₅
Super phosphate	33
Triple-super phosphate	67
Phosphate rock	40 - 140
Magnesium-Ammonium-Phosphate (MAP)	26
Sewage sludge ash Ulm	7 - 8

Phosphorus recovery in Germany

- Phosphorus recovery from ash WWTP Steinhäule – SePura GmbH -

- Capacity of the WWTP Steinhäule: 440.000 PE
- The sewage sludge is burned in a fluidized bed furnace at the WWTP (Capacity: 2 x 2 t DS/h)
- Sewage sludge ash is directly used for fertilizer production
- Since 2014 the whole production of the Ulm sewage sludge as is successfully brought to the market as phosphate fertilizer by SePura GmbH



Phosphorus recovery in Germany

- Phosphorus recovery from ash WWTP Steinhäule – SePura GmbH -

sePura.
soliPur[®] 160P

Kennzeichnung gemäß §4 DüMV

Stand Januar 2013

Phosphatdünger mit Magnesium und Spurennährstoff 16 (+3)

aus der Verbrennung von Klärschlamm

16 % P_2O_5 – Gesamtphosphat

8 % P_2O_5 – in 2 %-iger Zitronensäure lösliches Phosphat

3 % MgO – Gesamtmagnesiumoxid

0,05 % Cu – Gesamtkupfer

0,06 % Mn – Gesamt-mangan

0,13 % Zn – Gesamt-zink

Hinweise zur Lagerung:

kurzzeitig am Feldrand oder auf befestigten Flächen lagern.

Dünger ist nicht wasserlöslich und tolerant gegen

Niederschlagswasser. Unverträgliche Materialien: nicht bekannt.

Anwendungsempfehlung:

Zur Grunddüngung, das Phosphat ist wie weicherdeige Rohphosphate langsam wirkend. Ca. 70 % des Phosphates sind im Anwendungsjahr verfügbar. Hinweise der amtlichen Beratung sind zu beachten.

Zusammensetzung: Asche aus der Verbrennung kommunaler Klärschlämme: 100 %

Enthält Nickel, 40 mg/kg Trockensubstanz

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BERATUNG & VERTRIEB

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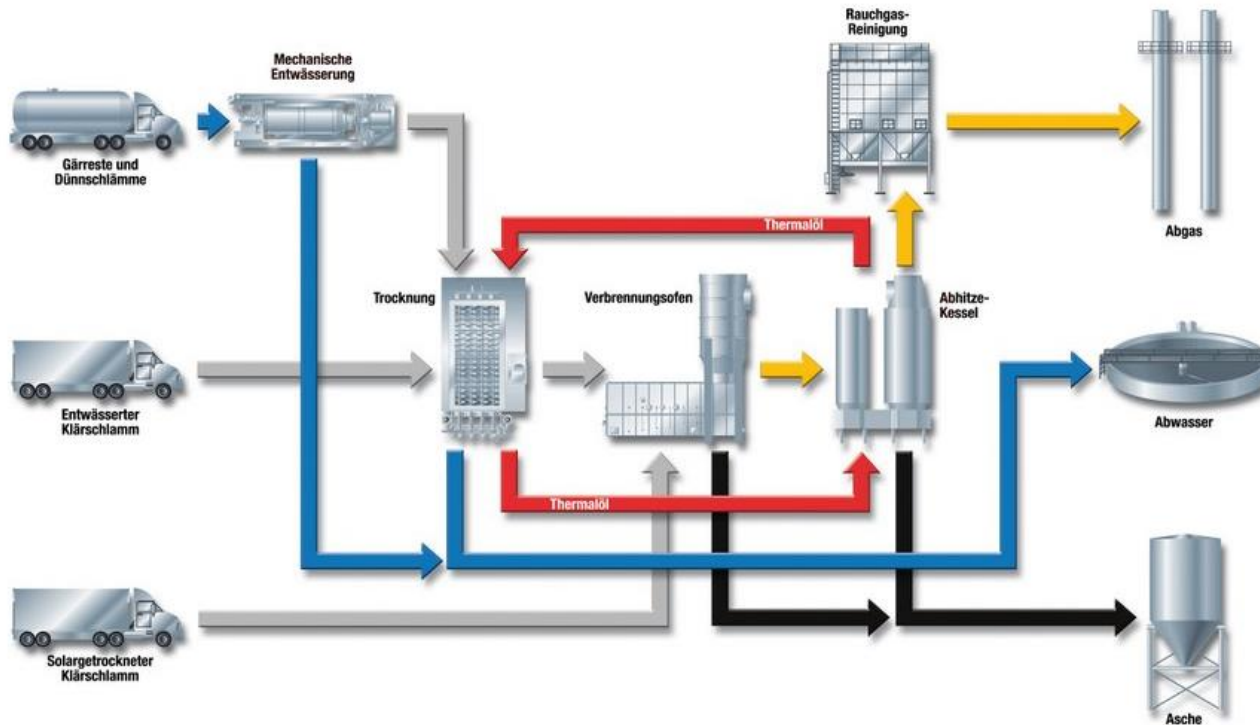
SePura GmbH - Germany

- Production of fertilizer from sewage sludge ash
- The limited values of the ash must be below the existing limitation according the German Fertilizer Ordinance
- The ash is only enriched with nutrients and further additives

sePura.
Wir machen was draus.

Phosphorus recovery in Germany

- Sewage sludge incineration plant EMTER – Altenstadt -



Incineration plant Emter

- Grate firing
- Capacity: 100.000 t/year
- Sewage sludge ash is directly used for fertilizer production (SePura GmbH)



Outlook - Production of Bio-Phosphorus-Fertilizer

- Development and operation of a cost-effective recycling plant for phosphorus at the incineration plant
- Dosage of lime to the incineration ash



IHR INNOVATIVER PARTNER
FÜR RECYCLING-LÖSUNGEN

Phosphorus recovery in Germany

- Phosphorus recovery from ash – SERAPLANT -

Suspension



Sewage sludge ash +
Phosphoric acid + if
necessary further nutrient
compounds
(Nitrogen and potassium)

Granulation



Spray Granulation



Commercial Fertilizer



**End-product with approx.
46 wt % P₂O₅**

- Flexible inputs
- Commercial products
- Proven Technology
- High plant-availability

Phosphorus recovery in Germany

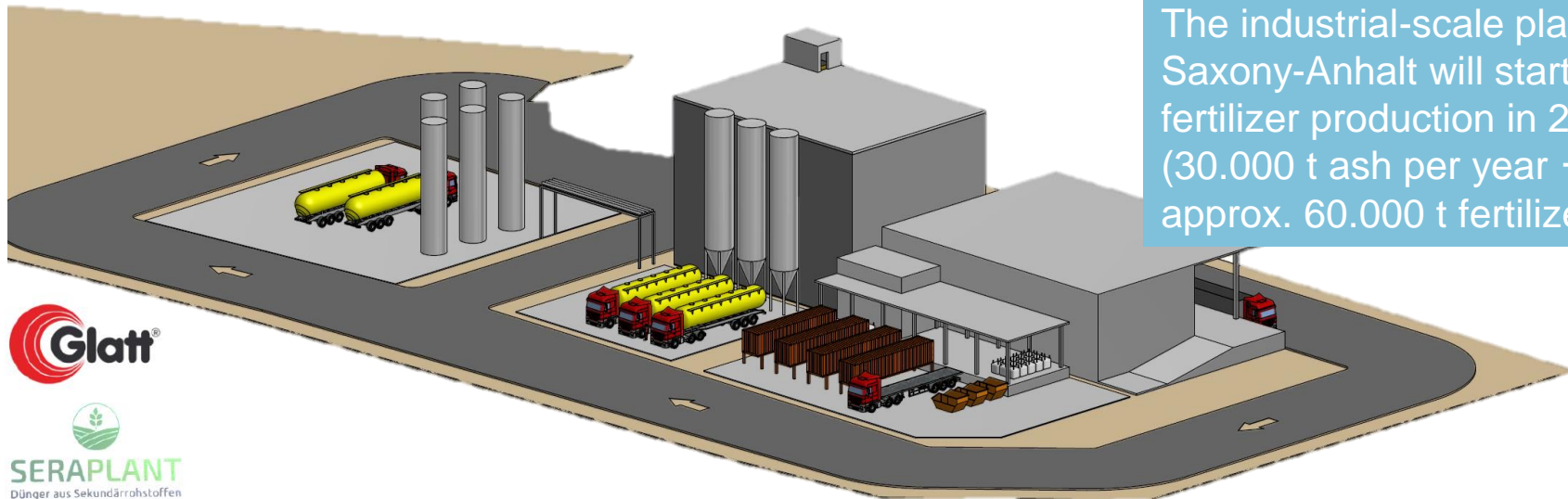
- Phosphorus recovery from ash – SERAPLANT -

Variation of used ashes and acids

- Successfull pilot trials with ashes from different mono-incineration plants (Neu-Ulm, Bonn, Berlin, München, Stuttgart)
- Meat-and-bone meal as further P-source
- Use of different acids (e.g. sulphuric acid, nitric acid)

Production of different commercial fertilizers

- Triple superphosphate (TSP) ($P_2O_5 = 46 \%$)
- Double superphosphate (DSP) ($P_2O_5 = 38 \%$)
- Superphosphate ($P_2O_5 = 17 \%$)
- Complex fertilizers NP, PK, NPK-Fertilizer



The industrial-scale plant in Saxony-Anhalt will start the fertilizer production in 2019! (30.000 t ash per year → approx. 60.000 t fertilizer)

Phosphorus recovery

- Summary -

- Phosphate is necessary for agricultural and is an essential, irreplaceable component for life
- Most important material flows associated with phosphorus recovery are primarily wastewater, sewage sludge or sewage sludge ash and meat-and-bone meal (MBM)
- Low public acceptance of the agricultural utilization of sewage sludge
- Only mono-incineration sewage sludge ashes contain phosphorus concentrations high enough for recovery
- The recovery rate of phosphorus from mono-incineration ashes is almost 90 %
- Products from sewage sludge ash have a good fertilization performance



Mono-incineration of sewage sludge will significantly increase in Europe



Production of fertilizer from sewage sludge ash are already carried out in Germany

Thank you for your kind attention !

We gladly answer your questions !



Source

Umweltbundesamt, 2016