SynGas

SEWAGE SLUDGE UTILISATION
Decentralised sewage sludge utilisation with energy recovery through the patented KOPF gasification process
The efficient and environmentally-friendly handling of sewage sludge is one of the major challenges faced primarily by municipalities. In this sector, Sülzle KOPF is your reliable partner, offering you comprehensive contemporary solutions for decentralised sewage sludge utilisation with energy recovery. Sülzle KOPF designs and implements these solutions based on a patented utilisation method that constitutes an economical and proven alternative to the standard processes.

The Balingen plant, which uses this method, has been in operation since 2004. In addition, SynGas has been able to expand its technical expertise at key interfaces through co-operation with AVAT Automation GmbH.

Environmental protection pays off
Sewage sludge utilisation as a method for energy recovery
A sector with a future
Utilising sewage sludge

The purification of waste water in mechanical-biological sewage treatment plants generates large amounts of residual sewage sludge. In Germany, the more than 10,000 municipal sewage treatment plants have to dispose of approx. 3 million t/a dried sewage sludge matter [TS]. Due to increasingly rigorous waste water directives and the corresponding intensification of sewage treatment processes, the amount of generated sewage sludge is expected to increase in the medium and long term. What is more, the progressive sealing of the landscape will also contribute to the collection of larger amounts of waste water and thus to a higher incidence of sewage sludge.

New general regulations
The German directive for settlement waste (TASI) states that the direct depositing of untreated sewage sludge is no longer permitted on landfill sites. In many areas, the application of sewage sludge to soil has been prohibited or officially declared a discontinued model by the government.

High pollutant loads
In future, the phosphorus recovery directive will prohibit co-incineration with other sewage to support decentralised thermal single treatment plants.

Sewage sludge contains various pathogens, such as worm eggs, bacteria, viruses and prions, along with hormones that may affect the endocrine system. During decomposition in the sewage treatment plant, the thermally resistant pathogens remain intact along with the remaining toxic elements. The spread of such a cocktail in the environment was the primary cause for the BSE virus. The effects of many of the substances contained in sewage sludge on the ecosystem are not known.

Resources made available
There is no alternative to the thermal treatment of sewage sludge. However, sewage sludge also contains recyclable resources. SynGas offers you a method that removes the harmful substances while making resources available. The sewage sludge is utilised directly, without any transport that would damage the environment, and produces electricity, heat and ashes.

Past Technology for the Future

Combustion
Large amounts of oxygen (hyperstoichiometric)
- CO + O → CO₂
- H₂ + O → H₂O
- CH₄ + 2O₂ → CO₂ + 2H₂O

Gasification
Low amounts of oxygen (hypostoichiometric)
- C + O → CO
- C + O₂ → CO₂
- CO + O → CO₂
- C + H₂O → CO + H₂
- CO + H₂O → CO₂ + H₂
- C + 2H₂ → CH₄
- CO + 3H₂ → CH₄ + H₂O

Source: Statistisches Bundesamt (Federal Statistics Office), Wiesbaden, Germany 2013
Advantages of the utilisation

Small plant size with great output
Optional uses of the product
Usability of the ashes
Overall effectiveness levels

Sewage sludge utilisation in stationary fluid-beds

Up to 2 MW fuel utilisation
Up to 70% cold gas efficiency factor
Up to 1.3 MW Syngas production
Up to 600 kW co-generation electricity
Up to 1.3 MW thermal output
400 m² footprint

GAS PRODUCTION
1. The gasification air is introduced into the reactor from the bottom. Combustion and gasification processes are counterbalanced.
2. The dust removed from the fluid bed is separated and discharged.
3. The temperature of the raw gas drops to around 500 °C in the recuperator, the gasification air is heated to around 450 °C.
   - This prevents the condensation of oils and tars that remain present in small quantities in the raw gas.

RAW GAS QUENCH
The gas cooler combines the functions of a quench and a filter.
1. In the top part of the system, water is introduced with fine nozzles, the droplets evaporate on the way down.
   - The cooling temperature of the gas is set at approx. 140 °C
2. Small remaining quantities of oils and tars are condensed, while the condensation of water vapour is prevented.
3. In the lower part, the condensed components are separated. They are conveyed to the gasifier where they are split into gaseous compounds.

SOLID MATTER PATH
Requires: dried sewage sludge – residual moisture content from 5 to 20%.
1. The sewage sludge is conveyed from a storage silo to the gas cooler.
2. It is moved to the gasification reactor (fluid-bed gasifier) via a double door system, a metering system and a screw conveyor.
   - Holding time: approx. 30 min (organic components are fully processed)
3. This results in a pourable product. The granulate is conveyed via a double door system to a cooling coil. From there, it drops into a closed container at a temperature of less than 60 °C and is thus available for utilisation as an inert mineral granulate.

Technology with Prospects

Description of the SynGas utilisation process
GAS TREATMENT
10. The produced gas is freed from dust in a micro-filter, dried and cooled to ambient temperature.
   - The humidity contained in the gas is mostly removed
11. The collected condensate is conveyed to the sewage treatment plant. The temperature of the gas is increased. The gas drying improves its suitability as a fuel.

POST-COMBUSTION CHAMBER
Excess gas may be produced which cannot be utilised. This gas is disposed of in a pollutant-free manner via post-combustion with the help of natural gas or biogas at temperatures over 850 °C.

ENERGY UTILISATION
12. After processing, the produced gas is mostly free of pollutants. Its exact composition depends on the sludge used. Examples for the applications of this gas include:
   - Electrification in a gas motor
   - Fuel in a steam or thermal oil generator

MINERAL GRANULATE
The end product of the gasification is inert, leaching-proof, grainy and rich in phosphor. It therefore has many application options.

LANDFILLING
The criteria of the TASI for allocation to landfill class I I Appendix B are complied with. Depending on the copper and zinc content of the sewage sludge, the granulate can be allocated to the German Working Group of the Federal States on Waste (LAGA) allocation classes Z0 to Z2. The mechanical properties of the granulate allow its use in landfill structures for landfill stabilisation. It can therefore be used in household waste landfills without problems.

USES
- Production of asphalt due to its mechanical structure (accordingly lowering the use of primary mineral raw materials)
- Filling in ditches and embankments due to its low level of pollutants and mechanical consistency
- Bottom layer for re-cultivation measures due to its high content of valuable minerals

The high phosphor content allows the use of a local secondary raw material for the manufacturing of fertilisers instead of phosphor gained by mining in remote areas.
- Substantial CO2-savings

This utilisation is expected to be of the utmost importance in the future.
SÜLZLE KOPF – TECHNOLOGIES FOR PEOPLE AND THE ENVIRONMENT

An intact, clean environment and low energy consumption are elementary expressions of a high quality of life and a balanced life philosophy. For this reason, SÜLZLE KOPF relies on environmentally-friendly inter-disciplinary concepts that are also economically attractive.

**Gasification plant, Mannheim**
- Installation site: Mannheim
- Population equivalents: 600,000
- Capacity: 5000 t/a
- Gasification medium: Air with vapour
- Gasification temperature: 850 ºC – 900 ºC
- Installed capacity: 2.2 MWth
- Co-generation station capacity: 1.5 MWth
- Dryer capacity: Drum dryer
- Dryer: 500 m²
- Dimension: 75 kW
- Internal consumption: 70 %
- Cold gas efficiency: 70 %

**First plant in Balingen**
- Installation site: Balingen
- Population equivalents: 124,000
- Capacity: 935 t/a
- Gasification medium: Air
- Gasification temperature: 850 ºC
- Installed capacity: 75 kW
- Dryer capacity: Solar dryer
- Dryer: 80 m²
- Dimension: 12 kW
- Internal consumption: 46 %
- Cold gas efficiency: 66 %

**Expanded plant, Balingen**
- Installation site: Balingen
- Population equivalents: 200,000
- Capacity: 1955 t/a
- Gasification medium: Air
- Gasification temperature: 850 ºC
- Installed capacity: 220 kW
- Dryer capacity: Belt dryer
- Dryer: 120 m²
- Dimension: 25 kW
- Internal consumption: 50 %
- Cold gas efficiency: 66 %

**Gas analysis comparison**

<table>
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<tr>
<th>Location</th>
<th>CO₂ % vol</th>
<th>H₂ % vol</th>
<th>CH₄ % vol</th>
<th>CO % vol</th>
<th>N₂ % vol</th>
<th>LHV, MJ/m³</th>
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<tr>
<td>Balingen</td>
<td>8.1</td>
<td>13.1</td>
<td>2.1</td>
<td>16.7</td>
<td>Rest</td>
<td>3.2</td>
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<tr>
<td>Mannheim</td>
<td>13.8</td>
<td>13.3</td>
<td>4.2</td>
<td>13</td>
<td>Rest</td>
<td>4.7</td>
</tr>
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**SÜLZLE KLEIN: Sludge treatment**
- Thickening / Drainage / Drying

**PLANT TECHNOLOGY**
- MANUFACTURING WITH OWN WELDING ENGINEERING
- SLUDGE TREATMENT
- SEWAGE SLUDGE UTILISATION