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Bad Oeynhausen

Energy-plus sewage plant shows the way

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Energy-plus sewage plant shows the way

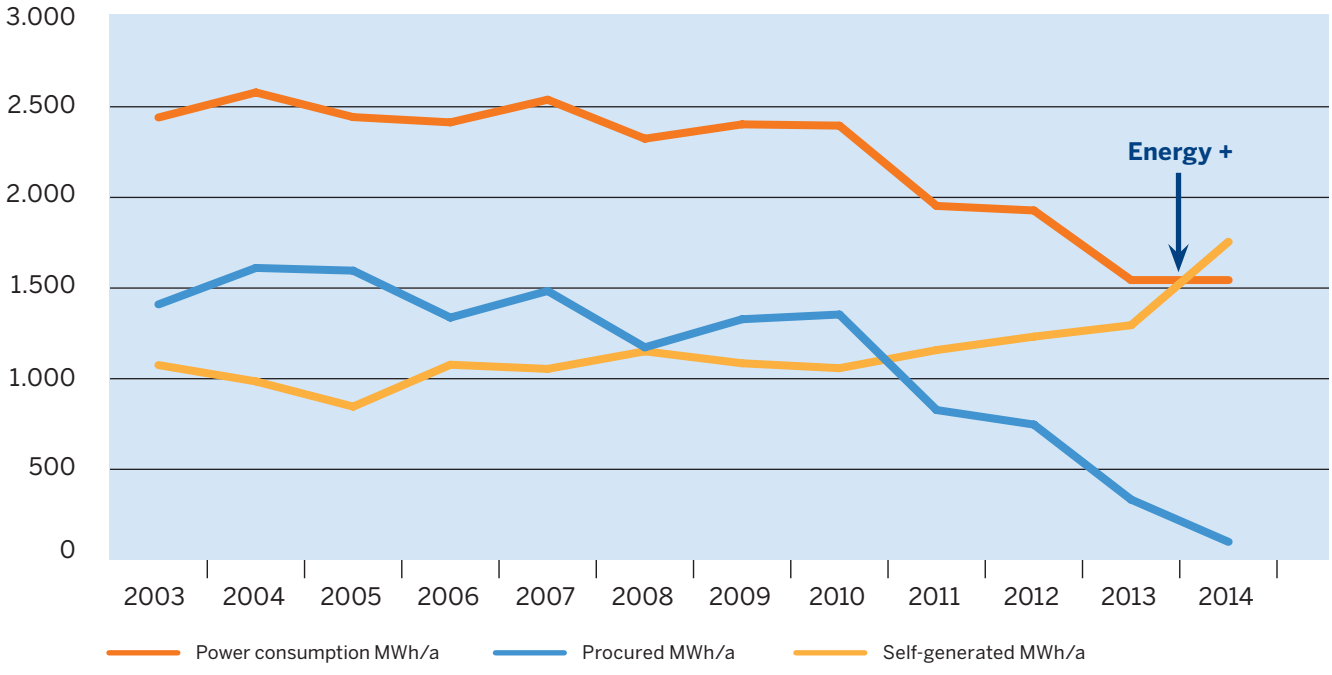
In the German town of Bad Oeynhausen a pioneering transformation project is underway. An average sewage treatment plant is being turned into an energy-plus facility and the process has just reached a new high-point. Following modernisation of the combined heat and power (CHP) plants this municipal sewage treatment plant is set to achieve 113 per cent energy self-sufficiency in 2014. The sewage gas arising is being used completely for heat and power co-generation. Considerably more gas is now produced. This has been achieved over a twenty-year process without the use of fossil fuels, cofermentation or other external energy sources. And this despite that fact that relatively adverse conditions, such as mixed water inflows, delivery heads of up to 18 metres and filtration operation, have not made optimisation any easier and, of course, reliable adherence to control levels has always been a prime concern.

The sewage treatment plant in Bad Oeynhausen is a typical, medium-sized facility. In terms of wastewater composition, process and design it is similar to many such plants in North Rhine-Westphalia. It was erected in 1972. Over the past few years its capacity utilisation has remained relatively constant at 63,000 population equivalent. What distinguishes this particular plant is the dedication and courage of the parties involved, and the sense of proportion shown in both the design and the implementation of numerous small- and large-scale efficiency measures.

Climate protection as a basis

The energy optimisation of this plant is an integral component of Bad Oeynhausen's climate protection strategy and is a major factor in the ambitious objectives. In 2007 the town council resolved to forge ahead with municipal climate protection as a strategic goal. A climate protection plan was drawn up to provide a basis for future activities. As part of this, the municipal campaign "Bad Oeynhausen – committed to climate" was set in motion. Since the end of 2011 the climate protection endeavours have been boosted by the participation of the town and its public utilities organisation (Stadtwerke) in the "European Energy Award" quality management programme. As well as advising and motivating external parties in matters of climate protection, the town focuses its activities on its own properties and facilities. Since 1990 the town has managed to cut its CO_2 emissions by 50 per cent. A major portion of the savings is due to the measures taken in the sewage treatment plant run by Stadtwerke Bad Oeynhausen.

Development of electrical energy in the Bad Oeynhausen sewage plant 2003 to 2014

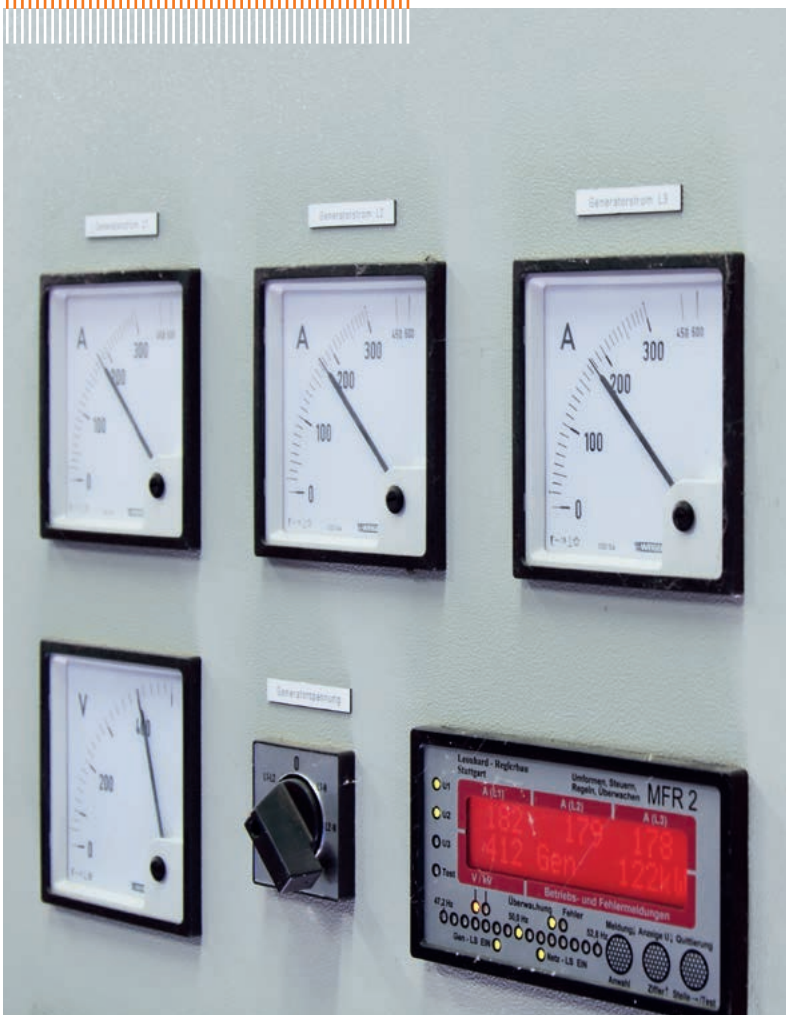


Optimisation of the process engineering

As early as the 1990s, measures had been taken to reduce the plant's energy demand. There were process engineering problems connected with nitrogen elimination. To tackle these, the plant was extended, the constantly aerated part of the biological treatment was switched to intermittent mode and the flow energy of the unaerated basins was reduced. Consequently the denitrification problems were eliminated. At the same time the energy procurement was cut by around 150,000 kWh per year.

Other measures taken

- Agitator to mix in flocculating agents: By means of modified dosing points at heavy-flow locations it has been possible to provide the mixing energy without additional electrical input. Saving: 11,000 kWh/year.
- Aeration blower to oxidize bivalent iron salts: Series of measurements showed that it was not necessary to operate the aeration blower to oxidize the bivalent flocculating agents. Saving: 22,000 kWh/year.
- Biofilter to combat odours: Following sensor measurements and with the support of the supervisory authorities, the biofilter used to combat odours in the computer building and at the pre-thickener was taken out of service. Saving: 96,000 kWh/year.



Automation optimization

With the renewal of the automation system the Bad Oeynhausen sewage treatment plant has taken a further major step towards energy self-sufficiency. Four questions were asked to analyse all the installations and processes:

Why do you still exist?

- Room fans for heat losses of now non-existent frequency converters were removed.
- Electric heating systems were shut down where they serviced workshops no longer occupied and were not required for structural reasons.
- The circulation in the digestion tower to prevent occasional foaming was shut down. In the winter it was possible to combat the excessive stringiness of the biomass using aluminium flocculating agents.

Why do you work for such long hours?

- The grit chamber aeration is only switched on for certain periods. Where there are low night-time inflows the blower shuts down.
- The sludge recirculation has been switched to intermittent mode where there is only a low solids load in the secondary clarifier, for example in the summer. In dry weather the circulation is switched on about every 30 minutes. To prevent sludge overflow one of the twelve secondary clarifiers is operated as a “bad basin” with a greater load. The sludge level and opacity are measured and a solids probe is used to check the process closely in order to prevent sludge overflow.
- Rabble rakes in the pre-thickeners and the filtrate compensation tanks are switched off where nothing is being taken off.

Why don‘t things go more slowly?

- Additional energy could be saved with an NH_4-N-controlled oxygen regulation system where the O_2 setpoint is influenced by a setpoint matrix.
- The flow energy for the denitrification basin has been lowered to about 0.13 W/m³ basin volume using frequency-converter-controlled drives. To prevent any adverse effects this process is started up cyclically for a few minutes in medium-load mode. To prevent sedimentation all the available machines are operated every day for a brief period at full load in heavy-duty mode.

How can the self-generation rate be increased further?

- With the downstream second digestion tank where only the displaced sludge is sedimented, gas stripping has been applied, increasing the gas yield. In turn the electricity yield has risen by about 70,000 kWh/year.
- The raw sludge inflow was optimised to ensure that the plant could cover the heat it needed for its own operation, especially in the cold season. For example, the drainage and pre-thickener separation ratio was improved in terms of measurement and the process engineering. The sludge blanket is automatically kept at a high level by means of continuous checks in the pre-thickener.
- The process temperature of the digestion tank is linked to the heat output of the CHP plants. The heat input into the reactor is set via fixed values of the mixer. The process temperature is maintained within a stable framework in conjunction with an adjusted digestion tower feed and occasional adjustment of the matrix. This means that all the sewage gas is converted into electricity.

Renewal of the plant engineering

Both energy efficiency and economic efficiency were major factors here.

- A modern high-capacity decanter was installed to drain the sludge. Saving: 20,000 kWh/year.
- Two turbo compressors with magnetic bearings were used for the biological treatment aeration blower. Saving: 65,000 kWh/year.
- The transverse aeration of the grit chamber was replaced by a modern, frequency-converter-controlled rotary piston blower. Saving: 10,000 kWh/year.

Energy efficiency that pays off

Stadtwerke Bad Oeynhausen has attained the goals set by its own efforts and its own resources. With a total expenditure of around 200,000 euros for energy efficiency measures, it is now possible to sustainably save annual energy costs to the tune of about 250,000 euros. The central concern was the energy efficiency potential and utilisation of the total raw sludge produced to generate energy. Success was assured by a dedicated and imaginative workforce, management’s faith in the skills of their employees and a clear commitment to climate protection by the town’s administrators. It has been possible to create an exemplary energy-plus sewage treatment plant thanks to thoroughly thought-out measures and an effective interplay of planners, implementing company and contracting body.

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