

Waste as a Source of Energy

The production of energy from waste, either at a waste sorting center, or from sewage sludge, in a sewage treatment plant for wastewater, is spreading quickly in Europe, primarily in Western Europe. These techniques of "recycling energy" call for complex technology and performance variables. This permits the municipality to, at the same time, treat the waste (and but also to value it economically), to protect the health of residents, and to limit greenhouse gas emissions. The new town of Tychy has developed significant expertise in these areas.

A value added on common waste

Rigorous management of domestic waste and waste water produced in urban areas is essential to live in a healthy environment and limit the impact of these highly concentrated residential areas on the surrounding ecosystems. In Tychy, a town erected in the 20th century in the context of the coal region, these two aspects have not been neglected—and to such an extent that the city is considered the region's "green city". Insomuch as the treatment of waste requires additional inputs for building infrastructure and investment, it can also be a source of income. Recycling certain materials is one of the main methods of enhancing the value of municipal waste. In Tychy, an additional source of income comes from recycled waste and sewage sludge since they both are used for the production and sale of electricity and heat. The infrastructure put in place makes good use of the methanogenic fermentation that the bacteria perform in the presence of an organic substrate in propitious conditions (anaerobic, temperature near 35 degrees C). The equipment set up in the domestic waste treatment station and the wastewater treatment plant (WWTP) enables the fermentation and recovery of waste.

An energy-autonomous sewage treatment center

Description of equipment - Fully owned by the municipality, the waste water treatment plant of Tychy treats a volume of **33,000 m³ of water each day**. It has the ability to produce as much energy as it consumes while still being quite strong in its water sanitation function.



Renovated WWTP building

The treatment, very classic, involves phases of both mechanical and biological treatment. In the biological treatment facilities lies one of the keys to the WWTP's zero energy balance. In fact, the process used is based on an effective system of oxygenation control and optimum regulation of the aerators. And ventilators are usually a major energy consumer. The process used, based on Austrian technology, assures the WWTP's very high energy efficiency.

At this point, the sludge from the treatment passes through two **biological, anaerobic digesters** whose total capacity reached **15,000 m³** by the end of 2007. That is where the biogas is produced and recovered. The digesters are maintained at 35 °C in order to ensure a production that is continuous and maximal. With a composition of **62% methane, 30% CO₂** and **8% H₂S**, the biogas that is obtained must be cleaned in order to eliminate much of the H₂S, which is a source of air pollution and corrosion. It is then conveyed and will feed two cogeneration engines, that **simultaneously produce electricity and heat**. The content of methane gas at the engine's inlet, an important parameter for optimal functioning, is constantly monitored. The energy efficiency of the engines is very high (**90%**) for power levels of 345 kW of electricity and 531 kW heat.

Summary of Energy Production -

The heat and electricity produced provided for half of the needs of the station (heating for the buildings and digesters, operation of electrical facilities and lighting) before the establishment of the second digester and the second engine (December 2007). The introduction of new equipment would cover all the energy needs of the plant. In 9,600 hours of operation the first engine installed produced **2.3 Gwh of electricity**.

Destination of energy produced - The cost of purchasing electricity for the network is 64 €/MWh yet electricity is sold 33 €/MWh over the network. The electricity produced locally is primarily consumed locally. In addition, the WWTP can sell **green certificates** for approximately **61 €/Mwh**, which electricity generating plants then have a legal obligation to purchase. **In the end, investment in the engines and the digesters is amortized in just 2 years.**

Financing the facilities - The first engine (installed in September 2006) was financed at 70% by the fund **Ekofundusz**, a national grant destined for projects focused on environmental protection, and at 30% by the plant. Obtaining this funding requires a long and complex administrative process. The second engine (installed in December 2007) and the second digester, with a capacity of 11,000 m³, have been set up as part of a larger project that includes connecting 20,000 new inhabitants to the municipal sanitation network, as well as undergoing a renovation of the plant. With a budget of 100 million euros, the project is financed almost exclusively by the European Cohesion Fund and the Government of Poland.

"The wastewater treatment plant in the town of Tychy is one of the most modern in all of Europe; it works based on technology that enables it, notably, to be autonomous in energy."

A Brief

Overview

Energy production at the WWTP and the waste treatment center (WTC)
 Procedure : méthanisation et combustion dans des moteurs co-générateurs.

Power for electricity:
 WWTP : 345 kW
 WTC : 345 kW
 for heat :
 WWTP : 531 kW
 WTC : 455 kW
 Number of employees :
 WWTP : 60
 WTC : 67

Total greenhouse gas emissions avoided (estimated)

- WWTP : 28,000 t_{eq} CO₂
 - WTC : 18,000 t_{eq} CO₂

Financially speaking

Cost of investments in facility and in production of biogas and energy:
 - WWTP : 6.7 million €
 - WTC : unknown
 Financing :
 the company, Voïvodship (region), Ekofundusz, the Government of Poland, European Cohesion Fund, Structural funds for Poland

Dates

- WWTP
 september 2006 : installation of the first co-generation engine
 december 2007 : installation of the second
 - WTC
 1997 : creation
 decembre 2006 : modernization and engine installation



The creation of a waste treatment company

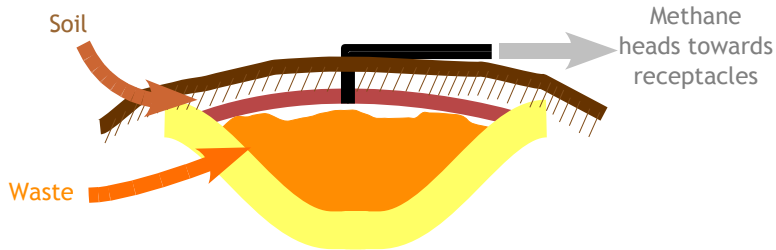
The town of Tychy and its 8 surrounding villages started a company to manage household waste, called "Master," which has the slogan, "Ecology is us", one that says a great deal about the activities of the enterprise. In fact, not only does it collect and sort waste, but it also produces energy from non-recyclable waste and offers educational activities on environmental protection. Founded in 1997 on an area of 140 unused hectare, the station was renovated in late 2006 with the help of EU structural funds for Poland (ZPORR).

Waste headed to various destinations

After collection, the waste is sorted by hand on a sorting assembly line. The recyclable waste (PET bottles, plastic bags, etc.) is all compressed, packaged and sold to companies specializing in recycling, primarily German companies. The non-recyclable waste items are then, since the renovation work in 2006, stocked and buried in 40 methane pits. In these pits, completely covered and airtight, microorganisms carry out the digestion of organic waste, similar to the process performed on sewage sludge. From this methanization process, 955,000 m³ of biogas is produced per year (on average, the gas is 53% methane). The biogas is retrieved (for if it were released, the corresponding annual emissions of greenhouse gases would be about 20,000 teq CO₂!) and channeled through underground pipes to a collection basin, where it undergoes quality control and pressure. The gas that emerges from this fermentation is «clean» and does not require special treatment, contrary to the gas produced from sewage sludge.



A pumping system then passes the energy into a cogenerative engine situated several hectometre. The power of the engine in electrical production is 345 kW and in heat production it is higher, 455 kW. The energy efficiency of the engine is pretty high, at 85%. After 5,000 hours of operation, it had produced 1.46 GWh of electricity.



Cross-section of a methane pit

Energy Usage

Electricity and heat are wholly sold on the network infrastructure, the town of Tychy being equipped with a network of district heating. The water network of district heating arrives at the plant with a temperature of 57°C, and leaves with a temperature of 68°C. The electricity generated at low voltage is then converted by an electricity transformer at a higher voltage, adapted to that of the network.

Exemplary treatment plants in Poland

These stations show signs of serious modernity, attributed to the technologies employed (optimal aeration of biological basins, control room for the high tech engines, a comprehensive information system, etc..) and also to their valuing energy releases as a push to replace other sources of energy (coal).

NB : Of the 700 landfill waste in Poland, the majority have not yet mastered the process of controlling landfill gases, which is dangerous to public health and which also generates significant GHG emissions (including methane, of course, which has a global warming power 23 times stronger than that of CO₂).

Useful advice

These innovative systems give way to a variety of benefits, such as environmental (treatment of waste or sewage and energy production through recovery and conversion), economic (profits from the sale of energy) and social (job creation).

One of the indispensable conditions for their implementation is the existence of a source of heat consumption that functions continuously over the year. The process used for waste treatment also requires a large surface of land and this is expected to grow with the accumulation of waste. Preparing the correct infrastructure requires significant initial research and the choice of a particular process must be based on all available information.

On financing, the initial investments are substantial, but can be quickly profitable and can also be supported with the assistance of european or national funding.

For more information...

Municipal website for Tychy : www.tychy.pl

Site of the WWTP : www.rcgw.pl

Site of the WTC : www.master.tychy.pl

Articles about Tychy on the ChallenGES Tour blog :

<http://challengestour.blogspot.com/>

Who to contact in Tychy ?

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