Preheating with saving effect:

gas-net F1 – an energy balance centre

New technologies lead to new considerations and new ideas. This also applies to equipment for gas measuring and control systems. The possibilities provided by the micro gas turbines which are now available allow new techniques for preheating natural gas – a necessary evil for control systems with high differential pressure. The German gas supplier DREWAG Netz GmbH has taken a new route in this respect while Elster, its partner, is supplying a measurement device which can handle all forms of energy: the gas-net F1.

The micro gas turbine makes it all possible

For a definition, let's first look at Wikipedia, the free encyclopaedia on the internet. In the section on gas turbines it states that: "Microturbines are becoming widespread for distributed power and combined heat and power applications. They are one of the most promising technologies for powering hybrid electric vehicles. They range from hand held units producing less than a kilowatt, to commercial sized systems that produce tens or hundreds of kilowatts. … Microturbine systems have many advantages over reciprocating engine generators, such as higher power-to-weight ratio, extremely low emissions and few, or just one, moving part. … They accept most commercial fuels, such as gasoline, natural gas, propane, diesel, and kerosene as well as renewable fuels such as E85, biodiesel and biogas."

Micro gas turbines in gas regulating and metering stations

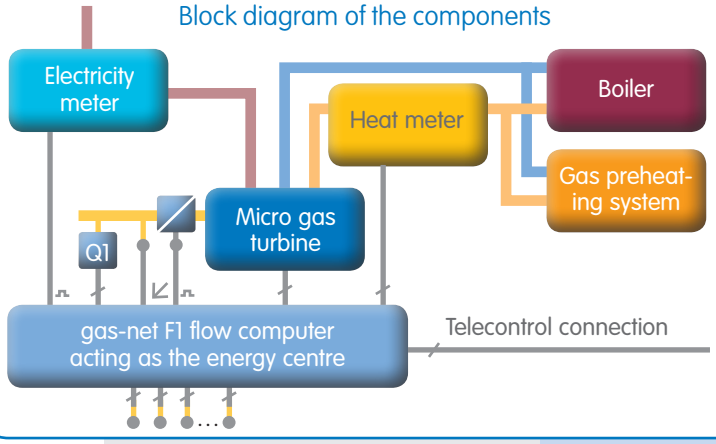
So why do we need a micro gas turbine in a gas regulating and metering station?

Micro gas turbine in a gas regulating and metering station

Micro gas turbines always make sense if, in addition to conversion to electrical energy, a system can also put the heat energy simultaneously converted to a reasonable use. If, in the case of a gas regulating and metering station, somebody comes to the conclusion that this heat could be used to preheat gas, the structure actually "designs itself". The block diagram shows in very simple terms how the components interact. The fuel for the micro gas turbine in this application is, of course, natural gas; the consumption is measured by a rotary gas meter. The measurements of volume, pressure and temperature as well as the gas quality data are transferred to the flow computer whereas the gas quality is measured by an Elster gas-net Q1. The electrical energy converted by the micro gas turbine is fed into the power supply network. The heat energy remains in the measuring system where it is used beneficially to preheat the gas. The existing boilers are retained in unmodified form, and the extended water circuit for the micro gas turbine is connected using a hydraulic valve. From a technical point of view, that is all you need.

Over and above the actual technology, however, mention should also be made of the fact that the carbon footprint of the process is dramatically improved by using a micro gas turbine.

Block diagram of the components



Measurement device gas-net F1 for all occasions

Well why not? An extremely interesting project discussion produced some remarkable results:

- Install a micro gas turbine for heat and electricity generation in a gas distribution station?
  Well why not?
- The heating value is measured in all gas distribution stations of DREWAG Netz GmbH. Record the gas volumes of the micro gas turbine as energy?
  Well why not?

- Record, register and forward the electrical and heat energy to balance the energy flows?
  Well why not?
- Record, register and forward the monitoring data of the micro gas turbine?
  Well why not?
- Record, register and forward weather data in and around the station?
  Well why not?
- Use lots of equipment for this?
  Well why?

After all, you can place your trust in a single measurement device to take care of all your information technology tasks: the Elster flow computer gas-net F1.

Its main purpose, of course, is the fiscal measurement, conversion and calculation of the energy content of the fuel for the micro gas turbine. But that is by no means everything that the gas-net F1 can do for the application. As a result of its extensive and flexible additional non-fiscal functions, in this application it can act as an energy and monitoring centre. That means that the gas-net F1 is connected with all the other devices using digital communication lines in point-to-point connections so that it can exchange information with them. As the block diagram shows, the gas-net F1 also performs the following tasks:

- Connection to the heat meter via Modbus (connected Modbus/M-BUS gateway); cyclical recording of the heat volume, hourly archiving of the heat energy in a process value archive; additional monitoring of the heat meter, recording of faults in an operations logbook
- Connection to the electricity meter using a pulse interface; conversion of the pulses into active electrical energy, hourly archiving of the active energy in a process value archive
- Connection to the micro gas turbine via Modbus; monitoring the operating parameters of the turbine (e.g. generator, inverter, compressor, turbine), recording of faults in an operations logbook; additional facility to remote control the micro gas turbine using the Modbus interface (e.g. on/off)
- Measurement of climate data such as indoor and outdoor temperature, humidity and other weather data by connecting additional sensors; cyclical archiving in a process value archive
- Connection to the remote control centre via IP network and the IEC 60870-5-104 telecontrol protocol; provision of all energy meters (fuel, active electrical energy, heat volume); provision of the current climate data; provision of the health status of all devices; facility to remote control the micro gas turbine via the control room
- Connection to the remote billing centre via IP network; provision of the fiscal billing archive for the natural gas; provision of the process value archive for all other types of energy and climate data; provision of the operations logbook

This means that, in addition to its main function as a flow computer for fiscal measurements, the gas-net F1 acts as a central system for the micro gas turbine itself and for all the equipment which supports the function of the turbine. While saving on other monitoring equipment, it consoli dates all the main data which allows the entire technical process to be observed, controlled and assessed either locally or remotely.

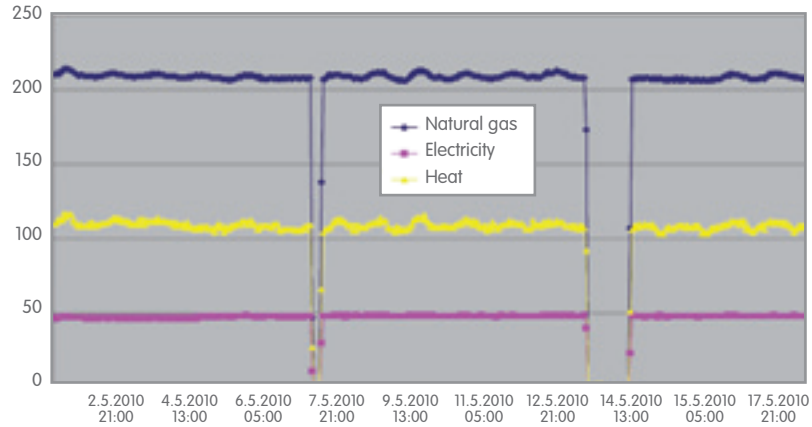
Energy balance of the micro gas turbine
The diagram shows an extract from the hourly recorded process value archive of the energy types. With an average consumption of 210 kWh of natural gas per hour, a typical level of 47 kWh of electrical energy is fed into the power supply network. At the same time, approx. 110 kWh are converted into heat energy and used to preheat the gas. We can perform a rough calculation of the Joule Thomson effect for this application. As an example we can assume that a gas expansion takes place from 40 to 20 bar at a base flow rate of 30,000 m³/h and an input temperature of +10°C. Based on an input heat energy of 110 kWh, the resulting gas temperature downstream of the regulator is approx. +6°C. In addition to the heat volume supplied by the existing boilers, this heat volume is sufficient for operating the DREWAG stations in low and base load condition.

Operating experience

The use of micro gas turbines in gas regulating and metering stations can be regarded as a good idea if the electrical and heat energy can be used locally. Feeding it into the power supply network presupposes that the network operator will purchase it. Naturally any servicing and maintenance work should only be carried out by trained personnel. Therefore it is important to become familiar with the new components in good time.

In addition, the turbine has proved to be a precise piece of equipment for accurate gas temperature control. The micro gas turbine reacts faster than a boiler and therefore has a positive effect on the control properties.

Energy balance (all values in kWh)



Roberto Heider roberto_heider@drewag-netz.de
Dr. Ulrich George u.george@elster-instromet.com