PROJECT PROFILE • ROSENHEIM

The waste-fuelled CHP plant at Rosenheim, Germany, supplies local power, process steam and district heating. Holger Scholz explains how variable speed actuators play their part in keeping the plant running during periods of low heat loads.

Control circuit optimization

in waste-fuelled CHP

We examine the Rosenheim combined heat and power plant in Bavaria, Germany, for this project profile. This case clearly illustrates that modern power generation plants are complex facilities comprising of many different sections. To achieve the optimum results, absolute synchronization of all components is needed – with any functional imperfections kept to a minimum.

Before explaining how SIPOS Aktorik GmbH (Germany) met the challenges presented at Rosenheim CHP, here is some background information on the plant: the CHP is a gas, fuel-oil and waste fuelled combined heat and power plant; and approximately 60,000 tonnes of domestic and industrial waste are converted by means of incineration into energy for power generation, process steam and district heat.


The Rosenheim combined heat and power plant in Bavaria, Germany

PLANT COMPONENTS

The extensive facilities at Rosenheim include: flue gas treatment (encompassing a spray absorber for the addition of lime and activated lignite); a fibrous filter with Goretex membrane filter tubes; and a selective non-catalytic reduction (SCNR) NOx removal plant. The steam boiler equipment at the power plant includes a refuse boiler with 30 tonnes

SIPOS actuators with integral frequency converters installed at Rosenheim

Actuators from SIPOS Aktorik stabilize the control circuits in the waste-fuelled CHP

The Rosenheim combined heat and power plant in Bavaria, Germany

per hour steam generating capacity; a gas/oil-fired boiler with the ability to generate 20 tonnes per hour of steam and a gas/oil-fired boiler with 44 tonnes per hour steam generating capacity.

The two steam turbines at the Bavarian plant are: turbine 1 (an AEG/Kanis, manufactured in 1987) comprising of a low-pressure turbine (4.5 bar, 28.5 tonnes per hour) and a high-pressure turbine (60 bar, 490°C, 30 tonnes per hour). The generator output for turbine 1 is 8.95 MW. Turbine 2 (an AEG/Kanis, manufactured in 1956) is 60 bar, 480°C, 19 tonnes per hour. The generator output of this second turbine is 2.5 MW.

Two gas/oil-fired boilers each provide 19.5 MW thermal output, and the gas engine plant consists of three gas engines with a thermal output (per engine) of 3300 MW per year, a thermal efficiency of 42%, an electric power output of 3352 MW per engine per year and an electrical efficiency of 44%.

ENERGY TRANSFER, CAPACITY AND RESIDUES

The electricity produced at Rosenheim totals approximately 60 GWh per year, which equates to around 30% of the city's power requirement. In a year around 100 GWh of district heat is produced – supplying just over 500 houses and businesses – and around 58,000 tonnes of process steam is generated.

The waste-to-energy plant thermally converts around 60,000 tons of refuse and waste. The incineration of domestic and industrial waste results in a weight reduction of two thirds, i.e. for every tonne of waste, 320 kg of residue remains. These residues are divided into waste from the flue gas treatment and slag from the incineration grate. The residues from the flue gas treatment are utilized in a number of ways, including for use in mining and landfill applications – after a stabilization process for harmful substances including pollutants and contaminants. The slag from the incineration grate can be used for road construction.

The incineration of one tonne of domestic and industrial waste represents a considerable saving of fossil fuel energy resources

ENERGY USE

The incineration of one tonne of domestic and industrial waste represents a considerable saving of fossil fuel energy resources. As a result, the incineration of waste contributes to the conservation of fossil fuels and the reduction of carbon dioxide emissions.

In the Rosenheim waste-to-energy-plant, cogeneration produces an optimal use of energy. The high pressure steam produced passes through a turbine to generate electricity, and the remaining energy is used for district heating or as industrial process steam.

From one tonne of waste, CHP Rosenheim produces:

- 0.3 MWh electricity
- 0.8 MWh district heat
- 0.3 MWh process steam

Since 1986, the Rosenheim incineration plant has included a flue gas treatment facility, utilizing a quasi-dry process combined with fibrous filters. For the enhanced treatment of the flue gases and the elimination of organic contaminants, particularly dioxins, furans and highly volatile heavy metals like mercury, the flue gas treatment process was expanded in 1992 with an activated lignite stage.

PLANT OPTIMIZATION AND MODERNIZATION

To conform to German regulations introduced in 1996, a DENOX (NOx removal) stage, utilizing the SNCR process with urea, was retrofitted. Additionally, the process of the quasi-dry flue gas treatment was optimized to enhance the separation of hydrogen chloride and to reduce the particulate matter to a minimum. As a result, the incineration plant provides an economic, simple, but still extremely effective, flue gas treatment that can safely fulfil all requirements.

As some of the plant sections had to be replaced after 40 years of operation,

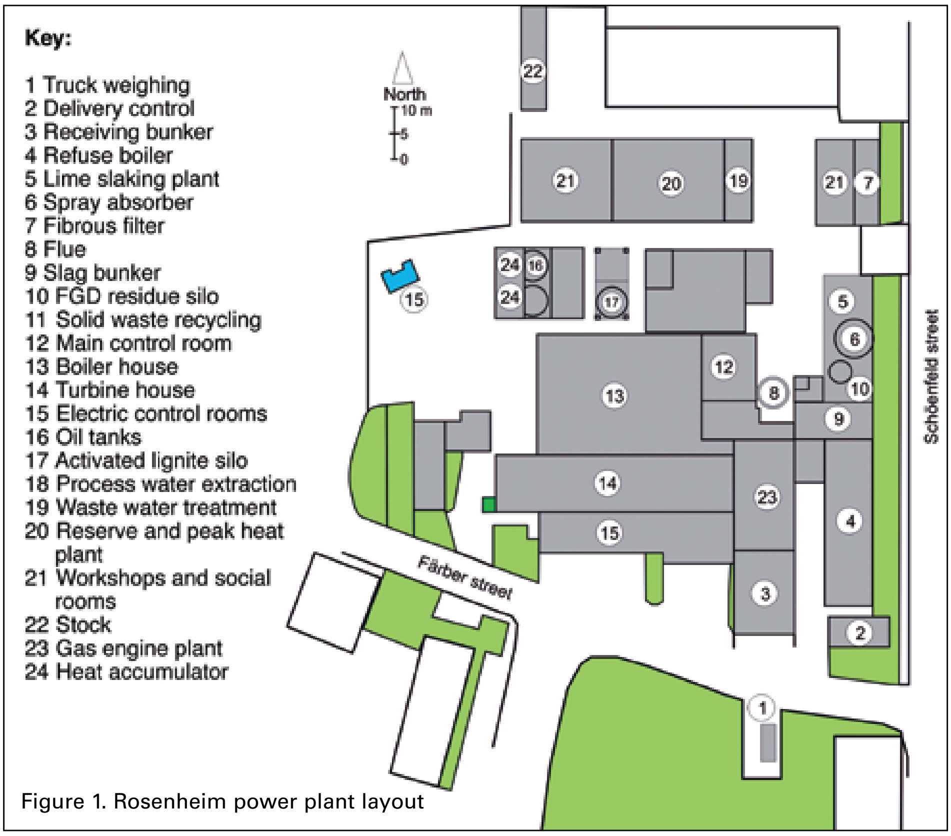

Figure 1. Rosenheim power plant layout

different strategies for modernization were developed. With the aim of not just providing private households and companies with power and district heat, but also achieving the maximum overall efficiency of the plant while keeping the pollutant emission as low as possible, a decision was made in favour of the use of three gas engines, each with 3.3 MW electrical and thermal outputs.

The heart of the waste-fuelled CHP – the gas engine plant with three newly installed gas engines – required safe cooling, i.e. the dissipation of the combustion heat generated during operation. In principle this was not a problem as the overall concept of a waste-fuelled CHP provides a use for this waste heat in the district heating network. However, cooling also had to be considered, and an emergency cooling system was installed with a heat exchange performance of 12 MW, a cooling water volume flow of 500 m³ per hour and around 100 fans – ensuring correct temperature and pressure conditions in the cooling water circuit.

CONTROLLING VALVE BEHAVIOUR

The emergency cooling system is designed to ensure safe exhaust heat dissipation from the three gas engines at full load. A butterfly valve installed in the cooling water circuit, controls the volume flow, depending on the water temperature. However, a real challenge occurs during low load operation. When the flow of the cooling water ranges between 5% and 10% of the total volume, the working point is in the lower section of the butterfly valve curve. For a general opening degree of 60% to 70%, this is far from a linear section. As a result, it is difficult for technology to predict accurate control behaviour and to achieve the required stability within the control circuit. The repercussions of continuous 'overshooting' of the control circuit would extend across the plant, resulting in fluctuations in the district heating network and a negative impact on the smooth operation of the gas engines.

A small group of actuator manufacturers are established as standard suppliers to the power plant sector, but after comprehensive tests, actuators from SIPOS Aktorik were selected to help, and the solution has provided reliable modulating operation for over a year, both for the closed-loop control of the emergency cooling system and at the pressure reduction station.

The use of SIPOS products has had several advantages for the structure and the operation of the waste-fuelled CHP at Rosenheim. Equipped with integral frequency converters, the actuators provide municipal utilities (such as Rosenheim) with:

- control station savings, due to the actuators' integrated control and power electronics
- avoidance of pipeline water hammer or excessive valve cavitation, by means of variable speed in the end positions
- good adaptation to plant sections by means of different output speeds for the 'open' and 'close' movement
- different output speeds, over a maximum of ten interpolation points, for linearization of the valve curve.

For the control circuit of the emergency cooling system it was decided that, with 5 rpm, an extremely low output speed could be selected at the output shaft of the actuator. To ensure that the behaviour of the control circuit is not unnecessarily sluggish, higher running speeds can be selected in the medium curve range (if opening angles are non-critical with the curve of the butterfly valve).

Rosenheim, like any environmentally conscious plant operator, seeks to avoid the waste of any generated heat energy. With this in mind, and in order to achieve further savings, solutions were sought for a reduction in the use of the emergency cooling system. Two heat storage tanks with a volume of 243 m³ have therefore been installed for the future collection of heat energy – this extension to the plant was commissioned in 2006 and another four heat storage tanks are planned. To ensure reliable flow control SIPOS actuators with frequency converters were selected.

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