

UTS Biogas Plant Söhnergy

by Jörg Herbold, Biological Service (UTS Biogastechnik GmbH)



The biogas plant Söhnergy in Schwaigern, northwest of Heilbronn, was completed and put into operation in early 2008. The feature of this system is the unprecedented heat utilisation concept. The operating company Söhnergy GmbH & Co KG was founded with the goal of an ecologically and economically sensible heat and energy concept for the neighbouring industrial site. Söhner Group is a leading manufacturer of electromechanical assemblies made from plastic as well as of plastic metal compounds.

In polymer processing much process cold is required to cool the tools and the production facilities. In order to provide the process cold, a 630 kW cold absorber from the company York is used which is being operated with the waste heat of the biogas CHP. The conversion of the biogas into electricity happens at the site of the biogas plant in a Deutz CHP with 1021 kW of electric power. The accruing heat is then led through a 950 m long district heating pipe to the industrial plant. Only the heat of the gas mixing cooler is used to heat the fermenter and the secondary fermenter so that the full heat of the waste gas heat exchanger and engine-cooling circuit of the CHP can be released into the district heating pipe. A Weishaupt gas burner was installed as a back-up system, which processes the gas providing the required heat in case the CHP should be out of service.

In a cold absorber, a refrigerant is vaporised in a continuous process with different pressure and temperature levels, and absorbed by a solution low in refrigerants. By leading the refrigerant through a second evaporation stage, and using external heat, the refrigerant is again separated from the solution and then liquefied. The system is based on the ability of some materials to absorb other substances well and to release them under different conditions. As a result the whole process operates at three different temperatures and two different pressure levels. With the first stage of evaporation low temperatures occur, with which a cooling medium is cooled. The two mediums used are ammonia and water with potential temperatures of up to -60°C or water and a bromide lithium solution with up to $+4^{\circ}\text{C}$. Water, or a cooling brine, is used as a cooling medium. With absorption refrigeration systems the solvent can be compared with mechanical refrigeration. In the case of mechanical cooling aggregates, the resulting refrigerant vapours are sucked through a compressor. With the absorption cooling system, the hygroscopic solvent absorbing the cooling medium acts as an absorbent.



On 3rd March 2008 the trial operation of the biogas plant was started. Since early July 2008 the plant has been running at full load. Renewable raw material is used exclusively as the fermentation substrate, mainly corn silage, rye and triticale as whole crop silage and sudan grass and sweet sorghum. The harvested energy crops are stored in specially constructed silage clamps on the site. The crops are grown by 44 farmers from the surrounding area. Controlled by a GPS system on the forage harvesters and transport vehicles, the harvest of each field can be assigned. By weighing and determining the dry matter of each individual load, an exact accounting of the individual farmers can be ensured.

Once a day the required amount of raw material is taken from the silage clamp and loaded in the Havelberger solids feeder with a loading volume of 80 m³. This machine feeds the material in 48 batches per day via a conveyor belt and feeding augers directly into the fermenter. The dosing station is placed on weighing bars, so that an accurate record and control of the input solids is guaranteed.



The biogas plant is designed so that the two fermenters of about 1800 m³ reactor volume each are directly fed in parallel. The secondary fermenter is positioned downstream with about 3300 m³ reactor volume. The partially fermented material is brought into the secondary fermenter from the primary fermenter, without any further expenditure of energy, through a special overflow. The secondary fermenter ensures that even the partially fermented material from the primary fermenters is processed completely. Through this two-stage process, the input material is effectively used and achieves about 35% higher gas yields than the expectations according to KTBL information. This exceptional performance of the organic conversion is achieved by the feeding/mixing technology, the overall process control as well as the generously measured fermentation tanks thus providing a long retention time.

For the mixing of the substrate in the fermenter two submersible hydraulic mixers are used. The hydraulic drive has several major advantages: the high torque at low revolutions, the EX-protection and the excellent heat dissipation through the externally located hydraulic aggregates. Thus, the efficiency of the mixers in the highly viscous and warm biogas substrate remains constant - in contrast to electrically driven submersible mixers. The mixers can be adjusted from the concrete roof of the digester through the service box in height and mixing direction. The patented UTS service boxes allow easy maintenance of the mixers during plant operation, without requiring the liquid level inside the fermenter to be lowered. The secondary fermenter is also equipped with two submersible hydraulic mixers. The final storage is equipped with two electrical submersible mixers due to the low mixing requirements and low temperatures. The hydraulic aggregates to operate the mixers are housed in the central pump building. This guarantees good heat dissipation and short distances for hydraulic pipes.

In automatic mode, the thinner substrate from the secondary fermenter is recirculated back into the primary fermenters. The UTS piping and pumping design has all fermenters connected with each other, so that balancing, exchanges and dilutions are all possible if and when required.



The pump building is spaciouly designed and easily accessible for maintenance. The central pump station and distribution of the substrate are housed in this building. This makes it possible to pump from one fermenter to the other. The integrated flow measurement and pneumatic valves allow an automated pump operation. The control system of the biogas plant is also placed in the pump building. It monitors and regulates liquid levels, temperatures, mixing and pumping operations. All procedures, except for the filling of the dosing station, are automated. The entire control system can be controlled by a PC in the CHP building. Through a data connection, the operators of the plant have access to the authorised remote monitoring allowing them to have external access to the controls of the biogas plant. This allows the operators of the plant to observe the system at any time. The remote monitoring also allows UTS experts to eliminate possible errors or provide assistance in operating the

plant correctly. Of course, a function to automatically call the operators in cases of emergency is installed to inform them and allow them to react in time.

A final storage tank of 4400 m³ was built to store the fermented material. Like the secondary fermenter, it is covered with a gastight tent roof. The resulting gas storage space is used as a buffer for the gas production and it also provides a large space for the biological desulphurisation. The biological desulphurisation with a dosed air input allows UTS not to rely on any chemical addition such as iron supplements which are often used with high hydrogen sulphide content materials.

The biogas produced in the primary fermenters is led into the gas storage of the secondary fermenter and the repository tank via stainless steel pipes installed above ground. There is the option to operate each fermenter independently or lead a gas mixture of all fermenters to the CHP. To monitor the gas quality and the automated control of the air entry for the desulphurisation, a continuous gas analyser is integrated.

The solids from the fermentation residues can be mechanically separated by a separator in a liquid and solid fraction. A proportion of the solid residue is fed into the plant again for fermentation, via the solids feeder, to increase the substrate utilisation. Nevertheless the majority of the solid residue is delivered to composting which creates a high quality plant substrate. Another possibility of use is to use the pressed residues after drying as a fuel in pellet form.

To have the plant quickly and reliably run on full output, the experts of UTS created a special schedule. This includes data of how to increase the input material in a certain period of time. In March 2008, the plant operators began to “feed” the fermenters, and after three months the contractually guaranteed power input was already reached. When increasing the feeding, it is important to note that the fermenters should not be overfed. If more substrate is fed than the bacteria can convert into biogas, the fermenters suffer from hyperacidity and as a result the infamous “crash” of the plant can occur. To avoid this problem, the experts of UTS have samples from the substrate analysed in a laboratory in regular intervals.

These samples are analysed for the content of organic acids and their composition, the percentage of organic solids, the ammonium nitrogen content and the supply of trace nutrients. In addition, one of the UTS experts visits the plant in the start-up phase every 14 days. On site some rapid tests are conducted and all important parameters of the biogas production are controlled.

Through a balanced strategy during the start-up phase, UTS can reliably and sustainably ensure that the biogas plant will reach the planned power output as quickly as possible. It is important to monitor and control the start-up since lots of money could be wasted during this period of time. If the plant is taken to full power too slowly, the potential revenue from feeding into the power grid is lowered. If the operators try to bring the plant to maximum output too fast, the biology may be disrupted by overfed fermenters. The overload of the biological process leads to problems often resulting in delay of performance for weeks and thus causes high costs/losses. The perfect start-up phase can only be achieved by an optimal feeding of the fermenters and comprehensive process monitoring.



The reliable and competent support of the plant, efficient and reliable technology and high performance biology with optimal use of substrates guarantee a successful operation of the plant. In combination with a reasonable heat concept, a biogas plant also pays for itself with high-price substrates.

For more information on reliable biogas technology, please visit www.uts-biogas.com