APPLICATION REPORT

Food & Beverage

Energy balancing in utility and supply processes at the Krombacher Brewery

Krombacher

- Determining consumption data for internal balancing
- Flow metering hot water, steam and compressed air
- Single-source complete measuring solution

1. Background

Internal energy balancing is an important instrument used by many breweries to determine the leading consumers throughout the entire brewing processes. In the plants, necessary energies such as heating water, steam and air are typically provided without exact knowledge of where and in what quantity they will be required. Virtually every production operation has a compressed air network but only rarely are those networks monitored and adapted to reflect actual consumption rates. Costs can easily be reduced if the compressors used to provide the compressed air can be controlled in keeping with consumption. Even with energy prices under 10 cents per kilowatt hour, it is worth monitoring the compressed air system with measurement equipment as costs created by leaks or untapped output can easily run up into the five figure range over the course of a year. Only when consumption rates have been measured, the processes can be controlled and optimised.

The same is true for steam: along with heating water, steam is one of the most important energy carriers in beer and beverage manufacturing plants. Every major production process, including pasteurisation, brewing, sterilisation, washing and cleaning requires steam or heating water. However, the supply of steam is extremely energy intensive as the boiler is usually fired using liquid fossil fuels or natural gas. Accordingly, it is essential to have accurate measurements of the quantity produced in order to optimise burner control and, ultimately, operate the plant in an efficient and environmentally-friendly way.

KROHNE

With production of around 6.4 million hectolitres in 2008, the Krombacher Brewery Group based in Kreuztal-Krombach is one of the largest private breweries in Germany. In the same year, Krombacher Pils was the best-selling brand of Pils in Germany with sales of around 4.6 million hectolitres. The brewery was looking for a suitable measuring technology solution for its auxiliary and supply processes for energy balancing.

2. Measurement requirements

There were three different measurement requirements to be met:

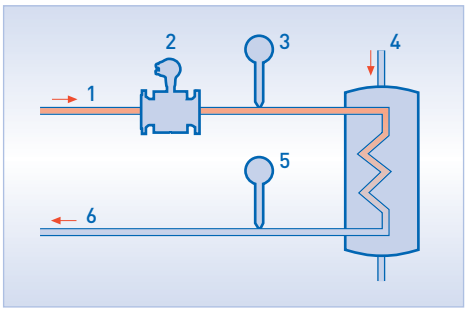
2.1. Measuring the heat flow volume of warm and hot water

The task was to measure the quantity of heat consumed in individual production areas (such as the steam generator, CIP system, heating circuit production or the ventilation system) in two separate heating circuits with the following conditions:

Circuit 1: heating water at 160°C and 14 bar.

Circuit 2: warm water at 90°C and 6 bar.

To determine the quantity of heat used, both the flow rate of the heating water as well as the difference in temperature before and after each consumer must be precisely measured.



Measuring the quantity of heat consumed by a component in a heating circuit

1 Feed line
2 Ultrasonic flowmeter
3 Feed line temperature sensor
4 Heat consuming unit
5 Return line temperature sensor
6 Return line

The objective is to determine both the individual and total demand for heating water, which can then be assigned to individual consumers as costs. No measurements were previously used for heat balancing.

2.2. Measuring the flow rates in the compressed air network

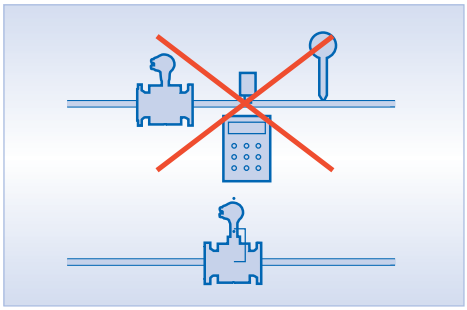
At various points in the compressed air system, the flow rate should be measured in standard cubic metres per hour. The pressure in the system is 7–8 bar at an ambient temperature assumed to be 20 °C ±10 °C.

Here, the objective is to determine consumption profiles and peak consumption to improve compressor monitoring. The measuring devices also detect leaks: if, for example, flow is being measured on a day off, this indicates a leak. The compressed air network is outfitted with measuring devices at various points for this purpose.

2.3. Measuring the flow rate of steam

The quantity of steam produced at each of three steam boilers is to be measured. The medium has a temperature of approx. 175°C at approx. 8 bars of pressure. The demands are as high as those placed on a mass measuring device. The device must be accurate as it is used, among other things, as a reference device for the gas meter of the energy provider. The device must be low maintenance, easy to configure and also feature the option of selecting from various units. The cost of purchase was also a factor when considering whether this type of device would be used.

The objective is to determine both the individual and total demand for steam, which can then be assigned to individual consumers as costs. Measurements have not previously been used for heat balancing.



3. KROHNE solution

Krombacher was looking for a complete supplier, one that could offer a solution for all of these measuring tasks.

3.1. Measuring heat quantity

KROHNE supplied a total of 16 UFM 3030 ultrasonic flowmeters for the heating water measurements. For the temperature measurement, two highly accurate OPTITEMP TRA-S12 temperature sensors are used per installation. They are calibrated and delivered in pairs for minimal deviation. Both temperature signal converters are connected as 2-wire devices directly to the UFM 3030 via the analogue inputs and simultaneously supplied. The converter displays the currently consumed quantity of heat as well as the total consumption in kilojoules or kilocalories per unit of time. A separate temperature controller is not necessary.

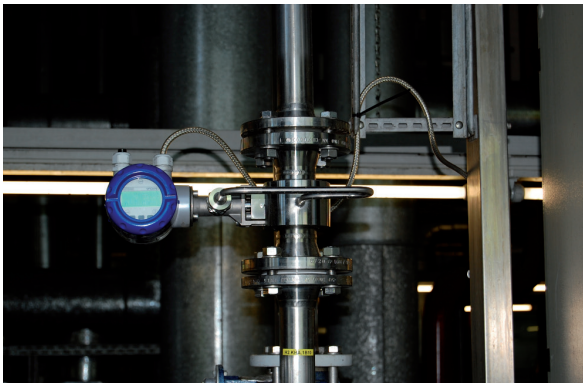
Measurement in a building climate control circuit

Measurement of the hot water in the brewing house

3.2. Measuring compressed air

Much thought was put into which measuring method would be best suited to the compressed air measurements in terms of the price/performance ratio. As part of the process, internal test measurements were conducted at Krombacher. Thermal mass measuring devices, vortex flowmeters without pressure compensation and the KROHNE OPTISWIRL 4070 C with integrated pressure compensation were tested. The test clearly showed that even the relatively small pressure fluctuations in the compressed air network have serious consequences in terms of accuracy and that pressure compensation is necessary. As the KROHNE device features this function and no additional components such as a pressure transmitter or evaluation unit are needed, the OPTISWIRL 4070 C came out on top with the least deviation compared to the reference device.

A total of 8 OPTISWIRL 4070 C DN 50s were calibrated to standard conditions and used to monitor the compressed air network and the connected consumers. For precise measurements at any time, any changes in pressure or temperature that occur in the network must be accounted for or compensated for during measurement as they can cause such things as the density of the medium to change. That is why the OPTISWIRL 4070 C features integrated pressure and temperature measurement as well as a computer that directly outputs the corrected volume flow.



Flow measurement at the compressor station

3.3. Measuring steam

To measure the amount of steam produced, one OPTISWIRL 4070 C with integrated pressure and temperature measurement was installed per steam boiler (3x DN 200, 1x DN 150). As vortex flowmeters, they primarily measure the volume flow rate and require a specified density in order to display the mass flow of a product. Here, too, the KROHNE device can display the desired parameter directly without the need for an external computing unit.

OPTISWIRL 4070 DN 200 at a measuring point directly behind a steam boiler

4. Customer benefits

With the newly installed measuring equipment, the Krombacher Brewery can optimally monitor and control its auxiliary and supply processes.

The following factors were crucial:

- The complete measuring solution comes from the one source
- By positioning the measuring points, usage and thus costs can be allocated to individual portions or segments
- The measurement data enables the detection of heat and flow rate losses in the circuits
- Consumption profiles can be created for the individual components, enabling the quantity provided to be controlled according to the need
- Hot water energy balancing is possible with just one device, a separate temperature controller is not necessary, thus decreasing installation costs: the temperature sensors are connected directly to the flowmeter via a 2-wire cable
- Reduced installation work and lower measuring inaccuracy even with compressed air and steam measurements thanks to the pressure and temperature compensation integrated into the device
- The KROHNE devices revealed the fewest measuring inaccuracies in the in-house comparison

5. Products used

UFM 3030

- Universal 3-beam in-line ultrasonic flowmeter for liquids
- Independent of conductivity, viscosity, temperature, density and pressure
- No moving or intruding parts, no pressure loss

OPTITEMP TRA-S12 temperature sensor

- High measuring accuracy
- Paired design

OPTISWIRL 4070 C

- 2-wire vortex flowmeter with integrated pressure and temperature compensation
- Suitable for liquids, gases, steam and saturated steam
- Available up to DN 300

APPLICATION REPORT

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