

Layman Report: sludge2energy A way to energy self-sufficient sewage treatment plants



Innovative concept of decentralised sludge utilisation
by generation and use of thermal and electrical energy



sludge2energy - LIFE06 ENV/D/460

►► Preface

When we speak about the future of sewage sludge disposal today, regional and supraregional differences are becoming evident. Everyone seems to talk about agricultural or thermal utilisation and phosphorus recovery but everyone also seems to interpret these topics most differently.

For many states the recovery of materials contained within sewage sludge still plays an important role. This applies to both landscaping and sludge spreading on agricultural land. The fertilization effect of sewage sludge and especially its phosphorus content is normally sufficient to cover the nutrients demand of typical agricultural land. On the other hand, there are a lot of countries where the agricultural application of sewage sludge is met with much scepticism due to its potential heavy metal pollution and content of organic pollutants, such as PFT (perfluorinated tensides). In these countries there has been a clear trend towards concepts for thermal sewage sludge utilisation for some years already, predominantly in centralised large-scale mono-incineration or co-incineration plants, and partly combined with the approach to recover the phosphorus contained within sewage sludge.

Our search for the energetically optimal utilisation finally resulted in our sludge2energy project which was developed in cooperation with ATZ Development & Research Centre and is presently in the implementation stage on WWTP Straubing, Bavaria as a pilot project of HUBER SE under the EU Life06 program. Our idea was to develop a decentralised solution for thermal sewage sludge utilisation which provides for the reasonable use of heat, avoids heat transport and related emissions, and makes plant operators independent of the disposal market giving them the advantage of long-term cost certainty.

The project started in 2005 when the sludge2energy system was developed by ATZ Development & Research Centre Sulzbach-Rosenberg (Bavaria) and the project was submitted to the European Commission to be accepted as a demonstration project and supported under its environmental program LIFE. After the acceptance and official start of the project on 1st October 2006 we began with detail planning and had to invest a lot of additional work and time to optimise the complete process. The groundbreaking ceremony for the project took place in April 2008. In December 2009, the sludge2energy concept was awarded as 'selected landmark in the Land of Ideas'. The first individual components were installed in 2010, the complete plant was put into operation in September 2011 when the test phase was completed.

The aim of the project is to show that decentralized and virtually energy self-sufficient disposal of sewage sludge is possible with the use of intelligent process technology and optimised plant components. Well-proven plant components have been combined to create an innovative overall concept.

►► Why thermal sewage sludge utilisation?

In Germany, about 53 % of the dry mass of the sewage sludge generated is treated thermally already today (49.4% in 2007). Sludge incineration offers the highest level of disposal safety but costs are relatively high. Co-incineration costs less, but on the other hand mono-incineration provides the option of phosphorus recovery. Another factor in favour of incineration is the fact that it allows to recover the amount of energy consumed for sludge transport, dewatering and drying.

For an optimised energy balance, process steps upstream of the incineration plant must be designed as energy-saving as possible and the energy set free by incineration must be used optimally. Best case, the incineration of sewage sludge can achieve a positive energy balance and make an eco-friendly contribution to the generation of regenerative energy in the form of heat and power.

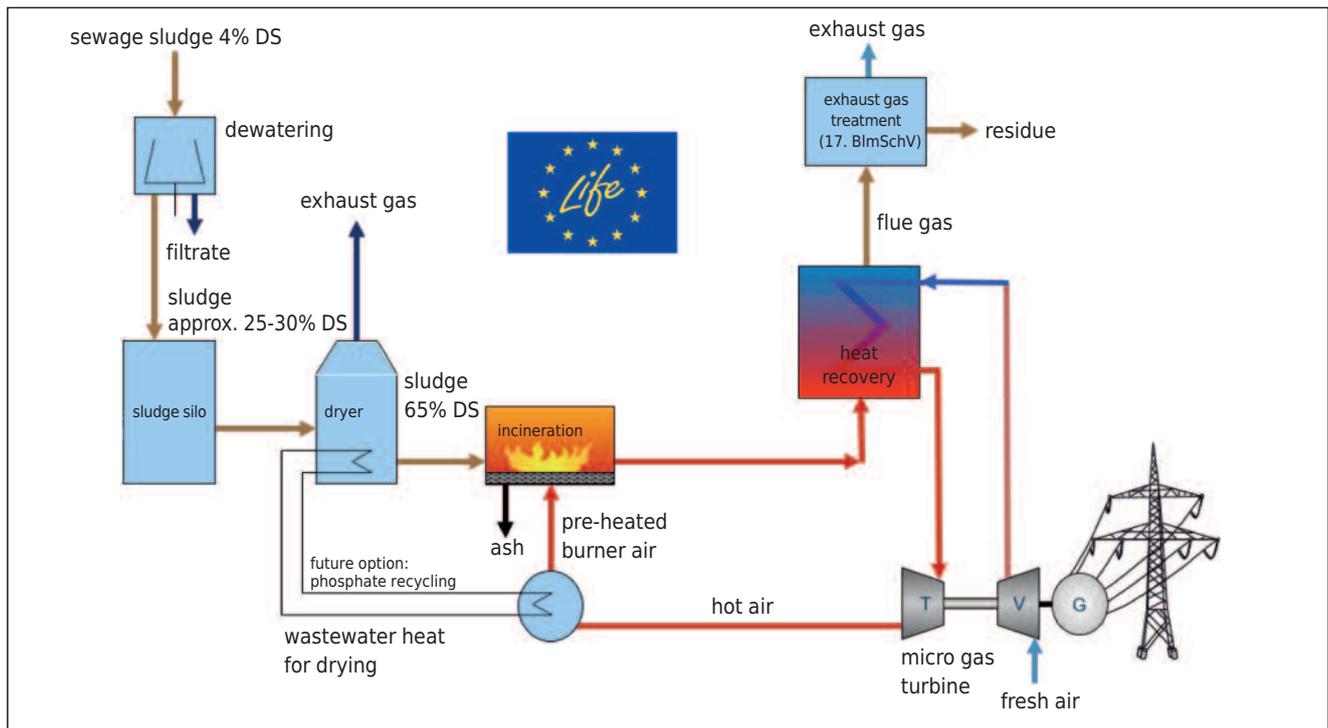


►► The sludge2energy system

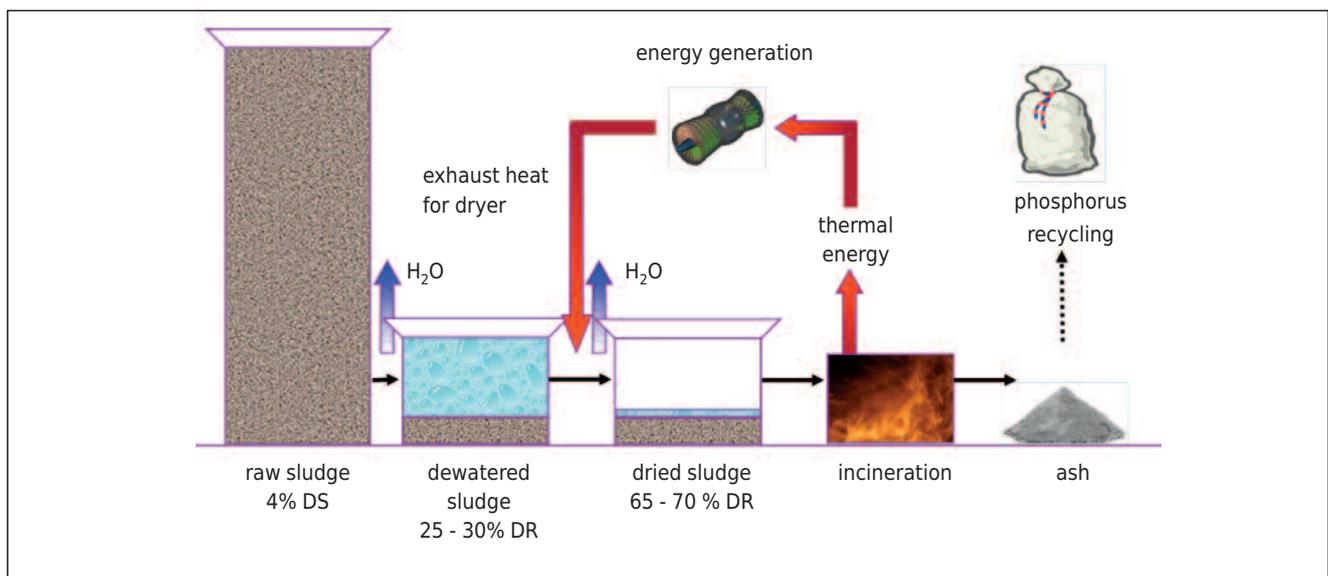
Basically, the sludge2energy system is the decentralised combination of sewage sludge drying followed by mono-incineration and power generation by means of a gas turbine. The main system components are a belt dryer, a micro gas turbine, and a grate stoker furnace for dried sludge.

A HUBER Belt Dryer BT^{plus} with a process temperature of about 120 °C is used as drying plant. In cooperation with the plant manufacturing company ZAUNER, HUBER SE

has developed an incineration system with 1 MV thermal output that is based on the design principle of grate stoker furnaces and meets all requirements of the applicable German standards 17th BImSchV in terms of air pollution prevention. The micro gas turbine used is a TURBEC turbine type T100P with 100 kW electric power. Presently, phosphorus recovery from the generated residual ash is in the planning stage as the last consequential step of sewage sludge utilisation.



Flow diagram of the sludge2energy system



Treatment stages of the sludge2energy system

➤➤ Sewage sludge drying

In the HUBER Belt Dryer BT^{plus} convective sewage sludge drying takes place at medium temperature. The sewage sludge is dried by the process air streaming through the installed two-belt dryers and the air is enriched with water. The exhaust air is further cooled by a washer. Fine dust particles, odours and other components are removed before the exhaust air is biologically clarified in another treatment stage. Exhaust air treatment complies with German TA standards (Technical Instructions for Air Pollution Prevention).

➤➤ Sewage sludge incineration and heat utilisation

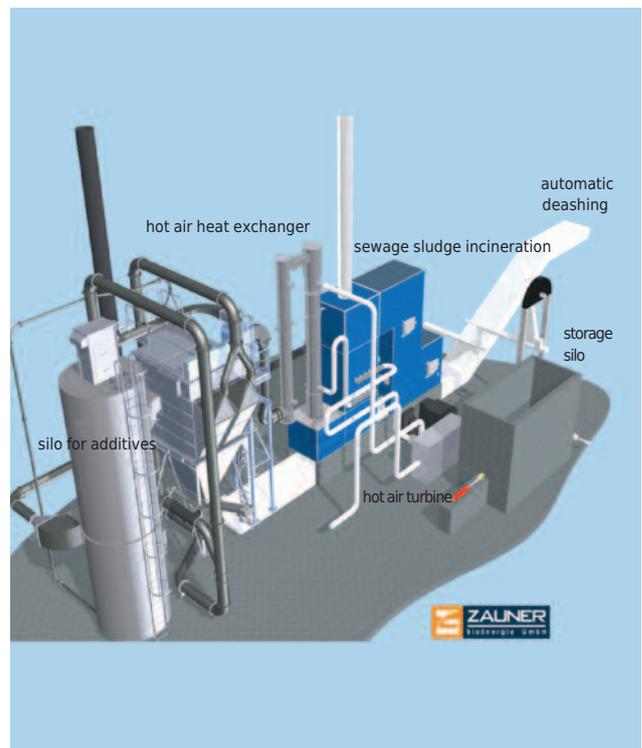
Thermal utilisation of the dried sludge takes place in an oven with grate furnace that provides a high flexibility for the fuels used and the benefit of easy and reliable operation. The hot exhaust air is used to heat compressed air. As the pressure is relieved in the micro gas turbine energy is produced and the relieved hot air is used to heat the air for drying and is also used as pre-heated air for incineration.



HUBER Belt Dryer BT^{plus}



Incineration



Schematic drawing of the incineration plant
 Source: Zauner

►► Energy balance

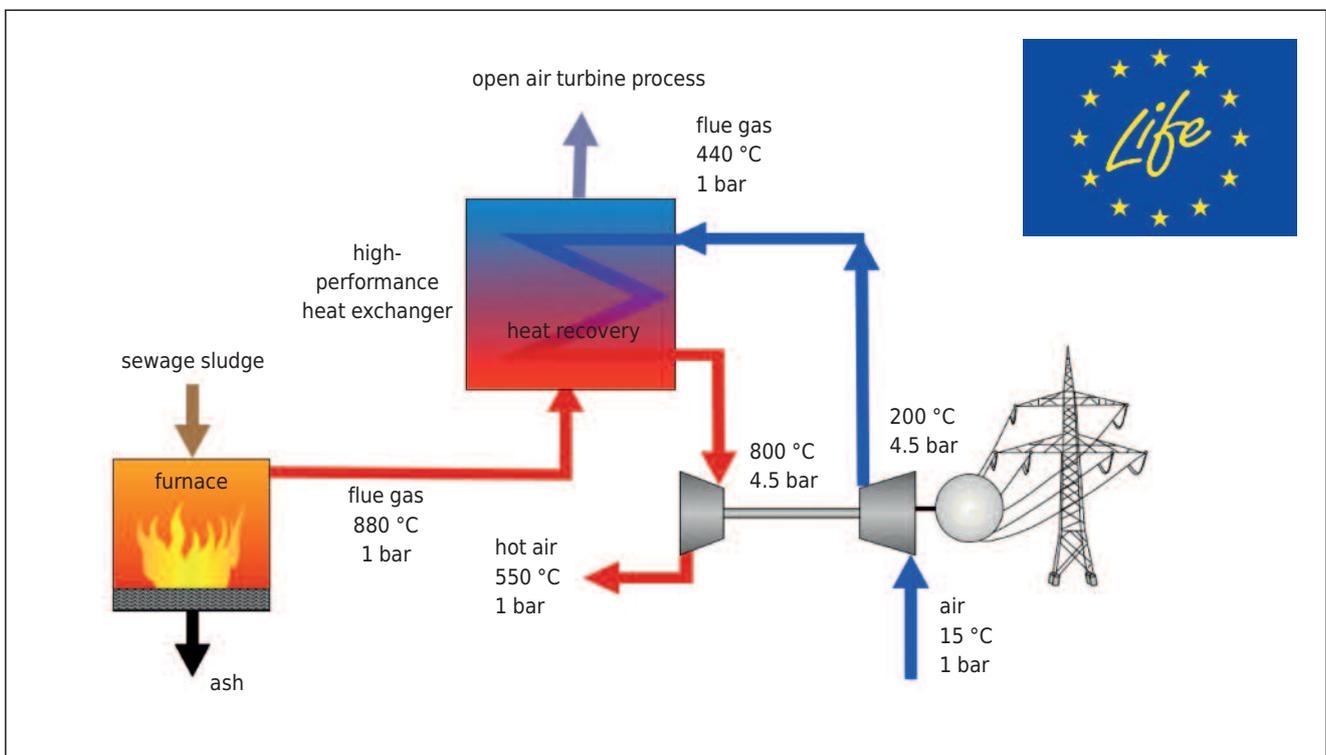
The plant on WWTP Straubing is designed for 200,000 PE and presently treats about 35,000 m³ wastewater per day. After anaerobic sludge treatment and dewatering by means of centrifuges this is an annual volume of almost 9,000 t sludge dewatered to on average 28-29 % DR. After incineration about 250 kg/h ash are left from the 525 kg/h dried sludge.

The thermal energy content of dried sludge is a substantial value for the creation of an energy balance. The thermal value of dried sludge with 65% dry residue is comparable with brown coal and provides 1,020 kWh of energy. With according boiler efficiency, about 800 kWh of thermal energy can be generated. After deduction of further thermal losses in the micro gas turbine about 700 kWh of thermal energy effectively remain for the drying process. With a thermal energy consumption of about 565 kWh for the drying process there is even a surplus of energy available.

About 40 kWh are required to operate the sewage sludge drying plant, but as the micro gas turbine produces about 80 kWh, another 40 kWh are available to operate the incineration plant – enough to cover the power demand of the incineration plant.

►► sludge2energy project data

- Applicant: HUBER SE
- Project partners:
ATZ Entwicklungszentrum, TURBEC R&D AB
- Project duration: 1st Oct 2006 to 30th Sept 2011



Energy utilisation in the sludge2energy process

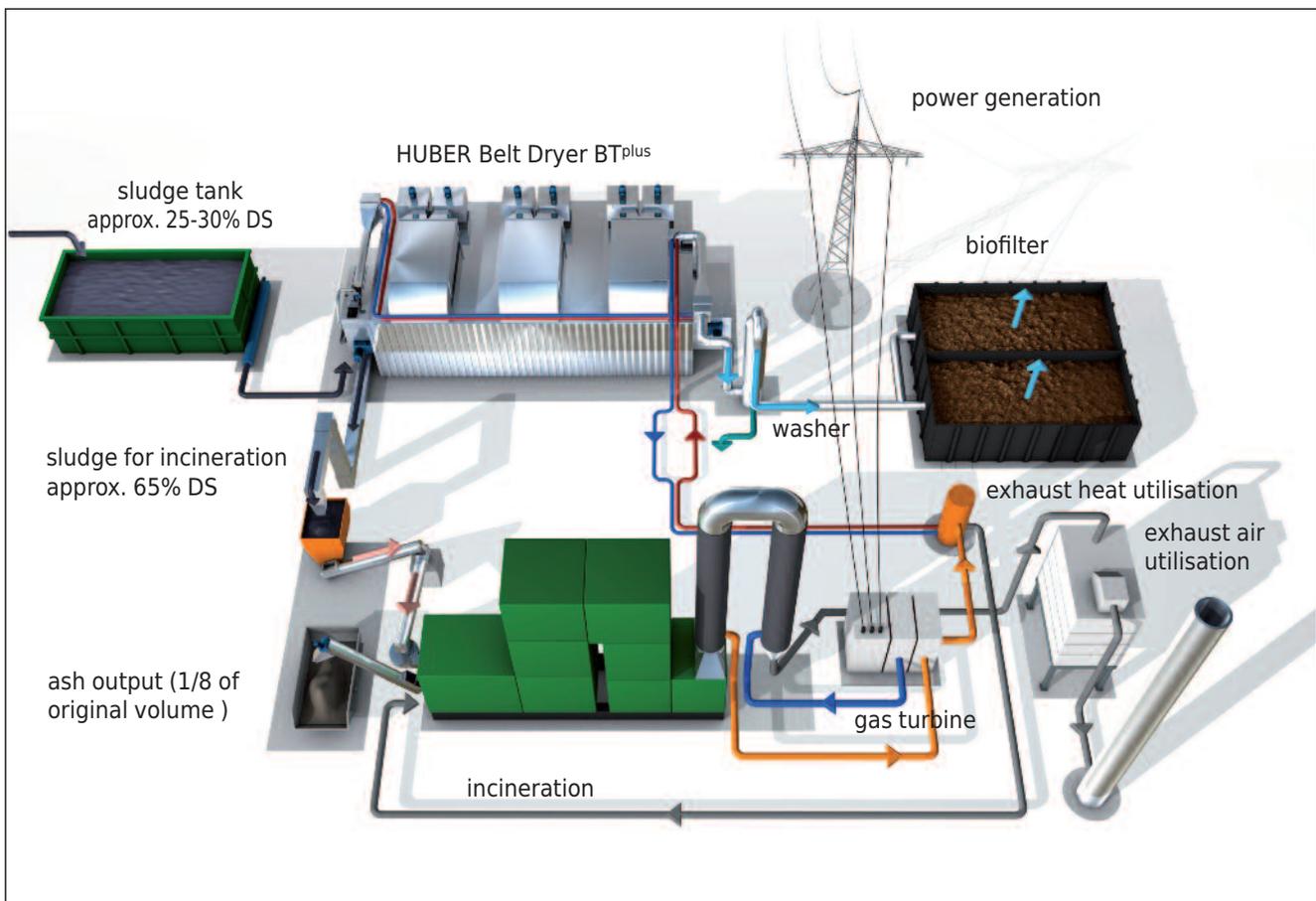
➤➤ Outlook

After some months of operation it will certainly be able to present the actual energy balance. From today's perspective we can say that energy self-sufficient sewage sludge incineration can be achieved at Straubing with the combination of a belt dryer, incineration and micro gas turbine. A substantial approach to saving energy is the energetic optimisation of the belt dryer and best possible utilisation of the incineration exhaust heat.

Meanwhile, the operators even have gone a step further and are thinking about possibilities how to recover the phosphorus contained within the ash from mono-incineration of sewage sludge. The necessary space is available on site so that there is a good chance that

another innovative treatment step will soon be added to the thermal sewage sludge disposal line on WWTP Straubing.

Visit <http://www.sludge2energy.eu/> to read more about sludge2energy.



Thermal sewage sludge utilisation on WWTP Straubing

HUBER SE

Industriepark Erasbach A1 · D-92334 Berching
 Phone: + 49 - 84 62 - 201 - 0 · Fax: + 49 - 84 62 - 201 - 810
 info@huber.de · Internet: www.huber.de

Subject to technical modification
 0,1 / 1 - 11.2011 - 11.2011

Layman Report sludge2energy