Future-proof and Ecological

Energetic and Material Recovery of Sewage Sludge
Phosphorus Recycling

10-20% phosphorus
SAFE DISPOSAL
Reliable recycling according to legal prescriptions and guaranteed take-over of produced fertilizer by PYREG®.

SUPERIOR PHOSPHORUS QUALITY
A phosphorus content of up to 20% in the fertilizer may be achieved. This product can directly be marketed without further treatment. Compared to ashes resulting from mono-incineration process, its plant availability is considerably improved.

REDUCED QUANTITY OF SEWAGE SLUDGE
The quantity of dewatered sewage sludge is reduced to only 10% - with clear effects on cost saving for transport.

SANITIZING
The process temperature of 550°C to 600°C ensures destruction of germs, medical residues, hormones, micro-plastics and other organic pollutants.

COMPLETE UTILIZATION
Without supplementary thermal energy, material and energetic recycling of sewage sludge to phosphorus fertilizer is obtained.
ECOLOGICAL CHALLENGES HAVE INCREASED
The requirements for disposal of sewage sludge are an international issue. In many countries sewage sludge regulations are expected to be modified shortly, so that spreading of untreated sewage sludge on agricultural land may be prohibited in the near future. And recycling of phosphorus from sludge will become mandatory in many countries. In Germany further restrictions will result from the Fertilizer Ordinance comprising several prescriptions issuing from European Nitrates Directive.

PYREG has developed an innovative and decentral recycling method, which is able to recycle the sewage sludge completely, i.e. transforming it energetically and materially to phosphorus fertilizer. This process does not only sanitize the sewage sludge, but also significantly reduces its quantity and delivers phosphorus as a recycling product. The PYREG® technology is a decisive investment to ensure a long-term safe disposal, independence and reduced transport cost.

PYREG PROVIDES SOLUTIONS FOR THESE CHALLENGES
- Requirements resulting from forthcoming amendment of the sewage sludge regulations with the obligation to recycle phosphorus.
- Tightening of limit values in the fertilizer ordinance: Prohibition of application of polymers, and protection of groundwater from nitrate pollution
- Significant increase of costs for transportation and disposal of sludge
LESS TRANSPORT MEANS LOWER COSTS AND LESS EMISSIONS

SEWAGE SLUDGE
4% DS

SEWAGE SLUDGE
DEWATERED, WITH 25% DS

SEWAGE SLUDGE
DRIED, WITH 80% DS

SEWAGE SLUDGE
IN THE FORM OF PYREG® PHOSPHORUS FERTILIZER

LESS TRANSPORT MEANS LOWER COSTS AND LESS EMISSIONS
Choose the Safe Solution

We know about your responsibility for safe disposal, efficient use of resources, and stable rates. For more than 10 years PYREG is working in the field of sewage sludge treatment with its sophisticated technology for complete, decentralized and ecological recycling of sewage sludge.

**CLIENTS CAN PROFIT FROM SEVERAL ADVANTAGES**

**Become independent:** A PYREG® plant enables the WWTP operator to process the sludge directly on-site i.e. where it is produced, so the operator becomes independent of subcontractors for external disposal. Transport cost thus may be reduced to only 10%, and the entire recycling process can exactly be calculated, scheduled and controlled. Amortization can be achieved up from a plant size of 30,000 population equivalent value.

**Environmental protection and efficient use of resources:** The phosphorus fertilizer produced does not contain germs, hormones, residuals of pharmaceuticals, micro-plastic parts etc. In the course of the running operation, supply of external energy is not necessary. Moreover up to 150 kW$_{th}$ may become available, to be used for dryers installed upstream. Cost for storage or disposal of resulting substances does not have to be expected. The phosphorus substrate produced can directly be marketed in fertilizer industries.

**Remain flexible:** For larger sewage sludge quantities, the PYREG® modules can be up-scaled by a combination of additional modules. The modular arrangement of several PYREG® modules in the redundant configuration of a combined plant increases the requested permanent safety of disposal.

**Proven technology:** The success of the reference plants working in numerous countries has enabled PYREG® to establish a serial production process. PYREG® furthermore offers its clients the service of a guaranteed take-over of phosphorus fertilizer produced.
In 2015 the waste water treatment plant (WWTP) Linz-Unkel [inhabitant equivalent value 30,000] was the first customer in Germany taking advantage of the PYREG® method for energetic and material recycling of sewage sludge. After being subjected to digestion, the sewage sludge is dewatered and dried. In the end, the recycling process takes place inside the PYREG® module, which transforms the input material to valuable phosphorus fertilizer. Due to its innovative design, the plant in Linz-Unkel turned out to be a pioneer in sewage sludge treatment.

Meanwhile a second plant of this type has started operation in Homburg [Germany], and the installation work for further sites is nearly complete.
The PYREG® Process

The PYREG® process uses the principle of the staged combustion. For that purpose, the dried sewage sludge is guided through PYREG® reactors operated at a temperature of 550 to 600°C. In the PYREG® reactors the sludge is not burned, but carefully degassed and then carbonized, by admission of a tightly targeted air stream. This way the material is completely sanitized. Due to the selected temperature level in the PYREG® reactors the phosphorus in the final product grants a high plant availability, in contrast to ashes resulting from conventional mono-incineration systems, burning the sludge at temperatures above 700°C. Supplementary costly pulping of the phosphorus is not necessary – the product is directly marketed in the fertilizer industries.

As the combustible gas generated in the PYREG® reactors is completely burned by the FLOX® method (flameless oxidation) at a temperature of 1,250°C inside a separate combustion chamber, thermal NOx is significantly avoided. The formation of problematic substances like condensate or tar is suppressed as well, because the carbonization gas is not cooled, but oxidized in the combustion chamber. Inside a flue gas cleaning system, harmful acid gas is absorbed by means of alkaline flue gas scrubbers, whereas volatile components like mercury are retained by charcoal filters.

The mineralization process is self-sustaining; after completion of the activation phase no further external energy is required to run the process, as the energy of the sludge is sufficient for the continuance of the thermal treatment. It is even possible to benefit from the excess heat produced; an amount of 150 kWth may be used for sludge drying.
Individual Assessment of Input Material

The sewage sludge from different WWTP varies significantly. Based on the individual sludge analysis we are able to make a first assessment of the potential fertilizer quality. Together with an evaluation how the PYREG technology can ideally be integrated into the existing material and energy cycles.

THE ASSESSMENT FOCUSES ON THE CORRESPONDING ANALYSIS AND THE FOLLOWING PARAMETERS

- The annual sludge volume
- Concentration of heavy metals and other contaminants
- Content of dry substance
- Additional sludge treatment like dewatering and/or drying (to be designed or already in place)

With respect to a safe and economically meaningful process, the dried sewage sludge should meet the following basic conditions:

RESULTING QUANTITY
1,400 t/a
DRIED SEWAGE SLUDGE
FOR EACH
PYREG® MODULE

MIN. CONTENT
OF DRY SUBSTANCE
80%

POURABLE AND FREE-FLOWING

MIN. CALORIFIC VALUE
10 MJ/kg
The PYREG® System

Due to the simple installation, their high efficiency and reliability, the compact PYREG® units represent an ideal solution for decentralized recycling of sewage sludge and various types of biomass.

COMPONENTS

- PYREG® Module: l: 9000 x w: 3000 x h: 2800 mm
- Container for flue gas treatment: l: 6000 x w: 3000 x h: 2800 mm

SPECIFICATION

RELEVANT PARAMETERS

- Maximum Energy Input: 500 kW
- Annual Throughput: Up to 1,400 t/a dried sewage sludge with a calorific value of 10 MJ/kg
- Yearly Production: Up to 500 t P-Fertilizer with 10 to 20% phosphorus
- Excess Thermal Energy: Up to 150 kW, to be used for drying of sewage sludge
Made in Germany
As an experienced solution provider in environmental technology, we are committed to establish close cooperation with our clientele and our subcontractors, while developing an optimum complete solution for recycling of sewage sludge.

The following services are offered:

- Tailored system configuration, including additional modules for drying, dewatering etc. upon request
- Support for permission application
- Advice for implementation of required infrastructure, technical interfaces etc.
- Each plant before start-up is subjected to a comprehensive functional test, together with training for personnel

POSSIBILITIES OF CONTRACT DESIGN
As an alternative to purchasing a PYREG® solution, an operator model may be agreed as well. Furthermore, support is possible for commercialization of fertilizer products. Take-over of phosphorus fertilizer produced is possible, too.

SUPPLEMENTARY OPTIONS
For the ideal integration of PYREG® technology into the existing infrastructure, we are offering a variety of supplementary components, like conveying or storing technology as well as the appropriate embedding into energy and heat concept.

ON-SITE SERVICE
Also for running production, assistance by our qualified service team may be agreed: Remote monitoring as well as on-site maintenance can be chosen. Each service agreement will precisely be adapted to the individual requirements of the customer. A service hotline for emergency cases is provided.
1999-2009
Development of the PYREG® process by Dipl. Ing. H. Gerber and Prof. Dr. Ing. W. Sehn at Bingen college, Germany

2007-2010
Operation of a PYREG® prototype at the sewage treatment plant AVUS Ingelheim

2009
Within the joint research project, PYREG GmbH was founded
PYREG GmbH is specialized in the development and production of equipment for energetic and material recycling of various biomasses. A large variety of biomasses may be transformed to biochar, activated carbon or phosphorus fertilizer. Excess thermal energy becomes available as well.

With 40 employees PYREG GmbH is located in Dörth (Germany) and has repeatedly been awarded for its innovative technology.