Innovative sewage sludge utilisation at the Linz-Unkel wastewater treatment plant
CLIENT
The Linz-Unkel sewage works (design capacity: 30,000 PE) is adjacent to the Rhine, approx. 20 km south of Cologne, and is operated by the Linz-Unkel Joint Waste Management Association. This is where the wastewater from the Linz and Unkel residents together with local industry is treated.

PROJECT
The Linz-Unkel WWTP is the first large scale plant in Germany using the PYREG® process for sewage sludge utilisation. The PYREG® process uses stages of thermal combustion to reduce dried sewage sludge at around 40 % of its original volume, with simultaneous full conversion to a high grade fertiliser material in which there is a high percentage of plant available phosphate.

The sewage works therefore meets the requirements of the amendment of the Sewage Sludge Directive which prohibits the agricultural sludge disposal and enforce mandatory phosphorus recycling.

PYREG GmbH’s PYREG® module and the optimally matching EloDry® low-temperature belt dryer by ELIQUO STULZ GmbH are at the core of the new sewage sludge utilisation plant.
EFFICIENT DRYING TECHNOLOGY

The fully digested sewage sludge is first dewatered in a new screw compactor. High dry material content of up to 31 % is achieved in the dewatered sludge, needing only moderate amounts of polymer to condition the sludge and with low power consumption. Dewatering is continuous, with the dewatered sewage sludge fed directly to the EloDry® low-temperature belt dryer without intermediate storage. This avoids odours from intermediate sludge holding and ensures the sludge structure remains intact to aid drying. The EloDry® low-temperature belt dryer then dries the dewatered sludge to a dry material content in excess of 85 %. This percentage dryness is required to ensure autothermic operation of the PYREG® reactor.

Continuous operation of the plant, together with a relatively high solids feed content and particularly efficient drying technology enables the EloDry® belt dryer to optimally utilise the available heat.

CUSTOMISED THERMAL DESIGN

A customised thermal design is an important factor guaranteeing the economic viability of the sewage sludge utilisation plant. The available heat is utilised several times, each at different levels of temperature. This is a milestone in the utilisation of sewage works heat energy.
The special construction of the dryer is an important part of this solution: The thermal requirements of the dryer are met by the existing micro-gas turbine on site and the waste heat of the PYREG® reactor. The heating levels here are between 80 °C and 85 °C, which is sufficient for the EloDry® belt dryer. Heat recovered from the dryer waste air will be used for heating the digestion tank and the operations building.

PHOSPHORUS RECYCLING

The dried sewage sludge is continuously conveyed to the PYREG® reactor. The PYREG® module operates in accordance with the principle of combustion in stages: Two dual screws transport the sludge through the PYREG® reactor, which is at approx. 650 °C. The sludge is not, however, fully burnt here, but only gently degassed, where after it combusts further through the measured supply of air.

Since different treatment parameters may be set for the PYREG® process, the phosphate in the sewage sludge remains available to plants — as opposed to the conventional practice of complete incineration. The sludge is also simultaneously fully sanitised (micro-contaminants such as pharmaceutical residues or micro-plastic will be destroyed).

CHARACTERISTICS ELODRY® DRYER

- **Type:** Low-temperature belt dryer
- **Active belt surface:** ca. 15 m²
- **Drying temperature:** 70 – 75 °C
- **Drying output:** max. 350 kg H₂O/h
- **Heat exchanger:** max. 260 kW (90/70°C)
- **Specific heat requirement:** from 750 kWh/t H₂O vapour
- **Specific electrical energy requirement:** < 40 kWh el/t H₂O vapour
- **Conformity:** ATEX (zone-free according to expertise)
- **Dimensions (mm; lxwxh):** 7,100 x 3,000 x 2,800

The sewage works Linz-Unkel EloDry® belt dryer includes waste air conditioning with heat recovery, a hot water installation with circulating pump and a

CHARACTERISTICS PYREG® MODULE

- **Annual throughput:** 1,000 tons DS
- **Original substance (OS):** 1,250 tons OS with 80 % DS
- **Annual production:** approx. 500 tons P-ash
- **Operating hours:** approx. 7,500 h/a
- **Minimum heating value OS:** 10 MJ/kg
- **Lumpiness OS:** < 30 mm
- **Fuel power:** 500 kW
- **Useful waste heat:** up to 200 kWh
- **Conformity:** CE & ATEX

A PYREG® module has 2 components:
- Plant container with PYREG® dual screw reactor & waste gas system container

- **Dimensions (mm; lxwxh):** 9,200 x 3,000 x 2,800 (PYREG® reactor)
- **Dimensions (mm; lxwxh):** 6,000 x 3,000 x 2,800 (waste gas system)
Once the plant reaches operating temperature, the process continues to run without the need for external heat; the energy required is provided by the sewage sludge. Up to 150 kW thermal energy may in addition be available for upstream sewage sludge drying.

CLEAN PROCESS TECHNOLOGY
The combustible gases generated in the PYREG® reactor are separated from mineral substances and burnt in a downstream chamber with the so-called FLOX® burner (FLOX = flameless oxidation) at temperatures of approx. 1,000 °C. An alkaline flue gas washer removes acid contaminants from the waste gas. Volatile sewage sludge components such as mercury are adsorptively bound to an active charcoal filter and other heavy metals and dust are also filtered out. Compliance with the strict limiting values of the 17th Federal Emission Protection Act is therefore assured.

AT A GLANCE
The new plant in Linz-Unkel represents an innovative, decentralised sewage sludge utilisation plant converting sewage sludge waste into valuable fertiliser raw material containing phosphate which is readily available to plants.

Result

Future-proof sewage sludge utilisation
The new sewage sludge utilisation plant of the Linz-Unkel sewage works will in future be treating approx. 18,000 m³ sewage sludge (700 tons TR) per annum. Of this, approx. 400 tons p.a. phosphoric ash will remain after thermal treatment, which will be utilised by the fertiliser industry without any additional treatment. This trail-blazing concept will assure the Linz-Unkel Joint Waste Management Association of

- Independence from sewage sludge disposal companies
- Ability for long-term cost planning
- Transportation by truck reduced by up to 90 %
- Flexible extension of capacity through modular plant construction
- Environmentally friendly, energy-efficient & labour-saving plant operation

Scope of services / Project partner

PYREG GMBH, DÖRTH
PYREG® module for thermal and material treatment of sewage sludge including phosphorus recycling
Tel.: +49 6747 95388-0, E-mail: info@pyreg.de,
Web: www.pyreg.de

ELIQUO STULZ GMBH, GRAFENHAUSEN
EloDry® low temperature belt dryer, heat recovery and utilisation systems, coordination & construction planning
Tel.: +49 7748 9200-0, E-mail: info@eliquostulz.com,
Web: www.eliquostulz.de

Construction period
May 2015 - March 2016

Contract value
Total approx. 1.4 million Euro
Linz-Unkel wastewater treatment plant – innovative sewage sludge utilisation by using the PYREG® process

PYREG®
Thermal and material treatment of sewage sludge including phosphorus recycling

EloDry®
Effective sewage sludge drying as part of an intelligent heat utilisation system

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