Factsheet:

PK-fertiliser production via thermal treatment

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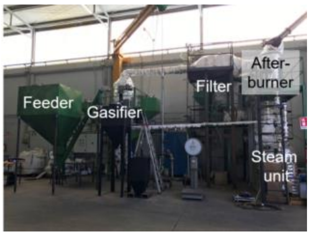
DATE: 11/01/2021

VERSION: V6

Disclaimer

This project has received funding from the European Union's Horizon 2020 research and

PK-fertiliser production via thermal treatment



Unique selling points:

- ✓ Output with high plant availability that can be sold as a fertiliser raw material
- ✓ Small-scale process that can be integrated onsite on WWTP

Description of the technology

The Pyrophos® process jointly developed by FHNW, CTU AG, AVA Altenrhein, FiBL and Landor is a multi-stage thermochemical process for sewage sludge via fluidized bed pyrolysis with subsequent post-combustion (Schaub et al. 2019). It is usually applied at wastewater treatment plants with a capacity of 100 000 population equivalents and greater. This corresponds to a loading rate of 1 t dry matter/h and higher.

Depending on the output requirements and availability, drained or dried sewage sludge, animal meal, animal meal ash or other phosphorus containing waste with low heavy metal pollution can be used as raw materials. The phosphorus containing raw materials are mixed with a potassium salt as an additive to improve the plant availability of the phosphates and fed into the reactor (Fig. 1). In the process, the heavy metals, which are volatile under reducing conditions, are partially expelled via the gas phase and retained in the exhaust gas cleaning system. At the same time, the thermal process converts the poorly soluble phosphates in the raw materials into potassium phosphates with a high solubility of over 80% in neutral ammonium citrate (NAC). Phosphoric acid can be used to stabilise the quality of the output. A post-combustion process produces ash containing potassium and phosphate, which can be processed into a multi-nutrient fertiliser.

Similar processes for phosphorus recovery are the ASH-DEC and the Euphore process. Thermal treatment of sewage sludge and other phosphorus containing organic wastes generate heat and typically reduce the carbon content to less than 1% thus eliminating most organic pollutants. Heavy metals are partially eliminated by evaporation either in elemental form (reducing conditions for mercury) or as metal chlorides (therefore, the addition of a chloride donor is needed). By adding alkaline metals, the phosphate form can be modified and solubility and thus plant availability be improved.

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Flow scheme of the technology

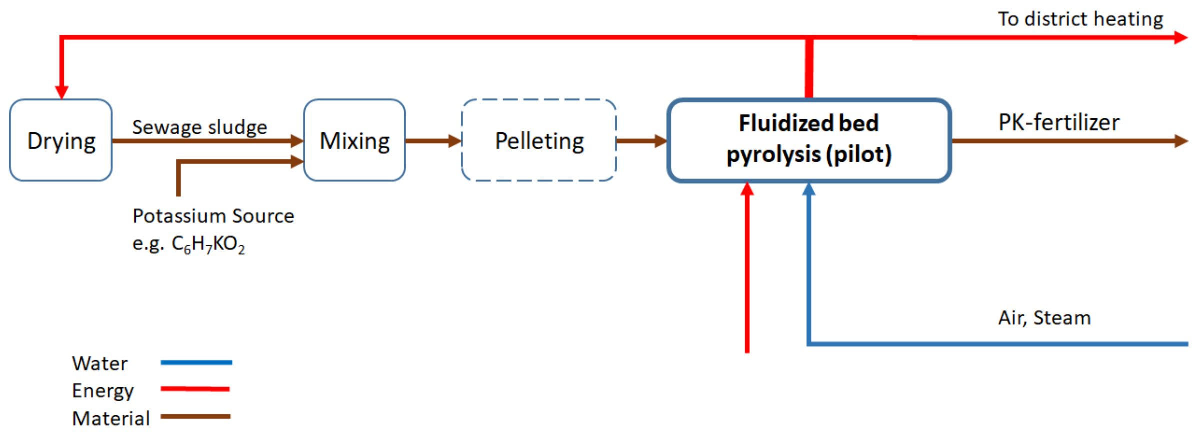

Fig. 1 Flow scheme of the thermal treatment technology applied in the NextGen project

Pictures of the technology

Fig. 2: Front and side view of the thermal treatment units (picture owner: CTU)

Synergetic effects and motivation for the implementation of the technology

- ✓ Removal of contaminants due to the thermal treatment with chloride addition
- ✓ Recycling of phosphorus
- ✓ Disposal and P recovery also decentralized and possible for smaller amounts of sewage sludge
- ✓ Profitability strongly dependent on energy usage options at the location
- ✓ Potential for cost reduction by using the heat recovery and exhaust air purification of an existing incineration plant

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Requirements of the technology and operating conditions

The Pyrophos process requires a high content in total solids of at least 75%. The temperature for the thermal treatment ranges between 700 °C and 1000 °C. Depending on the compositions of the sewage sludge, a maximum total phosphorus (P) content of 60 g/(kg TS) can be achieved. Potassium is added with a ratio between 2 and 4 kg K per kg P.

Parameter	Units	Min	Max	Reference
Total phosphorus	g/(kg TS)	-	**60**	NextGen D1.5 (in prep.)
Total solids	%	**75**	-	NextGen D1.5 (in prep.)
Temperature	°C	**700**	**1000**	NextGen D1.5 (in prep.)
Potassium addition	kg K/ (kg P)	**2**	**4**	NextGen D1.5 (in prep.)

Key performance indicators

Besides the P-recovery rate and the P and K contents of the PK-fertiliser, also the solubility in neutral ammonium citrate (NAC) is shown as a key performance indicator. This solubility with the abbreviation P_{NAC} is an indication for agronomic effectiveness of the fertiliser in terms of phosphorus and a requirement of the European fertiliser products regulation.

Parameter	Units	Min	Max	Reference
P-recovery rate of soluble phosphates (influent WWTP)	%	**90**	**100**	NextGen D1.5 (in prep.)
P_{NAC} of ash from sewage sludge	%	**>80**		NextGen D1.5 (in prep.)
P_2O_5 content of PK-fertiliser	%	**15**	**20**	NextGen D1.5 (in prep.)
K_2O content of PK-fertiliser	%	**12**	**16**	Calculated with P_2O_5/K_2O = 1.25-1.3

Links to related topics and similar reference projects

Thermal treatment	Reference
For PK-fertiliser production	Case study "Altenrhein", NextGen

References

NextGen D1.5 (in prep.) New approaches and best practices for closing materials cycle in the water sector, NextGen, Deliverable D1.5, Grant Agreement Number 776541.

Schaub, M., Stemann, J., Witgens, T. (2019). Verfahren zur Behandlung eines phosphorhaltigen Materials, Patent WO2019121741A1 veröffentlicht am 27.06.2019 https://worldwide.espacenet.com/patent/search/family/060954751/publication/WO2019121741A1?q=pn%3DWO2019121741A1

Outlook

Case study specific information will be provided, when the results of the other work packages are available:

- **Lessons learned from the case study**
- **Outcome of the assessments**
- **Legal and regulatory information concerning the whole value chain concerning the technology**
- **Business opportunities**

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