APPLICATIONS COMPENDIUM

For the Food and Beverage Industry
Dear reader,

This compendium comprises a selection of sample applications, which demonstrate how KROHNE has solved these industry-specific measurements to the satisfaction of our customers.

Whether it is standard or demanding applications with advanced requirements, our knowledge and experience of our customer’s processes is key to addressing these challenges. Using this expertise, allows us to provide the appropriate measuring device, or if required by the application – to engineer complex measuring solutions.

We hope you will enjoy browsing through our various examples on the measurement of flow, level, temperature, pressure as well as process analysis.

If you require any further information on any of these applications, or if you have a challenge that we can solve for you, please don’t hesitate to contact us: application@krohne.com
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Granulated sugar level measurement

- Storage of sugar of various grain sizes in concrete silos
- Non-contact radar measurement of medium that forms dust
- Automated inventory management of sugar supplies

1. Background

The Pfeifer & Langen Group is one of the largest sugar producers in Germany. In addition to several sugar plants, this long-established company also has plant locations for storage and logistics, one of which is located in Grevenbroich in the Lower Rhine region. Here, granulated sugar from the sugar factories is stored in four concrete silos. The silos are 30-40 m / 99-131 ft high and 20-30 m / 65-99 ft in diameter.

2. Measurement requirements

To match the supply of sugar to its production and make the filling process as efficient as possible, Pfeifer & Langen relies on level monitoring. In the past, a plumb line has been used to check the level manually. This method is extremely time-consuming as it required a company employee to regularly climb onto the intermediate floor of the silo and check the level at different spots through manholes. In addition, opening the silo presented the risk of an accident and of the product coming into contact with unwanted substances. In an effort to automate level measurement, Pfeifer & Langen were looking for a permanently installed measuring solution.

Due to the medium and the size of the silos, non-contact measurement was preferred. When selecting the measuring principle, the prevailing conditions in the silo had to be taken into account. This included the weakly reflective product surface of the sugar ($\varepsilon_r$-value: 1.8) as well as the formation of a variety of angles of repose in the silos. Depending on the grain size, dust can build up inside the silos. Under certain circumstances it could be several minutes following the filling process before the sugar compacts and settles. For this reason, ultrasonic measurement was eliminated early on as a viable solution.
3. KROHNE solution

The customer decided on the OPTIWAVE 6300 C non-contact radar level transmitter. Boasting a 24...26 GHz FMCW radar, the measuring device is designed for use in extremely dusty atmospheres. It features a patented, elliptical drop antenna that does not clog up, even in the presence of extremely adhesive media such as sticky sugar dust. Due to the measuring height and the low dielectric constant of the medium, in this application the large drop antenna (DN 150) made of polypropylene (PP) was selected. It was installed using a G1 ½ process connection. The devices were installed in the existing manholes in the intermediate floors of the silos. The shape of the OPTIWAVE 6300 antenna concentrates the radar beam which helps to achieve the measuring range required for this application. The measuring signal (4...20 mA) of the OPTIWAVE 6300 is transmitted to a control unit and the level is displayed in the control system.

4. Customer benefits

Pfeifer & Langen benefit from continuous level measurement and can now reliably monitor the amount of sugar available in the silos, even when dust has built up. All information is automatically made available in the inventory management system. This prevents a lack of supply, any resulting disruption in production and overfilling of the silos. As it is no longer necessary to manually check the level, the customer saves time and human resources. In addition, the OPTIWAVE 6300 incurs no further operating costs. While a crust of dust builds up on the antennas of other measuring devices and must then be removed manually or with the help of a purging system, the drop antenna of the OPTIWAVE 6300 is maintenance-free. As a result, Pfeifer & Langen did not have to install a compressed air line for purging, which saved energy costs, for example. And, as the silos no longer have to be opened, the integrity of the granulated sugar is guaranteed. The customer is extremely satisfied with the measurement in the concrete silos and is currently looking into further use of the OPTIWAVE 6300 in smaller silos on site.

5. Product used

OPTIWAVE 6300 C
- 2-wire FMCW radar level transmitter for non-contact measurement of distance, level, volume and mass of solids
- PP or PTFE drop antenna prevents product build-up in dusty environments
- Specific installation assistant for accurate measurement with moving surfaces
- Measuring range up to 80 m / 260 ft

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Level measurement in a beetroot hopper

- Non-contact radar level measurement
- Flow control
- Filling distribution

1. Background

Beetroots are a raw material used in the production of sugar. A company in France uses a beetroot hopper which holds about 20 thousand beetroots to supply the factory. Underneath the hopper, 4 root cutters cut the beetroot into fine slices called cossettes.

2. Measurement requirements

The factory must use a non-contact radar measurement technology to distribute the beetroots evenly and regularly into the hopper. The beetroot pulp is measured at atmospheric pressure.
3. KROHNE solution

KROHNE installed 3 OPTIWAVE 6300 C radar level meters, mounted vertically on top of the hopper at a height of 8 m / 26.25 ft. One of them is located at the end of the beetroot inlet belt to measure the “north” side of the hopper. The other two are located on either side of a scraper which lowers onto the belt and distributes the beetroots to the “east” and “west” side of the hopper. The zero point of measurement (4 mA) is set just above the yoke ears formed by the exit chutes, at a distance of 5.8 m / 19.03 ft from the radar devices. The maximum filling level (20 mA) is set to 0.8 m / 2.63 ft below the radar meters. These 3 measurements allow the beetroots to be distributed evenly into the hopper.

In addition, the average of the 3 measurements makes it possible to manage the flow of beetroots from the inlet belt by directing the supply system of the washer located upstream. Due to these 2 actions, these measurements are very important as it is the supply of the raw material to the factory that is at stake.

4. Customer benefits

- Precise, reliable measurement
- Less wear and tear on the blades of the root cutters in the case of uniform distribution in the hopper
- Flow control resulting in increased plant productivity
- On-site presence of KROHNE for several years

5. Product used

OPTIWAVE 6300 C

- Non-contact radar level meter (FMCW) for solids: optimised price/performance ratio
- 2-wire loop powered for minimal wiring expense
- Reliable and accurate level measurement (±10 mm / 0.39 in up to distance of 10 m / 32.8 ft) of low reflective product on non-flat, moving surface
- Measuring distance up to 30 m / 98.43 ft with DN 80 / 3” drop antenna

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Measuring layer thickness in a centrifuge

- Continuous measurement of layer thickness when filling centrifuge
- Controlling the layer thickness during the spin process
- Automated filling process

1. Background

A sugar producer fills a centrifuge with hot molasses sugar to press the moisture out of the molasses at high speed. The thickness of the layer of molasses on the wall of the centrifuge is reduced in the process. The layer thickness is thus a measurement of the moisture content of the layer of molasses.

2. Measurement requirements

The centrifuge is the shape of an upright barrel with a diameter of approx. 1.5 m / 5 ft. The filling process only lasts 5-10 seconds. The layer thickness on the wall of the centrifuge is to be continuously measured during this time so that the filling process can take place completely automatically. The measuring device can only be installed from above but must measure at a 90° angle. This is done using a 45° mirror which is attached to the end of a 700 mm / 2.30 ft waveguide and reroutes the radar waves. There is 150 mm / 0.5 ft between the molasses layer and the waveguide.

1. Measuring device
2. Waveguide
3. 45° tilted mirror
4. Layer thickness of molasses
3. KROHNE solution

For this type of application, KROHNE supplied 4 OPTIWAVE 7300 C radar level measuring devices with DN 50 / 2” horn antennas and G 1½” connection. The existing constructions were used for mounting.

Thanks to FMCW radar technology, the OPTIWAVE level meters measure over a very wide dynamic range. That is why neither the minimally reflective surface of the molasses layer nor the high speed of the centrifuge when filling and during the spinning process affect the measurement of the layer thickness.

Following each spin cycle, all parts that come into contact with the molasses sugar are automatically cleaned with water to avoid any caking.

4. Customer benefits

The customer is now in a position to completely monitor and automate the entire process of extracting the moisture from the molasses sugar. At any time, both while filling the centrifuge and during the spin cycle, the layer thickness on the wall of the centrifuge can be measured and the production process can be controlled accordingly, saving both time and money.

5. Product used

OPTIWAVE 7300 C

- Precise measurement in harsh conditions – even in tanks with agitated surfaces, foam or internal objects
- Product temperature up to 200 °C / 390 °F and operating pressure up to 40 bar / 580 psi
- For measuring ranges up to 80 m / 262 ft
- PACTware and DTM s are part of the standard scope of delivery
- Standard measurement error ≤ ± 3 mm / ± 0.12"
- 2-wire connection technology, minimal wiring expense
- Maintenance-free

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Measurement of Brix and mass flow in sugar production

- Determining the weight and sugar concentration in sugar cane juice
- Measuring without pressure drop or blockage of the measuring tube
- Cost-effective alternative to weighbridges and laboratory analysis

1. Background

A sugar manufacturer produces sugar from sugar cane juice. After harvesting, the sugar cane is crushed in presses to obtain the sugar cane juice. This juice is then weighed before it is made ready for further processing. In the past, measuring the weight of juice was done by large weighbridges (truck scales), which was inaccurate and cumbersome. To determine the BRIX value (sugar concentration), juice samples had to be collected and analyzed in the laboratory, which was very time consuming.

2. Measurement requirements

These methods resulted in significant investment and operating costs. The Brix values were also often late. Since Excise Duty is paid on the actual juice and not on the final product, eliminating uncertainties regarding the sugar concentration was important for the sugar producer. A decision was therefore reached to use a flowmeter to continuously determine the weight of the cane juice and the Brix values without delay. The meter was required to measure without risk of blockage and without requiring any maintenance.

Product: Sugar cane juice
Mass flow rate: 250...350 t/h
Pressure: 5...8 bar / 73...116 psi
Density: 1060 kg/m³ / 66 lb/ft³
Viscosity: 10 cP•s
Operating temperature: 40 °C / 104 °F
3. KROHNE solution

KROHNE supplied the Coriolis mass flowmeter OPTIMASS 7300 C. The meter was installed between the sugar cane press and the storage tanks. It measures the mass flow of the sugar cane juice as well as the sugar concentration (the Brix value) by way of integrated density measurement. The single straight tube design makes the OPTIMASS 7300 the meter of choice for measuring viscous liquids such as sugar without the risk of blockages or pressure loss.

4. Customer benefits

The OPTIMASS 73000 has enabled the sugar producer to reduce investment and operating costs in sugar processing significantly through the elimination of expensive weighbridge systems that require extensive maintenance. The Brix values can now be determined on-site and to the extent that the customer can almost entirely refrain from labor-intensive and costly laboratory analysis. The Brix values are provided to production immediately. Thus, the customer stands to gain from all the viable information to accurately determine the total sugar production of the plant resulting in more profit and savings in Excise Duty.

5. Product used

OPTIMASS 7300 C

- Coriolis mass flowmeter for the accurate measurement of mass and volume flow, density, temperature, concentration and liquids with solid content
- Single straight measuring tube without constrictions
- Choice of 4 different measuring tube materials
- Typical burst pressure of the outer housing above 100 bar
- Self draining and easy cleaning irrespective of process influences and installation
- Precision and excellent zero stability
- Low energy consumption saving operating costs
- Fast signal processing even with changes in process conditions
- Modular electronics design with dual redundancy and ‘plug and play’ electronics exchange possible

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Custody transfer measurement of sugary syrup

- Measuring system as per MID MI-005
- Mass flow measurement of sugary syrup
- Space-saving installation with straight tube design

1. Background

UNIFERM is a domestic and international supplier of ingredients for bakeries. The company supplies the bakery trade and baking industry with a comprehensive range of products including baking yeast, baking agents for bread and rolls, baking agents for fine pastries and separating agents.

2. Measurement requirements

Sugary syrup is used as a raw material in the production of yeast. This syrup is subject to custody transfer in accordance with MID 2004/22/EC MI-005. Measurement of the liquid sugar must conform to these requirements. Local installation conditions are taken into account and the data is made available to regulatory authorities.

A Coriolis mass flowmeter was chosen due to limited space on-site and the required measuring range in which the system operates.

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<th>Measuring system</th>
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<td>Medium:</td>
<td>Sugar syrup</td>
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<tr>
<td>Measuring range:</td>
<td>1.7...7.0 t/h / 62.5...257.2 lb/min</td>
</tr>
<tr>
<td>Minimum measured quantity:</td>
<td>20 kg / 44 lb</td>
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<tr>
<td>Temperature:</td>
<td>+5...+25 °C / +41...+77 °F</td>
</tr>
<tr>
<td>Pressure:</td>
<td>2 barg / 29 psig</td>
</tr>
</tbody>
</table>
3. KROHNE solution

KROHNE provided a Coriolis mass flowmeter OPTIMASS 7300 C. It was supplied in a compact version featuring a Titanium measuring tube (DN 25). The OPTIMASS 7300 boasts a single straight measuring tube and was thus able to be installed very compactly in a confined space. The general requirements for measuring systems for liquids other than water were taken into account. The measuring system’s compact design meant that having no inlet run was a possibility.

4. Customer benefits

The OPTIMASS 7300 C meets all custody transfer requirements according to OIML R117 and MI-005. The high linearity of the mass flowmeter as well as the associated maximum measuring accuracy allow for highly precise measurement in the specified measuring range while reducing costs for calibration.

5. Product used

OPTIMASS 7300 C

- Coriolis mass flowmeter for liquids and gases
- Highest accuracy for CT (MID 2004/22/EC MI-005)
  Flow rates up to 430,000 kg/h / 15,800 lb/min
- Best in class for zero stability
- Tubes available in 4 materials
  (Stainless steel, Titanium, Hastelloy®, Tantalum)
- Modular electronics concept
- Optional heating jacket
- OIML R117, MI-005, Inmetro, NTEP
- HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP etc.
Level measurement in starch production

- Storing bran in 20 meter high silos
- Permanent monitoring of bran stock for supply inventory
- Low operating costs due to simplified and maintenance-free installation

1. Background

The world’s production of starch and its by-products currently amounts to 6.5 million tons per year. Obtained mostly from corn, wheat and potatoes, starch is used as an additive in various industries: e.g. food processing, papermaking, clothing, chemical and pharmaceutical industry. Several processes allow for the production of starch: One of them, called ‘steeping’, separates the peel from the grain by soaking it in water for several days. The grain peel is then dried before being shredded and used as an additive in animal feeds.

2. Measurement requirements

One of the largest starch producers in France processes 3 million tons of corn and 1.5 million tons of wheat every year. The shredded peel (bran) is stored in several 20 meter high silos before being added to the next process. To avoid interrupting the production process, the stock must be permanently monitored. Bran is generally a low reflective medium and there is always dust and condensation involved. This and the uneven product surface make reliable level measurement a challenging task. The previously tested devices from competition – a TDR guided radar level meter with cable probe and a Radar instrument with traditional horn antenna – had to be removed frequently for cleaning and much time was spent climbing up to the top of the silos. During the cleaning, the production cycle was interrupted causing financial loss. Therefore, the customer was looking for a maintenance-free solution.
3. KROHNE solution

KROHNE delivered 2 OPTIWave 6300 C with a DN 80 (3”) Drop antenna made of plain PP and a G1½ process connection. Fitted on each silo roof, the non-contact radar (FMCW) level meters measure the level of bran and communicate the results to the DCS in the control room.

The OPTIWave 6300 C uses specific software algorithms for solids. Combined with the FMCW radar technology and the high signal dynamics of its electronics it allows for accurate and reliable level measurement even in dusty atmosphere and on a low reflective medium with an uneven or moving surface.

4. Customer benefits

The starch producer benefits from a maintenance-free level meter as the ellipsoidal shape, smooth polypropylene surface and completely encapsulated design of the OPTIWave’s Drop antenna is not affected by condensation and crusting. Therefore, interruptions of the production cycle and climbing on the silo roofs for periodic cleaning of the antennas are no longer necessary. As the level meter is unaffected by dust, measurements can also be taken during the filling process without the need for antenna aiming kits.

Since the OPTIWave 6300 C sends its accurate measuring values directly to the control room, the customer is now able to monitor its stock on a permanent basis. This enables the user to optimise supply inventory without the risk of overfilling the silo.

Thanks to the installation wizard, the meters are simple to set up and use. Being 2-wire devices, they also need less wiring. This reduces the installation and operating costs. Adding the competitive price of the OPTIWave 6300 C to all these advantages, this solution gives a fast return on investment.

The customer is very satisfied with the level meters. Another 14 silos of this production site will shortly be fitted with OPTIWave 6300 C and there is potential for 52 corn silos on other production sites of the company.

5. Product used

OPTIWave 6300 C

- 2-wire 24...26 GHz non-contact FMCW radar, ideal for solid applications
- No more purging systems: the Drop antenna made of plain PP or PTFE minimizes product build-up and condensation
- Measuring heights up to 80 m
- PACTware and DTM available fully functional and free of charge
- Wizard driven setup
- Reduced installation costs

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Level measurement in flour silos with intense dust formation

1. Background

Nestlé Wagner GmbH is among the largest manufacturers of frozen pizza in Europe. Today, the long-established company produces these baked goods with about 1400 employees at two locations in Nonnweiler, Germany.

Because the production facilities run in continuous operation, all of the individual production steps must always be executed without delay. This requires, among other circumstances, that all of the raw materials are always supplied in the necessary amounts. This includes the flour for the pizza dough, which Nestlé Wagner stores in several metal silos that are 12 m / 40 ft in height.

2. Measurement requirements

For optimum flour distribution and the accordingly production line planning, the silo equipment must be monitored continuously. Because flour is an adhesive medium associated with a high degree of dust formation, level measurement is demanding. At one of the two locations a measurement solution already had to be eliminated from the process because thick product deposits regularly resulted in measurement failures and high maintenance requirements. In addition, the measuring accuracy over the entire period was significantly limited due to the product surface of the medium, which has poor reflective properties ($\varepsilon$, value of approx. 2).

For this reasons, to record the tonnage reliably and as maintenance-free as possible in the future, the customer decided to test various level meters from several well-known manufacturers in parallel operation over a period of four months. All of the devices were non-contact radar level meters. All of the measuring solutions suitable for this application had to be approved in accordance with ATEX Ex iaD 20/21 for use in hazardous areas with dust and had to use materials that conform with FDA regulations.
3. KROHNE solution

During the test phase, the good measuring performance of the non-contact (FMCW) radar level meter OPTIWAVE 6300 C proved convincing. Moreover, the measuring instrument was the only one that did not require a purge connection. This was critical to the subsequent selection of the KROHNE device for level measurement on a total of seven flour silos.

With its 24...26 GHz FMCW radar, the OPTIWAVE 6300 is designed for level measurement in the very dusty atmosphere of the flour silos. Each measuring device is equipped for this task with a DN 80 / 3” drop antenna made of PTFE. In order to measure the level directly from above, the existing nozzles (DN 80 / 3”) on the roof of the silo were used in the installation.

4. Customer benefits

With the OPTIWAVE 6300 C, Nestlé Wagner can monitor the supply of flour for the dough reliably. In this way, the device makes a significant contribution to guaranteeing the continuous operation of production. Its FMCW radar technology proved to have considerably higher performance in this application than other radar technologies such as pulse radar, for example, because despite the very demanding surface characteristics of this medium, with a very low $\varepsilon_r$ value, the OPTIWAVE 6300 guarantees a strong signal in the silo and a high degree of measuring accuracy. Moreover, due to the low blocking distance of the OPTIWAVE 6300, a larger measuring range can be selected and the dead zone remains as small as possible.

Another advantage of the non-contact measuring device is the drop antenna developed and patented by KROHNE. In contrast to the open horn antennas of other test devices, the OPTIWAVE 6300 does not require a purge connection that must be equipped with compressed air and a timing sequence. This saves the customer both increased expenses for installation and energy costs for compressed air over the long term. Due to the elliptical antenna form, the product deposits have only a very slight effect on the measuring result. In this way, the specialist for frozen pizza is able to prevent high maintenance requirements and process interruptions.

5. Product used

OPTIWAVE 6300 C

- Non-contact (FMCW) radar level meter for measuring the distance, level, volume and mass of solids
- Drop antenna made of PP or PTFE for use in dusty environments
- Specific installation assistant for accurate measurement with moving surfaces
- Measuring range up to 80 m / 260 ft

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APPLICATION REPORT Food & Beverage

Volume and mass flow measurements of liquids and gases in breweries

- Reliable flow measurements to ensure constant beer quality
- Measurements not influenced by different process conditions
- Precise and constant dosing of different additives at all production levels

1. Background

When constructing a large new brewery near Enschede, the Netherlands, the beer producer GROLSCH was looking for a variety of devices to measure the volume and mass of liquid and gaseous products.

The GROLSCH brewery placed high demands on the devices, particularly in terms of measuring accuracy, reliability and being maintenance-free. All of the devices had to be equipped with the PROFIBUS PA communication interface to communicate with the ProLeit process control system. On top of that, the measuring devices were all to be supplied by the same manufacturer if possible.
2. Measurement requirements

GROLSCH wanted to use electromagnetic flowmeters (EMF) to measure the volume flow of electrically conductive and liquid products. These devices would be used in production areas, fresh water and cooling circuits as well as in wastewater treatment plants.

The EMFs to be used in production areas were required to have industry-specific, hygienic process connections for the food and beverage industry. They also needed to be made of FDA-compliant materials, be certified according to EHEDG and 3A and cleanable using CIP and SIP.

The Coriolis mass flowmeters were required both for highly viscous as well as electrically non-conductive liquids and for gases. In the past, hops were processed in solid form as pellets. Today, hops extract in liquid form is used to improve the brewing process and achieve a more stable beer quality. The extract has a density of approx. 1.3 kg/l / 81.1 lb/ft³ at a viscosity of a few thousand mPa·s. By heating it up to approx. 45° C / 113° F it was able to flow with more ease through tempering to enable processing at low flow velocities.

They were also used to measure gaseous carbon dioxide in CO₂ recovery plants.

3. KROHNE solution

3.1 OPTIFLUX: Electromagnetic flowmeters (EMF) from KROHNE

KROHNE supplied approx. 300 OPTIFLUX 6000 and 4000 electromagnetic flowmeters in a variety of sizes and with various pipe connections for use in the new GROLSCH brewery. Both the compact and remote EMFs feature a PROFIBUS interface to enable communication with the ProLeit process control system.

The majority of the EMFs supplied were hygienic OPTIFLUX 6000 devices. These devices are equipped with a gasket system which prevents the gaskets from expanding into the measuring tube when heated. Some of the remote and compact versions of this EMF are fitted with the IFC 300 converter which comes standard with the application and device diagnostic system to help the user properly install and operate the measuring devices. The sizes ranged from DN 2.5 / 1/10"…DN 150 / 6" and included industry-specific connections for the food and beverage industry and operating temperatures up to 150° C / 302° F.

OPTIFLUX 4000 flange devices were used in the brewhouse. These EMFs can be used up to 150° C / 302° F when mashing. The OPTIFLUX 4000 devices are also used in wastewater treatment. These EMFs are approved for use with water in addition to their approvals for the food industry. The OPTIFLUX 4000 EMFs are also fitted with the IFC 300 signal converter. Constant checks and information regarding the operating status help detect failures early on so that appropriate countermeasures may be implemented.

All OPTIFLUX 6000 and 4000 EMFs can be easily cleaned using SIP and CIP technology. The accuracy of better than 0.2% from the measured value leaves nothing to be desired.
3.2 OPTIMASS: Coriolis mass flowmeters from KROHNE
KROHNE supplied a variety of sizes of OPTIMASS 7000 and 3000 mass flowmeters with different pipe connections to measure liquid and gaseous products in the new GROLSCH brewery. The compact and remote versions of these Coriolis mass flow measuring devices are equipped with a PROFIBUS PA interface.

The OPTIMASS 7000 devices are used to dose the liquid sugar and hops extract as extremely high precision and measuring accuracy are needed to guarantee the constant quality of the beer. The straight single tube without flow splitter provides decisive advantages when it comes to dosing the highly viscous hops extract. Due to the extremely low pressure loss, it is possible to work with low flow velocities. This is particularly advantageous with shear sensitive and sensitive products. The OPTIMASS 3000 devices are used for measuring the carbon dioxide in the recovery systems and offer an accuracy of up to 0.1%.

The OPTIMASS 7000 and 3000 devices can be easily cleaned using SIP and CIP technology. In addition to measuring mass and volume flow, the OPTIMASS devices can also measure current density and temperature. This makes it possible to calculate derived parameters such as Brix and Plato.

4. Customer benefits

The process control system at GROLSCH measures and controls all of the areas and processes in the brewery. This includes the silo system, the brewhouse, fermenting and storage cellars, filtration and wastewater systems as well as decentralised CIP stations. The preparation and supply of media are also included. KROHNE volume and mass flowmeters perform admirably here. All devices are fitted with PROFIBUS PA.
5. Products used

5.1 Electromagnetic flowmeters from KROHNE

OPTIFLUX 6000
- Hygienic and aseptic stainless steel version featuring unique gasket design
- Suitable for all CIP and SIP processes
- All industry-specific pipe connections
- PFA liner reinforced with stainless steel mesh for high dimensional stability and vacuum resistance
- Standard sizes DN 2.5...DN 150, corresponds to 1/10”...6”
- EHEDG and 3A-approved
- Wet-calibrated on officially certified calibration rigs according to EN 17025

OPTIFLUX 4000
- Measuring sensor for the process industry
- Sturdy and reliable, even at high temperatures up to 150° C / 302° F
- Electrical conductivity: water from 20 μS/cm, other liquids from 1 μS/cm
- Simple installation and start-up
- Standard sizes DN 2.5...DN 1000, corresponds to 1/10”...40”
- Wet-calibrated on officially certified calibration rigs according to EN 17025

5.2 KROHNE mass flowmeters

OPTIMASS 7000
- Only mass flowmeter with a single straight measuring tube made of stainless steel, Hastelloy®, titanium or tantalum
- Minimal pressure loss
- Reliable measurement of mass and volume flow, density, temperature, concentration for liquids, even with solid content
- Any installation position, self-draining, easy to clean even using CIP and SIP, maintenance-free
- High measuring accuracy even with changing process conditions, outstanding zero point stability
- Compact and remote version

OPTIMASS 3000
- First choice for applications with low flow volume
- One installation length for all three sizes
- Z-shaped measuring tube made of Hastelloy® or stainless steel
- All common process connections available, including hygienic connections
- Certified secondary containment in Stainless Steel 316L
- Self-draining and easy to clean, even using CIP and SIP, maintenance-free
- Simple installation and start-up

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Measuring alternating media in the mash filter of a brewery

- Separating wort from mash slurry in the lautering process
- Monitoring media change from sugary wort to spent grain (malt)
- Detecting spent grain passing through the filtration system to trigger process shutdown

1. Background

The Brasserie St-Feuillien is a Belgian brewery famous for their internationally acclaimed ales. Their various types of beer are brewed at a production site located in Le Roeulx, in the French speaking part of Belgium.

The facility uses the traditional way of brewing which basically consists of malting, worting and fermentation: In a first step barley is malted, i.e. it gets steeped in water, germinated and then dried (kilned). The malt is then converted into fermentable sugars by mixing it with water. The mashing process results in a sugar rich liquid called wort, which is then separated from the spent grains in the lautering process. Only after the liquid is extracted from the malt can it be boiled with hops in the worting kettle, fermented and further processed to produce beer.

2. Measurement requirements

For the separation of the wort from the malt the Brasserie St-Feuillien uses a membrane free mash filter. In order to find out when it is no longer efficient to extract more wort from the mash, the filtering process needs continuous monitoring. Once the sugary liquid is drained and the insoluble grains start passing through the filter, the mash filter has to be put on hold to secure product quality. Therefore, the customer was looking for a technical solution to detect a change of medium from the sweet wort to the clogging malt.
3. KROHNE solution

KROHNE recommended using the OPTISWITCH 6500. The device was delivered as a long version (250 mm/9.8”) with G½ process connection. It was welded in the mash filter using a welded sleeve (HWN 200).

The switch uses a high frequency signal sweep that is radiated from the sensor tip into the mash filter. The medium acts as a virtual capacitor, which together with a coil in the sensor head, forms a circuit creating the switching point signal. This virtual capacity will depend on the dielectric value of the medium. With the help of a configuration tool the switching point of the OPTISWITCH 6500 was quickly fine-tuned. The switching point is accurately defined and when the switch comes into contact with the grain, its switching point is triggered. This information is indicated by an LED which shines through the housing cover.

4. Customer benefits

The OPTISWITCH 6500 ensures that the wort extraction is as free from malt bits as possible, thus helping the Brasserie St-Feuillien run the lautering process efficiently and maintain the highest product quality. Both types of medium are always well detected so that immediate steps can be taken, if the malt starts passing through the filter press.

Given the sticky spent grain, it is an additional advantage to the customer that the device is easy to clean and the risk of clogging products is minimised. The OPTISWITCH 6500 doesn’t need any maintenance. Its measuring performance is not affected by its mounting position and it is resistant against CIP and SIP agents which have to be applied by the brewery on a regular basis.

The customer is very satisfied with the OPTISWITCH 6500. The switch is part of a whole instrumentation package of KROHNE products for various brewing processes at ST-Feuillien.

5. Product used

OPTISWITCH 6500
- Hygienic switch for level detection and dry-run protection
- Measures alternating media
- Excellent for media separation
- Insensitive to build up or foam
- Hygienic switch completely in Stainless Steel
- Process temperature -40 ...+200°C / -40...+392°F

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Flow measurement on a flash pasteuriser

- Pasteurisation system for up to 60,000 l/h (ca. 15,850 US gph) beer, juice or soft drinks
- Electromagnetic flow measurement for the automated control of heat retention times
- Efficient use of hot water corresponding to beverage flow rate

1. Background

KHS GmbH is one of the world’s leading suppliers of filling and packaging systems as well as technical systems for the beverage industry. This includes fully-automated flash pasteuriser such as the Innopro KZE C. This system makes it possible to heat liquid foods to a minimum of +72 °C / +161.6 °F or up to +120 °C / +248 °F (high-temperature pasteurisation). That means that microorganisms and germs in beer, juice and soft drinks are killed, considerably increasing the shelf life of these beverages even without cooling.

2. Measurement requirements

In the Innopro KZE, hot water is circulated at a regulated temperature using a system of plate heat exchangers and steam while maintaining a constant temperature. In the heating section the beverage is heated in a counterflow and brought to pasteurisation temperature. Following flash pasteurisation the microbiologically impeccable drink is cooled and transferred to the filler.

The Innopro KZE controls the pasteurisation fully automatically according to the beverage flow (up to 60,000 l/h, ca. 15,850 US gph). To do this the system must be fitted with a hygienic flowmeter that transmits the measured values via a Profibus interface to the higher-ranking control unit.
3. KROHNE solution

KHS equips the Innopro KZE with the OPTIFLUX 6300 C. The electromagnetic flowmeter (EMF) continuously measures the flow of the respective customer-specific beverage. The measuring device has been designed for hygienic applications in the food and beverage industry and measures extremely accurately with a deviation of 0.2% (of the measured value), even with beverages with a high fibre and fruit content.

The OPTIFLUX 6300 C transmits the measured values digitally via Profibus interface to the control unit (PLC) of the end customer. Thanks to the comprehensive diagnostic functions of the KROHNE device, all parameters and operating states can be determined and further processed at any time.

4. Customer benefits

Using the OPTIFLUX 6300 C enables consistent and gentle pasteurisation. The heat retention time and use of hot water can be automatically controlled via the flow rate. In this way, the OPTIFLUX 6300 C contributes to the making of a safe product as well as consistent, cost-efficient production.

In the past KHS has successfully used the OPTIFLUX 6300 for other systems (e.g. for beer stabilisation). The measuring device met expectations in this application as well. Thanks to the high-performing measuring technology and accompanying application-focused services, KROHNE has qualified as the standard supplier for flowmeter technology at KHS GmbH.

5. Product used

OPTIFLUX 6300 C

- Electromagnetic flowmeter for the food and beverage industry
- For demanding mixing, dosing and filling applications with liquids
- Robust stainless steel housing and PFA liner
- DN 2.5…150 / 1/10…6”; process temperature up to 140 °C / 284 °F
- All industry-specific process connections
- On-site verification of flowmeter with OPTICHECK
- 3A, EHEDG; FDA, EC 1935/2004
- HART®, FOUNDATION™ fieldbus, Profibus® PA and DP, Modbus etc.

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pH monitoring in alcoholic fermentation

- Distilling traditional alcohols from sugar beet syrups
- Inline pH measurement for process control
- Cost saving installation of sensor with integrated transmitter technology

1. Background

Tereos France is a world leading producer of sugar and one of Europe’s main manufacturers of starch-based products and alcohols. Among others, the company operates several distilleries of which one is located in Val des Marais, in Northern France, where agricultural raw materials are turned into traditional alcohols. Prior to the main distillery processes, low-purity syrups with a sugar content of 55…65% are extracted from sugar beet and subsequently transformed into alcohol ("wine") of 5…13 Vol.-% for further processing. The fermentation process is carried out in 7 tanks. For the desired degree of alcohol, these tanks are kept at 32…37 °C / 90…99 °F. This way, the distillery produces about 200m³ of "wine" per day.

2. Measurement requirements

The best fermentation condition is maintained at a pH value of between 2.5 and 4. For this reason it is very important that the pH value of the low-purity syrups in the tanks is monitored on a regular basis. The customer therefore established a pH measurement cycle (7 samples, 1 cleaning; cycle time: approx. 1 hour). Samples taken manually also get checked in a lab every two hours. If the pH value rises above 4.5, sulfuric acid and phosphoric acid (nutrient) have to be added to prevent the growth of bacteria, which can contaminate the alcohol solution. Tereos previously used a pH sensor from an alternative supplier for this application, however the sensor and external transmitter were affected by hydraulic shocks caused by the medium. The liquid entered the transmitter via the cable gland and damaged the device. This interrupted process monitoring which also had an impact on the acid dosage as the dosing pump stopped working. The rise of the pH value could not be prevented effectively and the performance of the dosing pump could not be controlled. Therefore the customer looked for a new solution capable of measuring pH reliably at high pressure conditions of around 5 barg / 72.5 psig.
3. KROHNE solution

KROHNE offered SMARTPAT PH 2390. The pH sensor was installed directly into the pipe. The rugged sensor design makes this sensor type suitable for this application because of the high pressure resistance of up to 6.9 bar / 100 psi. It can be easily adapted to such harsh applications with alcoholic solutions.

The 2-wire loop powered SMARTPAT PH sensor features integrated transmitter technology. The entire transmitter technology is miniaturised and fits into the sensor head, eliminating the need for an external transmitter. The SMARTPAT PH sensor stores all data and sends these as bidirectional digital signals with 4...20 mA / HART® directly to a PLC that controls the dosing pump.

4. Customer benefits

Tereos now benefits from a stable pH value that helps them maintain the best fermentation conditions for their alcohol production. An accurate dosing of nutrients is guaranteed in case the pH value rises above 4.5. The dosing pump no longer stops due to a damaged pH sensor and its performance can now be reliably monitored. The mechanical protection of the sensor prevents product entry and guarantees operational safety.

Given that the SMARTPAT PH 2390 features integrated transmitter technology, the investment costs of the complete measuring loop is significantly reduced in comparison to the previous measuring system that needed a separate transmitter. Maintenance and costs are also reduced because the sensor can be configured and calibrated offline in the laboratory under controlled conditions. Calibration errors and cumbersome sensor handling on-site are no longer an issue. The sensor can be cleaned and regenerated to extend the lifetime.

Tereos stands to gain from the single source supplier KROHNE that does not only provide the sensors but the whole range of professional equipment (e.g. buffer solutions) as well as consulting services.

5. Product used

SMARTPAT PH 2390
- 2-wire loop powered sensor with integrated transmitter technology
- Special sensor design for harsh applications
- Low maintenance cost and long service cycle
- Large PTFE diaphragm for reliable pH measurement
- Double junction for extended life time and a wide application range
- With integrated Pt1000 and standard VP2 connector

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Portable flow measurement of wine and juice

- Electromagnetic flow metering to automate transfer operations
- Monitoring the quantity of juice and wine moved from one tank to another
- Highly flexible solution for temporary flow measurement and pump control

1. Background

Based in Tenterden in Kent, England, the award winning Chapel Down winery produces truly world-class Traditional Method sparkling wines and a range of still wines, as well as premium beer and cider. They boast some of the best winemaking facilities in England.

2. Measurement requirements

Daily work at the winery frequently involves transfer operations where wine or juice is moved from one tank to another. In order to monitor the quantity of transferred products as well as to control the pump accordingly, Chapel Down previously used sight glasses running down the side of the tank. However, this manual way of checking was labour intensive.

The winery operator was therefore looking for a portable measurement device that could provide accurate measurement and volume monitoring of juice and wine during those transfer operations. Josh Donaghay-Spire, winemaker at Chapel Down, specifies: “We were keen to automate the transfer process, however we needed a flowmeter that could cope with dissolved CO₂ as this makes the more traditional flowmeters ineffective.”
APPLICATION REPORT

3. KROHNE solution

After careful consideration, they decided to have a portable device manufactured that incorporated KROHNE’s OPTIFLUX 2100 C electromagnetic flowmeter. The device consists of the OPTIFLUX 2100 (DN 32 / 1¼”) attached to an inlet and outlet pipe and mounted on wheels. The device can then be easily moved around the winery to perform accurate measurement wherever it is required. The inlet pipe is attached to a tank and the medium is then pumped through it at a flowrate of 5…10,000 l/ hr [1.32…2642 gal (US)/h]. It passes through the electromagnetic flowmeter and then via the outlet pipe into another vessel. The OPTIFLUX 2100 accurately measures the volume of the medium and once the desired quantity has been reached the pump is switched off.

4. Customer benefits

By automating the process using KROHNE’s OPTIFLUX 2100, the Chapel Down winery now has consistently accurate measurement and instead of two people being required to carry out the transfer operation, the process can be carried out by one person alone.

Josh Donaghay-Spire of Chapel Down comments, “We were aware that KROHNE had previous experience with a similar application and that their OPTIFLUX 2100 could easily cope with the process conditions whilst providing accurate and reliable measurement. We can now not only make more efficient use of manpower but we can also calibrate certain tanks which previously didn’t have calibration charts.”

5. Product used

OPTIFLUX 2100 C

- Electromagnetic flowmeter
- Bi-directional flow metering
- Tamper proof, fully welded construction
- Also available in customer specific constructions
- Standard in house wet calibration of sensors up to DN3000 / 120”
- Extensive diagnostic capabilities
- Maintenance-free
- On-site verification of flowmeter with OPTICHECK

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Flow measurement of potato mash in Vodka production

- Measuring the volume flow rate of fermented mash fed into the distillation column
- Reliable solution to automate the process and reduce production time
- Monitoring the feedstock to finished product ratio

1. Background

The family run Chase distillery, located in Hereford, England, produces the award winning Chase Vodka which is the World’s first super premium English potato Vodka. The entire process from seed to bottle takes place on the Chase estate ensuring that a close eye can be kept on all stages from growing the potatoes to distilling and bottling.

2. Measurement requirements

Vodka production involves a fermentation process starting with the mashing of potatoes and the addition of a brewer’s yeast. After about a week, the fermented potato mash is distilled four times in a bespoke copper batch pot and then twice more in a rectification column. In the past, the distillery used a manual method to monitor the flow of fermented potato mash into the distillation column. However, it was planned to automate the process, so Chase were looking for a flowmeter that was capable of measuring the flow rate of the medium at the distilling stage.

The density of the medium going through the meter can vary from 0.95 to 1.1kg/l / 59 to 69 lb/ft³ and flows at a rate of 2000 l/h / 54 lb/m with pressure of 1 barg / 15.5 psig at a temperature of 30 °C / 86 °F. With the available space being limited, Chase required a meter that had a small installation envelope, but could still measure accurately and was capable of being CIP cleaned at 65 °C / 150 °F.
3. KROHNE solution

After careful consideration, the Chase distillery decided on KROHNE’s OPTIMASS 1300. The Coriolis mass flowmeter was installed in a vertical pipe run feeding the distillation column. The OPTIMASS 1300 has a dual straight tube design which makes it ideal for use in hygienic applications as there are no crevices or bends for bacteria to gather and the meter can be easily drained and cleaned. Due to the hygienic nature of the application the OPTIMASS 1300 was supplied with hygienic fittings and also has all of the necessary hygienic industry approvals. Initially, the OPTIMASS 1300 has been used with a local display. However, in the future it is planned to interface the meter with the PLC using mA outputs to measure volumetric flow, density and temperature.

4. Customer benefits

The OPTIMASS 1300 has enabled Chase to monitor the feedstock to finished product ratio accurately. Since installation it has also reduced production time by highlighting an underperforming feed pump that was increasing the mash charging time which in turn lengthened the production time.

Tim Nolan, engineering manager at Chase, is very pleased with the performance of the OPTIMASS 1300, “Installing the KROHNE meter has meant that we can automate the process and ultimately reduce production time. It also allows us increased flexibility as we can install the meter on other parts of the process to verify efficiency,” he continues, “KROHNE have supplied us with a meter that complies to our hygienic requirements and has proved to be very reliable.”

5. Product used

OPTIMASS 1300

- Coriolis mass flowmeter for standard food and beverage applications
- Cost effective solution for accurate measurement of mass flow, density, volume, temperature, volume concentration or solid content
- With innovative twin measuring tubes and an optimised flow divider for minimum pressure loss
- Supports a wide range of industry standard hygienic connections
- Resistant to installation and process effects
- Easily drained and easy to clean
- Modular electronics with data redundancy

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Flow measurement of whisky

- Equipping a bottling plant for single malt whisky with flow instrumentation
- Cost-effective measurement with twin-straight tube Coriolis mass flowmeter
- Various measuring tasks – from monitoring tanker offloading to controlling the volumetric amount of spirits transferred to blending and bottling areas.

1. Background

The Glenmorangie Company Ltd is one of the most famous producers of Scottish single malt whisky. Their critically acclaimed products range from the Original Glenmorangie 10-, 18- and 25-year-old whiskies to special cask, extra matured and a range of limited edition whiskies.

All of the Glenmorangie whiskies are produced and matured in casks at the Glenmorangie distillery near Tain, Ross-shire, in the Scottish highlands. After maturation, the whiskies are sent to the company’s bottling plant in West Lothian, near Edinburgh.

2. Measurement requirements

At the bottling plant, the whisky is offloaded and stored before being taken to the bottling areas. In order to increase efficiency and to continuously monitor the various volumetric flows, Glenmorangie were looking for a flowmeter to perform the various measuring tasks. The customer required the meter to be both cost-effective and accurate.
3. KROHNE solution

The OPTIMASS 1300 C Coriolis mass flowmeter could fulfill all of Glenmorangie’s requirements. A total of thirteen flowmeters were installed in their bottling plant. Two meters (DN 50 / 2”) are used for offloading the tankers which come from the distillery. Three meters (DN 40 / 1½”) measure the spirit taken from the storage to the blending area. The remaining eight meters (DN 25 / 1”) are used in the blending process and on the final product for bottling. All mass flowmeters have been provided with stainless steel measuring tube.

![OPTIMASS 1300 C measuring single malt whisky](image)

4. Customer benefits

The OPTIMASS 1300 C helps Glenmorangie improve the bottling processes of their plant. Besides the great deal of information provided by the meter to control the various process flows, Glenmorangie stand to gain from numerous other benefits. Compared to other entry level mass flowmeters it has an outstanding price/performance ratio. Its accuracy (±0.15%) is far higher than competitors’ lower cost meter ranges, thus meeting exactly what the customer was looking for. Due to its twin-straight tube design, the OPTIMASS 1300 C is also much easier to install than bent tube meters as it requires a much smaller footprint. There were no installation restrictions for the KROHNE meter, so it fits perfectly with the environment of Glenmorangie’s bottling section. A further advantage of the meter design is that it allows self-draining, so there are no additional steps for the customer to take to remove traces of previous product flows through the meter tube.

5. Product used

**OPTIMASS 1300 C**

- Coriolis mass flowmeter with twin straight tube design for applications with spirits
- Mass, volume and density measurement at blending and bottling areas
- Best price/performance ratio of its class
- With optimised flow divider for low pressure loss
- DN 15…100 / ½...4”; PN100 / ASME Cl 600 lb
- Immunity to crosstalk: resistant to installation and process effects
- On-site verification of flowmeter with USB powered verification tool OPTICHECK
- HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP, Modbus etc.

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## 3 Dairy Products

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Equipping a cheese dairy with flow, level and analysis instruments

- Automation of a production site for premium cheese
- Providing information on various plant operations – from raw milk reception to cheese preparation to sterilisation and wastewater management
- Cross-company and cross-country project management to fulfil customer requirements on time

1. Background

Royal-Aware, a family-owned Dutch business, specialises in the maturation, cutting, wrapping, storage, transportation, and sale of cheese and other food products. With the ambition to become the best value supply chain partner in the food and agricultural business in Europe, the company also started their own cheese production in 2015. Their state-of-the-art cheese factory in Heerenveen, The Netherlands, allows Royal-Aware to develop up to 80 specific recipes and provide customers with tailor-made cheese products. The cheese dairy has a production capacity of up to 100,000 t/year.

2. Measurement requirements

The complete project management and engineering was done by Royal-Aware themselves, starting construction in 2013. Process technology and components were supplied by several suppliers according to the companies’ specifications.

With regard to process measuring technology, only a partner with ample experience in cross-company and cross-country cooperation would have been able to meet the demands on time. Various measurement tasks in different plant areas had to be mastered:

- Fluid handling at raw milk reception and during cheese milk preparation
- Monitoring CIP processes
- Controlling wastewater discharge

Among others, it was specified that the process instrumentation be manufactured using EC 1935/2004 regulation-compliant material as well as industry-specific hygienic connections. For digital communication with the PLC, it was mandatory that most of the instrumentation have PROFIBUS® DP capability.
3. KROHNE solution

KROHNE was selected as the main instrument vendor to equip various production and auxiliary processes with flowmeters, level transmitters and analytical sensors.

The well thought-out project concept from consultation, to instrumentation, to integration, service and on-site support tipped the scales in KROHNE’s favour.

The following key applications were the focus of attention:

3.1 Raw milk reception

In order to determine the amount of raw milk delivered by road tankers, the raw milk reception docks were equipped with OPTIFLUX 6300 electromagnetic flow meters (EMF). Given the outdoor environment, the devices were completely fitted with insulation to guarantee a stable milk temperature at the measuring point.

3.2 Cheese milk preparation

Before the raw milk can be fed into the production line, it has to be prepared accordingly. This includes separation, standardisation and pasteurisation.

Separation: In a first step, the delivered raw milk is separated into skimmed milk and fat. In order to accurately monitor the flows, OPTIMASS 7300 C Coriolis mass flowmeters were installed after the separators.

Standardisation: Subsequently, the cheese milk is produced, i.e. the skimmed milk is standardised to the desired fat content according to the selected cheese recipe. This involves accurate dosing of large quantities of skimmed and full cream milk.

- KROHNE supplied two OPTIMASS 2300 for the dosing system. The twin straight tube Coriolis mass flowmeters in stainless steel were installed with aseptic flange connections (DIN 11864-2) into the vertical dosing lines before the tanks.

- An OPTIFLUX 6300 EMF was mounted after the dosing system to control the cheese milk transported to the milk pasteuriser.

Pasteurisation: In the flash pasteuriser the cheese milk is gently treated to extend its shelf life. During this process, hot water is circulated at a regulated temperature using a system of plate heat exchangers and steam, while maintaining a constant temperature. In the heating section the cheese milk is heated in a counterflow and brought to pasteurisation temperature:

- The pasteuriser is equipped with OPTIFLUX 6300 to control the amount of cheese milk flowing through the system.

- In order to keep the ionic concentration in the condensate below a certain limit, the conductivity in the supply circuits is measured by OPTISENS COND 1200 conductive conductivity sensors. The sensors were installed into the condensate reflux and supplied with a MAC 100 signal converter.

Flow measurement at the raw milk reception with the OPTIFLUX 6300

Milk standardisation with the OPTIMASS 2300 C

Milk pasteurisation with the OPTIFLUX 6300 C

Conductivity measurement with the OPTISENS COND 1200 and MAC100 signal converter
3.3 CIP systems

To ensure plant and product safety and to comply with regulations, the dairy operates a comprehensive cleaning system of storage tanks, dosing stations and CIP lines. Each area requires consistent monitoring.

Among others, KROHNE

- equipped the tanks storing the concentrated agents with OPTIFLEX 2200 C level transmitters to ensure a reliable stock management
- supplied very small OPTIFLUX 6300 units enabling precise dosing of the caustic cleaning agents into the CIP circuits
- provided numerous EMF OPTIFLUX 6300 units for the CIP lines to allow for reliable monitoring and control of the CIP processes.

3.4 Wastewater management

In cooperation with an adjacent milk processing company, Royal-Aware operates a facility to treat dairy wastewater from cheese production. Before the effluent is discharged into the treatment facility, it has to be continuously monitored in terms of quality and quantity. KROHNE supplied the corresponding flowmeters as well as analytical instruments:

- In order to control the pH value in the effluent, the pH sensor SMARTPAT pH 8150 is used. The sensor was installed into the vertical effluent pipe. Due to its integrated transmitter, there was no need for an external transmitter as the sensor is directly connected to the control room.
- The volume flow of dairy wastewater is monitored by the electromagnetic flowmeter OPTIFLUX 2100 W. With its rugged, chemically resistant liner, the meter is particularly suitable for this application.
4. Customer benefits

The KROHNE devices ensure a high level of automation of the customer’s most important processes – from raw milk reception to wastewater discharge. All specifications of the customer were considered and supplied as requested, helping Royal-Aware start production on time.

Royal-Aware benefits from the single source supplier KROHNE. Having only one contact person for on-site support and service, make it much easier for the customer to quickly resolve application related issues in the future.

Key to success was the well thought-out project concept and the close cooperation [across companies and countries] between KROHNE as the full service provider for measuring technology, Royal-Aware as the end customer as well as various contractors.

This complex project once again added to KROHNE’s large application expertise and years of experience in the food and beverage industry.

5. Products used

**OPTIFLUX 6300 C**
- Electromagnetic flowmeter for the hygienic measurement of raw milk and other conductive dairy products as well as CIP agents
- DN2.5...150 / 1/10...6", EHEDG and 3A certified

**OPTIMASS 2300 C**
- Twin straight tube Coriolis mass flowmeter for high volume measurement of milk and other dairy products
- DN100 / 4", EHEDG and 3A certified

**OPTIMASS 7300 C**
- Single straight tube Coriolis mass flowmeter for milk separation and standardisation
- DN10...100 / 1/2...4", EHEDG and 3A certified

**OPTISENS COND 1200 and MAC 100**
- Conductive conductivity sensor for monitoring condensate reflux to increase flash pasteuriser safety
- G1/2, G3/4, G1, NPT 3/4 (male); 0…20000 μS/cm

**OPTIFLEX 2200 C/F**
- Guided radar (TDR) level transmitter for stock management of CIP agents
- 0.6…40 m / 2…131 ft, independent from physical property variations

**SMARTPAT pH 8150**
- pH sensor for measurement of dairy wastewater
- PG13.5; with integrated transmitter

**OPTIFLUX 2100 W**
- Electromagnetic flowmeter for dairy wastewater applications
- DN25...1200 / 1...48", with rugged and chemically resistant liner

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Equipping a cheese dairy with inline spectroscopic analysis systems

• Full automation of a production site for mozzarella and its by-products
• Making full use of process information from raw milk reception to the production of cheese, cream and whey
• Continuous non-contact measurement of fat and protein in dairy products as well as COD loads in wastewater

1. Background

The Belgian dairy fabrelac specializes in the manufacture of high-quality mozzarella cheese, cream and whey derivatives. The products are sold to customers from different parts of the food and beverage industry, where they are used in the manufacture of other finished products. Among others fabrelac is today one of Europe’s leading suppliers of mozzarella, processing around 120-140 million litres / 32-37 million gal [US] of raw milk per year.

2. Measurement requirements

Due to its volatile organic composition, milk is a difficult medium to process, making the production of mozzarella demanding. From raw milk reception to production, the medium can vary greatly in fat and protein content. The quality of the medium is therefore under constant change, affecting the subsequent processing steps of the dairy.

In the past, fabrelac had the milk protein and fat content determined through laboratory analysis. This not only required manual sampling, which was very time-consuming, but also meant that there was always a time delay before the values could be used for process control. There was no transparency over the milk quality. A continuous adjustment and optimisation of the operating parameters was therefore not possible. To improve production processes in the long run, fabrelac decided to take steps towards full automation of the dairy plant. This way, the following measuring objectives were to be obtained:

a) Increasing cheese yield: Making full use of process information to maximize mozzarella output
b) Gaining constant cheese quality: Producing mozzarella in accordance with product specifications
c) Making the most of by-products: Monitoring the quality of excess whey and cream to be sold
d) Saving costs: Avoiding costly and time-consuming sampling to save money and reduce workload
Implementing this level of automation also requires a new approach to milk monitoring since its quality has to be monitored at each stage of production. The customer therefore started searching for a suitable solution that could continuously provide information about milk quality.

3. KROHNE solution

Since fabrelac had already been using KROHNE measuring solutions, they were confident in using KROHNE’s spectroscopic analysis system, the OPTIQUAD-M 4050 W, in a 6 month trial.

Following a successful trial period, fabrelac in collaboration with KROHNE identified a total of 11 measuring points to be equipped with OPTIQUAD devices.

3.1 Raw milk reception

As fat tends to float on top, it is very hard to determine the average fat content in the raw milk stream. In order to monitor the fat and protein content of each tanker load, two OPTIQUAD-M (No 1 + 2) were installed into the 2 raw milk lines between the reception terminals and the two buffer tanks of the dairy. When relating the readings of the OPTIQUAD-M to the readings of the electromagnetic flowmeter installed in the same line, fabrelac can calculate the average fat and protein content of the raw milk streams.

Another OPTIQUAD-M (No 3) was mounted in the line behind the buffer tanks. At this measuring point, the fat and protein content is once again determined before the milk is heated and the preparation of cheese milk begins. This device was tested against a competitors’ NIR spectrometer that failed this application due to the still very low temperature of the raw milk. The measured values are then used to standardise the fat content during cheese milk preparation.

3.2 Cheese milk preparation

Depending on its fat content, the heated milk is turned into cheese milk, i.e. standardized to the desired fat content by adding cream or skim milk respectively. According to the actual fat value input, a control system opens or closes the valves of the whey cream or skim milk lines. Another OPTIQUAD-M (No 4) is therefore used to measure the fat content in the whey cream added. This way the process can be driven up to the desired value threshold.
3.3 Cheese production

Before the standardized cheese milk is finally processed to mozzarella in 7 production tanks, the fat and protein content of the medium is once again measured by another OPTIQUAD-M (No 5). This unit measures the fat content in the cheese milk to ensure that a high degree of consistency in cheese quality is continuously achieved. Further options have also been evaluated: although currently not used, fabrelac now has the opportunity to set up a complex continuous control-loop for the cheese milk preparation, based on both the readings of OPTIQUAD-M No 3 and No 5. Before the systems were installed, the process was only controlled by samples taken from the raw milk tanks.

3.4 Whey processing

A by-product of mozzarella production is whey which is yielded when the cheese is formed into blocks by a casomatic cheese press. The excess whey is filtered and separated into whey cream and non-fat whey. While the whey cream is led back into the production process, the non-fat whey is further processed to non-fat whey concentrate. OPTIQUAD-M (No 6) is installed behind the filtration that removes the solid parts from the whey stream. This unit is used to determine the fat-to-total-solids ratio before the whey gets separated. No 6 also measures the protein value in the whey stream. This is a 'back-to-front' way to determine the cheese quality: if there is too much protein in the whey (compared to the average of the previous batches), it lacks in cheese, which may lead to the whole batch being disposed of as the ripening process has failed. Fabrelac also uses this measuring point to evaluate different cheese ripening recipes or additions to the cheese milk. Fabrelac also monitors the fat content (OPTIQUAD-M No 7) in the low fat whey stream behind the separator. If the fat content in the stream exceeds a certain threshold, the reverse osmosis (RA) system must stop immediately to protect it from the remaining fat particles entering its membranes. Depending on the fat content, the stream is directed into one of three tanks to standardize the non-fat whey. Before the non-fat whey concentrate is ready to be delivered and sold to customers, the protein-to-total-solids ratio is finally monitored by another OPTIQUAD-M (No 8). This unit was therefore installed behind the RO system, i.e. after the water is removed and the low-fat stream is processed to powder.

3.5 Cream / skim milk processing

In order to gain and sell additional quantities of cream as a by-product of the raw milk, fabrelac also monitors the fat ratio in the cream by using the OPTIQUAD-M (No 9), and another OPTIQUAD-M (No 10) in the cream loading process that is used for billing purposes.
3.6 Inline measurement of COD value

Since organic wastewater loads are created during production, the dairy has to monitor disposal to ensure that it is as environmentally friendly as possible. Before the wastewater is transferred to the municipality, the concentration of chemically oxidizable substances in the water must be checked. This is done by measuring the chemical oxygen demand (COD). At fabrelac, the COD value has been determined by manual sampling and analysing the COD in the laboratory several times every day. To make this labour-intensive process more efficient and to optimise wastewater loads, an OPTIQUAD-WW 4050 W (No 11) is used to continuously monitor the COD value prior to draining into the wastewater treatment plant.

4. Customer benefits

The spectroscopic analysis systems help the customer take a great leap forward towards full automation of the whole plant. Equipping the dairy with the OPTIQUAD allows fabrelac to establish either single control loops for each production step or an integrated control system across single processes. The OPTIQUAD-M enables fabrelac to assess the quality of raw and cheese milk as well as whey or cream, allowing them to re-adjust the operating parameters dynamically at every stage of production, e.g. when standardizing raw milk. The customer can continuously drive the fat or protein value to the desired threshold. This way, a consistent product quality as well as an optimal utilization of resources is maintained. For this reason, by-products such as whey concentrate and cream can now also be produced and sold in considerable quantities. It is the main advantage that fabrelac is now able to significantly reduce the quantity of defective mozzarella end products to be disposed of. Using the OPTIQUAD-M also means less sampling, helping fabrelac greatly reduce costs. For example, payment for the raw milk in the past was based on the fat and protein values fabrelac got from the suppliers. The two OPTIQUAD-Ms now used in the reception process have already paid for themselves as fabrelac could lower bills due to deviations between values given by suppliers and the values actually measured during the reception process. With regard to the whole dairy process, the employees benefit from a far less time-consuming workload. They also no longer need to run after process reports as the KROHNE device continuously provides readings of each measuring point. By doing inline measurement of the plant’s wastewater loads, fabrelac can also check the COD value in much less time and with considerably less effort. With the help of the OPTIQUAD-WW manual sampling and laboratory COD analysis are no longer necessary. Even in this area, the dairy benefits from a device that measures at least as accurately as the laboratory tests. Having this many measuring points, fabrelac was also able to quickly detect disturbances in the process: a seal that leaked only under certain circumstances could be located by comparing and interpreting the readings of OPTIQUADs along the process and the know-how of the operators.

5. Products used

**OPTIQUAD-M 4050 W**
- Non-contact spectroscopic analysis system for the continuous inline measurement of protein, fat, lactose and total solids in milk products
- For use in dynamic control loops
- Significantly reduces the need for sampling, sample transport and preparation
- No costs for chemicals, reagents and cleaning agents
- High precision and long-term stability

**OPTIQUAD-WW 4050 W**
- Spectroscopic analysis system for the continuous inline measurement of organic wastewater loads
- Can measure extremely large COD loads
- Reduced costs for laboratory COD measurement
- Reduced maintenance costs
- Impressive price/performance ratio

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Please visit our website for a current list of all KROHNE contacts and addresses.
Level measurement of raw milk

- Improved stock management at the raw milk reception
- Minimised maintenance and product loss
- Hygienic level measurement using non-contact radar with PEEK antenna

1. Background

Latteria Soresina is one of Italy’s largest and oldest manufacturers of dairy goods. The long-established company produces and distributes milk, butter, cream, whey and typical Italian cheeses including Latteria Soresina’s renowned Grana Padano. The dairy operates four production sites in the Lombardy region that only process high quality milk produced by a selected group of farmers close to the production facilities.

2. Measurement requirements

The dairy was looking for improved stock inventory at one of their plants. This involved continuous level measurement of raw milk stored in outdoor tanks before processing. In the past, Latteria Soresina used hydrostatic pressure transmitters to measure the raw milk level. However, this contact technology often required expensive and time-consuming maintenance. In addition, the customer experienced accuracy drift and reliability issues. The customer therefore desired an alternative level solution on their milk tanks.

The vertical stainless steel tanks are 10 m / 32.8 ft height with a capacity of 100,000 litres / 26471.2 US gallons. They have lateral agitators to stir the milk which is kept at +4 °C / +39.2 °F by tank insulation. The tanks are filled and emptied from the bottom as well as CIP cleaned and sterilised from time to time using caustic soda and nitric acid at +70 °C / +158 °F.

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The new level transmitter must comply with the stringent hygienic and quality requirements of the food and beverage industry regarding material and process connections too. Given the environment of the outdoor installation, a high degree of ingress protection (IP67) was also compulsory.

<table>
<thead>
<tr>
<th>Medium:</th>
<th>Raw milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range:</td>
<td>0...10 m / 32.8 ft</td>
</tr>
<tr>
<td>Dielectric constant:</td>
<td>ε = ca. 80</td>
</tr>
<tr>
<td>Viscosity:</td>
<td>ca. 1 cP</td>
</tr>
<tr>
<td>Density:</td>
<td>1.03 kg/l / 64.3 lb/ft³</td>
</tr>
<tr>
<td>Pressure:</td>
<td>Atm</td>
</tr>
<tr>
<td>Temperature:</td>
<td>4 °C / 39.2 °F</td>
</tr>
</tbody>
</table>
3. KROHNE solution

Latteria Soresina decided in favour of KROHNE’s 2-wire radar level transmitter OPTIWAVE 7300 C. The dairy preferred the non-contact FMCW radar technology to pulse radar technology from competitors as it provides a more stable measurement in agitated environments. The OPTIWAVE reliably measures the level of the raw milk in spite of the moving surface of the medium, and the presence of foam and tank inserts.

The OPTIWAVE 7300 C was supplied with hygienic, FDA compliant PEEK antenna. It has been mounted on a nozzle on top of the tank using a hygienic Tri-Clamp 2” process connection. The quick setup function enabled the dairy to easily configure and start-up the device.

For inventory purposes, all measurements are continuously transmitted to the control room as a current output signal (4…20 mA).

4. Customer benefits

The OPTIWAVE 7300 C helps Latteria Soresina improve stock management at raw milk reception. This hygienic, non-contact solution has increased the reliability, accuracy and long-term stability of their level measurements. The OPTIWAVE 7300 C is a top mounted device that minimises the frequency of maintenance activities and associated product losses.

5. Product used

OPTIWAVE 7300 C

• 2-wire non-contact radar (FMCW) level transmitter perfectly suited to the requirements of the dairy industry
• Increased accuracy and reliability for the measurement of dairy liquids, pastes and slurries
• Hygienic design: FDA and EC 1935/2004 compliant and suitable for SIP/CIP
• Reduced maintenance costs
• Long service life and stable operation for optimal productivity
• Measuring distance up to 80 m / 260 ft at max +150 °C / +300 °F
• PACTware and DMTs included as standard
• Current (mA), optional 2nd current output, HART®

Contact
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Please visit our website for a current list of all KROHNE contacts and addresses.
1. Background
Frischli Milchwerke GmbH produces fresh and long-life dairy products for retailers, catering establishments and other large consumers at several locations in Germany. The privately-owned dairy also operates one of Europe’s largest and most modern production sites for individual coffee cream portions in Eggenfelden, Germany, producing around 1 billion portions at this location annually.

2. Measurement requirements
The raw milk needed for production (max. 22,000 kg/h / 808 lbs/m) is fed through the raw milk reception via two pipelines (DN 50 / 2") to several buffer tanks. The milk is first stored in these buffer tanks and then further processed into coffee milk in several stages. In order to compare the milk yield with the amount of raw milk delivered, it is necessary to have an accurate measurement of the raw milk volume as possible. To determine the volume of raw milk, Frischli previously used two standard mass flowmeters. The measurements, however, were repeatedly affected by entrained gas in the raw milk caused during transportation. Due to low temperatures and the corresponding viscosity, the operation of a deaeration tank also could not fully eliminate the entrained air. A two-phase stream occurs due to the entrained air which affects the oscillation signal of the traditional measuring device, thereby causing inconsistent sensor amplitudes. As a result, the electronics of the devices used was regularly disrupted when searching for the natural resonant frequency of the measuring tube, causing significant measuring errors or “frozen” measured values taken during the last stable readings. The required transparency of the processed raw milk volume could therefore never permanently be established, and so Frischli decided to install a mass flowmeter which can also reliably measure media with gas entrainment.
3. KROHNE solution

KROHNE recommended the replacement of the old device with the OPTIMASS 6400 C. The Coriolis mass flowmeter was installed in the two raw milk lines in front of the buffer tank. In accordance with the legal requirements, it has a hygienic aseptic flange connection according to DIN 11864.

In contrast to other mass flowmeters available on the market, the OPTIMASS 6400 is fully immune to the negative effects of entrained gas in the raw milk. Using the patented functionality of Entrained Gas Management (EGM™), the measuring device continuously maintains the volume, mass and density measurement, even with entrained gas between 0...100%.

4. Customer benefits

Frischli is very pleased with the OPTIMASS 6400. The problems of flow measurement caused by entrained gas have now been resolved and continuous monitoring of the raw milk volume is possible. Significant measurement distortions or even the failure of the measuring point no longer occur. The measuring point is maintained regardless of the gas content in the raw milk, and the customer can continue to work with stable measuring results.

Today, by using the KROHNE measuring device, frischli benefits from greater transparency of the volume of raw milk delivered. The customer uses this knowledge to balance the raw milk yield. In this way, the dairy plant can always compare the coffee cream produced with the actual raw milk volume delivered and, if required, determine the optimization potential of operational processes.

5. Product used

OPTIMASS 6400 C
• Twin bent tube Coriolis mass flowmeter for liquids and gases
• Entrained Gas Management (EGM™): continuous measurement even with gas concentrations from 0...100% and sudden changes in the gas content
• Communication: HART®, FOUNDATION Fieldbus, PROFIBUS® and Modbus
• Modular electronics concept

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Please visit our website for a current list of all KROHNE contacts and addresses.
Protein measurement at raw milk reception to increase cheese yield

- Continuous spectroscopic analysis of protein, fat and lactose in raw milk
- Supply of raw milk into different tanks for high and low protein content
- PLC-based control of valves through inline analysing system

1. Background

A key parameter in the production of cheese is the milk protein content. The higher the amount of protein, the more cheese yield can be expected. Protein-rich raw milk is therefore much better suited for high-margin cheese products than raw milk with low protein content. The protein content varies, depending on the raw milk delivered.

A European producer of dairy products offloads tanker lorries delivering raw milk by way of an open drain system that feeds the milk into a buffer tank. In the past, the company used to pump the milk from the buffer tank into a single remote storage tank before processing it to cheese products. Thus, the protein content was only determined in the milk mixture after the milk was separated and standardised.

2. Measurement requirements

In order to obtain a cheese yield increase, the company decided to improve the process of milk reception by supplying the delivered raw milk with high protein content into a separate storage tank. Therefore, the customer was looking for a measurement solution that could continuously provide precise readings of the protein content in delivered raw milk in order to run a PLC-based automated control system. Depending on the protein content measured, the valves of the pipeline feeding the two storage tanks were to be controlled accordingly. It was also a requirement that the instrument measure the fat and lactose content.
3. KROHNE solution

The cheese producer decided in favour of the OPTIQUAD-M 4050 W. The installation of the Analyzer Unit was done on a VARINLINE® measuring section at a 90° angle to the DN 150 / 6" pipeline that transports the raw milk to the two storage tanks. The OPTIQUAD-M measures directly in the pipeline without coming into contact with raw milk. The spectroscopic analysis system provides exact readings of protein, fat and lactose content every 10 seconds. The 4…20 mA current output of the Operating Unit sends the measuring signal to the PLC. Whenever the measured protein content exceeds the average content measured the day before, the PLC directs the flow to the tank for milk with high protein content. Milk with lower protein content is used to produce different types of drinking milk.

4. Customer benefits

As the KROHNE inline analysing system enables the customer to establish a dynamic control loop, raw milk quantities with protein content above average can now be collected separately. The OPTIQUAD-M provides the PLC with all the information necessary to open or close the valves in the pipeline at any time. The new raw milk storage process also renders it possible to raise the protein content in relation to the fat content even before the raw milk is divided into cream or skim. Depending on the cheese type, this leads to a significant increase in cheese yield thanks to the optical protein analysis. The fat and lactose analysis also enables the customer to calculate the fat and lactose ratio in the raw milk delivered. The inline measurement also opens up new possibilities for long-term monitoring of protein, fat and lactose values. Since the OPTIQUAD-M can be easily cleaned using the CIP method and does not require consumables, operating and maintenance costs for the dairy are kept to a minimum.

5. Product used

OPTIQUAD-M 4050 W
- Spectroscopic analysis system for the continuous inline measurement of protein, fat, lactose and total solids in milk products
- Non-contact analysis
- For use in dynamic control loops
- Eliminates the need for sampling, sample transport and preparation
- No costs for chemicals, reagents and cleaning agents
- High precision and long-term stability

Sample calculation of additional cheese yield:

Selected raw milk
Additional protein content of 0.03% =
Additional cheese yield of approx. 1% =
+78 kg cheese per 100,000 kg raw milk

+119,574 € per year *

*At a daily raw milk reception of 100,000 kg, 356 production days and an average cheese price of 4.20 €/kg.

Please visit our website for a current list of all KROHNE contacts and addresses.
Increasing the excess cream in ESL milk production

- Standardizing the fat content of ESL milk
- Continuous fat determination in the end product using the optical inline analyzer
- Reducing operational and production costs

1. Background

The Ammerland company is among the largest producers of dairy products in Europe. Among other products, the company produces ESL milk with various minimum fat content. To do this, the milk producer separates the raw milk delivered into skim milk (approx. 0.05 % fat content) and cream during production, and then the skim milk is mixed with the desired amount of cream. The precise standardization of the fat content is a significant step in the process in the production of ESL milk.

2. Measurement requirements

To control the supply of fat content and to achieve the desired fat value in the standardized milk, the dairy had previously used indirect fat standardization. In this process, the flow rate of skim milk and cream was determined by Coriolis mass flowmeters. While a Coriolis mass flowmeter can precisely measure the fat content in the fatty cream, it is unable to do so in mediums with low fat values. For this reason, in the past the exact fat content in the milk product itself could only be proven in time-consuming laboratory tests. Therefore, the dairy was looking for another technical option for continuously and precisely measuring the fat content in the ESL milk that had already been standardized with the goal of controlling production processes without delay.
3. KROHNE solution

With the OPTIQUAD-M 4050 W, KROHNE provided a spectroscopic analysis system for the continuous, inline measurement of the fat value in drinking milk products. To do this, light is coupled into the medium though the optical window. The system simultaneously determines the values of optical effects such as transmission, scattering, fluorescence and refraction, which form the basis for calculating the percentages of protein, fat and lactose.

A standard VARINLINE process connection was used to install the OPTIQUAD-M analysis unit directly into the production line without a bypass. The OPTIQUAD-M Operating Unit is built into a stainless steel housing and is connected to the analyser unit using a serial interface and is installed in close proximity to the analyser unit. It outputs the measurement values and transfers them to the control system via its 4 to 20 mA signals.

4. Customer benefits

By doing the inline analysis of fat and protein content directly in the standardized ESL milk, the Ammerland dairy was able to improve the control over the use of cream for standardizing drinking milk products and, therefore, significantly increase the amount of excess cream. Today, by using the OPTIQUAD-M, with the same amount of raw milk the milk producer can use additional quantities of cream for other end products.

Optical measurement is very precise and long-term stability is guaranteed because it does not require moving parts nor does it need daily calibration. In addition, the customer benefits from reduced operational costs due to the elimination of cleaning processes because, in contrast to bypass devices, the OPTIQUAD-M measurement takes place directly in the pipeline without coming into contact with the medium. Because inline analysis is also suitable for use in other applications, the customer has already decided to use more OPTIQUAD devices.

5. Product used

OPTIQUAD-M 4050 W

- Spectroscopic analysis system for the continuous inline measurement of protein, fat, lactose and total solids in milk products
- Non-contact analysis
- High precision and long-term stability
- For use in dynamic control loops
- Eliminates the need for sampling, sample transport and preparation
- No costs for chemicals, reagents and cleaning agents
- Wall mounting of operating unit in stainless steel housing (ingress protection class IP 65)

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Please visit our website for a current list of all KROHNE contacts and addresses.
Mass flow measurement in the production of cottage cheese and spreadable cheese

- Dosage of ingredients
- Measurement of the quantity of the end product
- Consistent quality in the different cheese types

1. Background

Edelweiß, one of Germany’s leading cheese producers, produces a wide variety of premium brand cottage cheese and spreadable cheeses. Depending on the final product, the base products vary, including milk and vegetable oil as well as various other ingredients but they must all be precisely dosed to ensure consistent quality. In addition to monitoring the dosing of the ingredients, the producer also monitors the overall yield of cheese from the raw milk product.

Years ago, cheese producer Edelweiß made the decision to replace all measuring devices with CORIOLIS mass flowmeters because these meters measure with higher accuracy and repeatability, thus ensuring the consistent quality of the end products. Measurement properties such as electrical conductivity and viscosity have no influence on the measuring accuracy.

2. Measurement requirements

Besides milk, vegetable oil is the second major base material in cottage cheese production. Vegetable oil is highly viscous and is not electrically conductive. To ensure that the oil can flow freely, the pipelines are heated to prevent blockages when flow velocities are low. The quantity of oil used is measured directly at the outlets of the storage tanks. Solids and entrained gas must not influence the measurements. In addition, the devices must be suitable for use with foodstuffs and have the appropriate approvals.
APPLICATION REPORT

3. KROHNE solution

KROHNE supplied the cheese producer Edelweiß with OPTIMASS 7300 C mass flowmeters in a variety of sizes for these applications.

The single tube technology which features no flow splitters or built-in components in the measuring tube keeps any additional pressure loss to a bare minimum.

There are no special requirements when it comes to installing the meters in the pipelines and there is also no need for the otherwise commonly used inlet and outlet sections.

As they are a component of the pipelines, the straight tube meters are easily cleaned by way of CIP and SIP. The meters are maintenance-free.

4. Customer benefits

For creameries and cheese dairies, OPTIMASS mass flowmeters from KROHNE offer many advantages including low investment and follow-up costs.

Excellent accuracy and repeatability ensure exact measuring results and thus consistent quality in the different types of cottage and spreadable cheese.

OPTIMASS 7300 C measuring devices can measure temperature and density in addition to the mass flow, which is important with changing process parameters. This enables different products to be processed one after the other using the same measuring device.

5. Product used

OPTIMASS 7300 C

- The only mass flowmeter with a single straight measuring tube available in Stainless Steel, Hastelloy®, Titanium or Tantalum
- Minimal pressure loss
- Reliable measurement of mass and volume flow, density, temperature, concentration and solid content
- No installation restrictions, easily drained and easy to clean
- High measuring accuracy, even when process conditions change
- Available with all the hygienic connections common to the food industry

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Determining the concentration of salt in cheese production

- Measuring density in the supply line of a brine bath
- Monitoring the salt concentration for the proper ripening of cheese
- Automated process to control the water to salt ratio in salt brine

1. Background

A European manufacturer of soft cheese produces Camembert cheese at one of its sites. This cheese plant has a brine bath in which the cheese wheels stay submerged for a certain period of time. The salt is absorbed from the brine by the Camembert which allows it to ripen properly.

2. Measurement requirements

For an even ripening process and to avoid deficient products, the water to salt ratio in the brine bath must remain at 70:30. As unsteady salt concentration has an immediate impact on the cheese quality, the cheese dairy recently tried to monitor the ratio using an electromagnetic flowmeter. However, this device turned out to be too inaccurate for this application. Therefore, the cheese dairy considered testing an alternative measuring principle. In order to avoid the need for heavy duty pumps, the pressure loss caused by the meter was to be negligible. It was also required that the device meet the hygienic requirements of this application.

<table>
<thead>
<tr>
<th>Product</th>
<th>Salt brine (salt concentration: 30%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>2 bar / 29 psi (max)</td>
</tr>
<tr>
<td>Density</td>
<td>1180 kg/m³ / 73.6 lb/ft³</td>
</tr>
</tbody>
</table>
3. KROHNE solution

The customer decided on the OPTIMASS 7300 C Coriolis mass flowmeter. It has a straight tube design and was installed with hygienic process connections into a DN 50 / 2” line feeding the brine bath with salt brine. The flowmeter measures not only the mass flow but also the density of the salt brine reliably, allowing it to also determine the salt concentration. If the density falls under a certain threshold, salt is added accordingly.

4. Customer benefits

The cheese dairy is now able to precisely monitor the salt concentration in the salt brine. This allows the customer to run an automated process to maintain the desired water to salt ratio in the brine bath for an equally high product quality. The customer particularly benefits from the precise density measurement of the OPTIMAS 7300 which in a comparative test proved to be virtually as accurate as laboratory analysis. Due to its single straight tube, no pressure drops occur when using the OPTIMASS 7300. Thus, there is also no reason for the customer to raise the pump capacity.

5. Product used

OPTIMASS 7300 C

- Coriolis mass flowmeter for the measurement of mass and volume flow, density, temperature, concentration and liquids with solid content for demanding applications
- Straight tube without constriction
- Supports a wide range of industry standard hygienic connections
- No installation restrictions, easily drained and easy to clean
- High measuring accuracy, even when process conditions change
Measurement of protein and total solids in WPC

1. Background

A German dairy company produces different whey derivatives at one of its sites. Everyday, the whey (a by-product of cheese production) is refined into different products and sold to cheese processing plants and companies in the food, beverage and animal feed industry.

One of these whey products is whey protein concentrate (WPC). This is whey protein, which is produced through the concentration of whey. The standard method used is ultrafiltration (UF). The aim is to increase the total protein to total solids ratio by removing water, lactose, and other non-protein compounds. In doing so, the whey is separated in a lactose-containing permeate and a protein-containing retentate.

2. Measurement requirements

The customer uses a two-stage UF plant for the concentration process. The first plant produces WPC 60 directly, or initially WPC 35 only, which can then be concentrated as WPC 80 in the second plant. To ensure optimum operation of the UF plant, the ratio of protein to total solids (TS) in the retentate must be known.

In the past, the customer had the protein and total solids content determined through laboratory testing. This not only required manual sampling, which is very time consuming, but also meant that there was always a time delay between the measured values and the production process. A continuous adjustment of the operating parameters was therefore not possible. To automatically regulate the UF plant, the whey processing company decided to use an inline analysis system. This was designed to continuously control the final concentration in the retentate and without much time and personnel effort, in order to set the operating parameters in such a way that the greatest WPC yield is achieved.
3. KROHNE solution

For the continuous measurement of protein and total solids, the whey processing company now uses the OPTIQUAD 4050. The spectroscopic inline analyser was coupled to the process via an optical window in the standard VARINLINE® housing behind the ultrafiltration of WPC 35/60 and 80. Unlike conventional bypass-devices, measurement takes place directly in the pipeline – and without the measuring sensor coming into direct contact with the medium. The OPTIQUAD uses several light sources for measurement. Up to four optical methods and up to 12 wavelengths are used. At the request of the customer, a measured value is provided every 3 seconds and transmitted to a controller.

4. Customer benefits

Using the OPTIQUAD-M, the customer can now determine the ratio of protein to total solids continuously. With connection to a PLC system, the dairy plant can operate an automated control loop. This allows the customer to readjust the operating parameters dynamically as soon as the actual WPC value deviates from the setpoint. In this way, the company can better drive the process up to a desired minimum threshold, without ever falling short. This also enables the production of more WPC using the same raw materials.

Today, the customer can forgo time-consuming and labour-intensive sampling and their laboratory testing as much as possible. This also reduces the known sources of errors associated with manual sampling. The procurement cost of the OPTIQUAD-M is attractively priced as other comparable devices (such as the FT NIR spectrometer) and is financed by the dairy plant through flexible leasing.

In the future the customer could optimise its process even further. If the dairy plant were also to use the OPTIQUAD-M in front of the UF units for the whey standardisation, an even more precise protein and total solids content could be set in advance and the WPC production further maximised.

5. Product used

**OPTIQUAD-M 4050 W**

- Spectroscopic analysis system for the continuous inline measurement of protein, fat, lactose and total solids in milk products
- For use in dynamic control loops
- No time loss through sampling, sample transport and preparation
- No costs for chemicals, reagents and cleaning agents

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Measuring massflow and density in milk loading

- Loading excess milk onto milk lorries
- Determining the milk quantity and the separation point between water and milk
- Precise and cost-effective alternative to weigh bridges

1. Background

A French Cheese dairy periodically adapts their milk stocks to demand changes. If production has to be reduced, the cheese producer clears their stock quantity of milk by selling it to the market. For this purpose, the milk is directly loaded onto milk lorries (tank trucks) for delivery. During the loading procedure the milk is pushed through the line using water.

2. Measurement requirements

In order to measure the milk quantity as accurately as possible, the cheese dairy was looking for a suitable measurement solution that was also able to precisely determine the density of the milk loaded (1025...1040 kg/m³ / 64...65 lb/ft³). In this way, the separation point between water and milk could be identified so as to ensure only milk was loaded onto the trucks. The cheese dairy considered using either a weigh bridge or a flowmeter complying with their hygienic requirements.
3. KROHNE Solution

The customer decided in favor of the OPTIMASS 7300 C Coriolis mass flowmeter. The meter allows for continuous measurement of mass flow and density. Once the specified quantity of milk has been reached, the filling process stops automatically. The switch-off point between milk and water is determined by the integrated density measurement. The OPTIMASS 7300 is a single straight tube meter and is manufactured in accordance with the requirements of the food and beverage industry. It is easily drained and cleaned using CIP/SIP.

4. Customer benefits

Using the OPTIMASS 7300 the cheese dairy benefits from significantly more accurate and reliable measurement of the milk quantities. The integrated density measurement enables the customer to control the milk loading process automatically and without water entering the trucks. The maintenance-free mass flowmeter from KROHNE also offers the customer substantial financial advantages when compared to a weigh bridge which would have caused much higher installation and operating costs.

5. Product used

OPTIMASS 7300 C

- Coriolis mass flowmeter for the accurate measurement of mass and volume flow, density, temperature, concentration and liquids with solid content
- Straight tube without constriction
- Supports a wide range of industry standard hygienic connections
- For demanding applications
- Easily drained and easy to clean, irrespective of the type of construction and process influences
- Excellent zero stability
- Rapid signal processing, even with product and temperature changes
- Modular electronics with data redundancy – “plug & play” replacement of electronics

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4 Soft Drinks & Juices

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4.5 Equipping a filling machine with Coriolis mass flowmeters ....................................................................................... 80
1. Background

Beverage producer Topochico Soft Drinks in Monterrey, Mexico, produces table water, soft drinks and wine mixers [sangria] for both the domestic market and export.

When equipping a new mixing plant, Topochico wanted to find a measuring device manufacturer able to provide all of the devices required. The number of measuring device manufacturers was to be reduced, obtaining everything for flow, mass, level, temperature and pressure measuring points from one source.

If possible, the measuring devices were also to feature an additional function, enabling them to measure quality parameters as well as perform the actual measuring task. Further, the devices had to be available with the desired pipeline connections.

Topochico also required a contact person for on-site support.

The reduction in measuring device suppliers is advantageous for equipment manufacturers and beverage producers. Purchasing processes are simplified as the purchase volume per supplier increases and it is easier to communicate with just one contact person.

Moreover, installation and follow-up costs are reduced because the mechanical and electrical installation for the various measuring devices is identical or at least similar. Further, the devices can be adjusted and operated via standardised concepts. Maintenance and the procurement of spare parts follow the same process.
2. Measurement requirements

The measuring devices used should be made of FDA-compliant materials and comply with all hygienic requirements including 3A approvals. The compact measuring devices should be able to be easily cleaned with CIP/SIP and it goes without saying that the devices should be available with all of the common hygienic connections.

**Principal configuration of a mixing plant for soft drinks and the typical measuring tasks**

**Mass flow measurement of the syrup concentrate**
Measuring the various kinds of syrup is the most important flow measurement in a mixing plant. On the one hand, syrup is the most expensive beverage component used in production. On the other hand, the syrup contributes significantly to the quality of the end product. The mass flow measurement may not allow itself to be affected by changes in process conditions. In addition, it should be possible to determine the quality parameters by measuring the syrup concentration in °Brix. Minimal additional pressure loss and the capacity for easy drainage were other very important requirements for the mass flowmeters.

**Volume flow measurement of make-up water**
The product properties of make-up water may vary depending on the origin and intended use. The most important parameter is the electrical conductivity of at least 20 μS/cm (μmhos/cm). This value was not to affect the devices available for selection for volume flow measurement. In addition, it had to be possible to assess the quality of the make-up water via a conductivity measurement.

**Non-contact measurement of the beverages ready to be filled**
Topochico was searching for absolutely reliable and accurate level and volume measurement for the ready-to-fill end products in the storage tanks. They required the continuous measurement of the volume in the tank in real time.
3. KROHNE solution

KROHNE supplied Topochico with the following measuring devices for this application:
4 OPTIMASS 1300 C mass flowmeters to measure the syrup
4 OPTIFLUX 6300 C electromagnetic flowmeters to measure the make-up water
6 OPTIWAVE 7300 C radar level meters to measure the end products in the storage tanks

OPTIMASS 1300 C mass flow measurement of the syrup concentrate

In addition to measuring the flow of the various kinds of syrup, the
OPTIMASS 1300 C also measures the syrup concentration in °Brix for quality
assurance. The device is easily drained, which is important when there are
frequent product changeovers. The measuring section features two parallel,
straight stainless steel pipes with flow splitters. The mixing ratio of water to syrup
can be accurately set prior to dosing. Diluted syrup phases which may occur during
product changeovers can now be almost completely utilised. This reduces syrup
loss. Due to the minimal loss of pressure, a smaller nominal size than that of the
process line could be used for these devices. The device can be cleaned via
CIP / SIP and is approved according to 3A.

OPTIFLUX 6300 C electromagnetic measurement of the make-up water

OPTIFLUX 6300 C can be used for water starting at an electrical conductivity of
20 μS/cm (μmhos/cm). Thanks to the integrated conductivity measurement,
Topochico no longer has a need for separate measurement. The measured
conductivity is transmitted via a 4...20 mA current output (alternatively via Bus) to
the in-house laboratory. In addition to this measurement, the device also features
application and device diagnostics to help the user operate the devices optimally
and thus achieve the superior plant availability. OPTIFLUX 6300 C is available in
sizes DN 2.5...150 / 1/10"...5" with all of the industry-specific hygienic connections.
The maximum operating temperature is 140 °C / 284 °F. The devices feature FDA-
compliant materials and are certified to 3A.

OPTIWAVE 7300 C Level measurement of finished products (FMCW radar)

The volume contained in the tank is continuously measured and displayed (in
real time) by the OPTIWAVE 7300 C. The OPTIWAVE 7300 C radar level meter was
especially designed for liquid products and works according to the non-contact
FMCW principle (Frequency Modulated Continuous Wave).

The continuous measurement provides stable measured values and is ideally
suited to moving process conditions such as agitated surfaces. The device can
measure the distance, level and volume in the tanks.

4. Customer benefits

The high demands placed by Topochico on the measuring devices used were met and even exceeded in
all areas. The deciding factor for Topochico was that KROHNE offered a selection of measuring devices
to equip a mixing plant for flow, level, temperature and pressure measurement in a variety of versions
and qualities. The devices have 3A approval and conform to the FDA, as required. Further, all devices are
available with different hygienic connections. The fact that this was all available from one source, added
to KROHNE’s years of experience in the industry, tipped the scales in KROHNE’s favour as a supplier.
Previously, special custom-made devices had been necessary for many applications in the food and
beverage industry. Now, standard measuring devices cover these needs.
5. Products used

OPTIMASS 1300 C
- Coriolis mass flowmeter for accurate measurement of mass flow, density, volume, temperature, volume concentration or solid content
- Innovative twin measuring tubes
- Self draining and easy to clean
- Unaffected by type of installation and process effects
- Various hygienic process connections available (DN 25...80 / 1...3”)
- Optimised flow divider for minimum pressure loss
- Modular electronics concept with data redundancy
- Available as compact or remote version

OPTIFLUX 6300 C
- Electromagnetic flowmeter developed in cooperation with customers from the food industry
- Stainless steel version for all hygienic uses
- Unique seal concept
- Suitable for CIP / SIP processes
- All industry-specific connectors and lengths
- Available in compact and remote versions
- Sizes DN 2.5...150, corresponding to 1/10”...6”
- High form stability and vacuum resistance

OPTIWAVE 7300 C
- FMCW non-contact radar level meter for liquids
- Reliable measurement in difficult process conditions even in tanks with agitated surfaces, foam or internal objects
- Hygienic antenna for processes where stringent hygiene standards must be obeyed
- Hygienic flange versions available: BioControl®, Tri-Clamp®, DIN 11851 (DN 50 / 2”); SMS 51; others on request
- Operating condition for the hygienic antenna option: -20...+150 °C / -4...+300 °F
- Measuring range up to 80 m / 260 ft
- PACTware and DTMds are included by default

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Equipping an inline blending system with measurement technology

- Controlling and monitoring the inline blending processes
- High demands placed on measurement technology used
- Complete solution with standard devices from the one source

1. Background

KHS AG is one of the world’s leading manufacturers of filling and packaging machines as well as process control systems for the food and beverage industry. In addition to components used to fill, clean and package liquids, KHS also supplies the entire range of process technology, including systems for blending syrup.

The KHS Innopro Paramix C is a newly developed, fully-automated blending system featuring horizontal, two-stage vacuum deaeration. It is a flexible system suited to the production of fruit juices, nectars and the carbonation of mineral water. The blending system consists of three components and can be expanded to include a fourth or fifth component if needed. Soft drinks can be blended or re-diluted in a large range. As an option, finished beverages can be supplied, carbonated and / or chilled. Likewise, beer coolers can also be blended and / or chilled.

The finished, carbonated beverage is stored for the interim in a buffer tank injected with CO₂. For non-carbonated products, nitrogen or sterile air is used optionally for superposition. The finished product is then supplied to the filling machine and bottled in PET or glass bottles or drink cans.

The KHS Innopro Paramix C belongs to the latest generation of blending systems. The purpose of developing this new generation was to achieve shorter product changeovers while maintaining minimal product loss.

Increased automation and a reduction in the space required also played a role. Thanks to its compact dimensions, the system can be put in a standard marine container and sent to the customer. Its blending capacity is between 6,000 l/h and 72,000 l/h.
2. Measurement requirements

To ensure a high degree of system automation, the flow rates of the components introduced must be measured at various points. These include:

- **Mass flow measurement of syrup concentrate**
  The measurement of syrup is the most important flow measurement performed in the blending system. On the one hand, syrup is the most expensive beverage element used in production; on the other hand, it has a significant impact on the flavour of the end product. In the past, it was common to measure syrup using an electromagnetic (volume) device but that method should be replaced by mass flow measurement. Mass flow measurement provides greater measuring accuracy when determining the flow rate and it also determines the syrup concentration in °Brix.

- **Volume flow measurement of non-carbonated mixed product**
  The quantity of the non-carbonated blended product should be determined prior to carbonation. This measuring point features a sufficiently long, straight inlet distance to enable the use of different types of measuring devices.

- **Mass flow measurement of CO₂ to carbonate the blended product**
  This measurement helps to ensure a consistent input of CO₂ into the liquid. A measuring principle that provides high accuracy regardless of the pressure and temperature of the gas was required.

- **Visual monitoring of the minimum throughput by way of measuring the CO₂ content**
  As an option, KHS offers CO₂ and Brix determination in the blended product as a measurement of quality. However, this measurement requires a minimum flow through the analysis unit used. The flow is then displayed on a measuring device.

The reliable functioning of the measurement technology in the blending system should be guaranteed in each process phase. Particularly during start-up and shut-down of the system, the correct mixing ratio must be precisely maintained in order to keep syrup and water loss to a minimum. This means that the devices used must meet a variety of requirements including easy drainage and a large turndown ratio.

Because of its compact size, the system generally contains no long straight inlet distances. This presents an additional challenge for the measurement technology used. KHS was looking for an appropriate customised solution from the one source if possible.

3. KROHNE solution

KROHNE is the standard supplier of measuring devices for KHS and won the contract to equip the inline blending system with measurement technology. The diagram depicts the design of the system with the measuring devices installed. The level measurement depicted in the syrup tank and in the buffer tank is optional and is not taken into account here. The filling equipment is for illustrative purposes only; it is not part of the blending system and is also not considered in this case.
The measuring tasks in the inline blending system were tackled as follows:

3.1 Flow measurement of syrup concentrate

An OPTIMASS 7300 Coriolis mass flowmeter is used to measure the highly viscous syrup.
3.2 Volume flow measurement of the blended product

The non-carbonated blended product is measured using an OPTIFLUX 6300 electromagnetic measuring device prior to carbonation.

3.3 Mass flow measurement of CO₂

The quantity of CO₂ used to carbonate the blended product is measured using an OPTIMASS 8300 Coriolis mass flowmeter.

3.4 Monitoring the quantity of CO₂ in circulation

As an option, KHS offers CO₂ and Brix determination in the blended product as a quality measurement. The analysis unit used requires a minimum throughput of liquid. A H250 variable area flowmeter is used to visually check the minimum flow rate of approx. 300 l/h.
4. Customer benefits

KROHNE met KHS requirements with standard measuring devices. In addition to the basic demands such as CIP/SIP capability, the selection was made on the basis of the advantages for the individual measuring points. They include

• **Mass flow measurement of syrup concentrate**
  The OPTIMASS 7300 used features integrated measurement of Brix concentration. This makes it possible to adjust the mass flow and precise syrup concentration prior to dosing. Diluted syrup phases which may occur during product changeover can now be almost completely utilized. There is now no need to discard the water/syrup mixing phases. Instead, they can be blended into the finished drink using the KHS minBrix™ control unit. This results in a reduction in syrup loss and annual savings in excess of 2,200 litres of syrup for this system.

  The measuring device features a single straight measuring tube without a flow splitter. That means it is easy to clean, there is very minimal pressure loss and is easy to drain. This is a requirement so the system can be offered to end customers who want to frequently change their products.

• **Volume flow measurement of non-carbonated blended product**
  The aseptic sealing concept was crucial in selecting the OPTIFLUX 6300. There is an EPDM seal between the aseptic process connection and the flowmeter. It is designed so that when faced with an increased temperature, it does not expand into the measuring tube but rather it expands backwards into an expansion space. This means that no deposits can build up on the seal, endangering the quality of the blended product. Using this seal prevents almost all transfer of aroma from product to product following a changeover.

  For the end user of the system (beverage producer), the OPTIFLUX 6300 can also take on the role of checking the quality of the blended product. The device features an application and device diagnostics function as standard, enabling it, for example, to display the conductivity of the medium and to output it via the current outputs or bus. The beverage producer is then notified when there is a deviation from the average conductivity expected.

  A further criterion was the availability of larger nominal sizes: The OPTIFLUX is available in the nominal sizes DN 2.5 to DN 150 with all industry-specific aseptic connections. This means that even with large nominal sizes like DN 125 and DN 150, aseptic measuring devices can be used and the blending system can be equipped with a larger version of the same measuring device without having to switch suppliers.

  If end customers require even higher accuracy, KHS has ensured that KROHNE also has an alternative for these applications in the form of a mass flowmeter.

• **Mass flow measurement of the CO2 supplied to carbonate the blended product**
  At this measuring point, a gas flowmeter that can reliably measure very low gas quantities is required. In the past, thermal mass measuring devices were used but they could not reliably measure if the end customer was using moist gas. For this reason, they were replaced by OPTIMASS 8300 mass flowmeters.

  The device features two bent measuring tubes with flow splitters [twin tube loop]. Thanks to the reduction in the cross section and the resulting increase in the flow velocity of the gas, it can even measure small mass flows of gas.

• **Visual monitoring of the minimum throughput by way of measuring the CO2 content**
  A reliably functioning flow indicator was required for this measuring task. The H250 variable area flowmeter used measures the flow purely mechanically without a power supply and features an easy to read display. This allows for a “fleeting” visual check to ascertain whether the CO₂ dosage contains the right amount of gas.
5. Products used

**OPTIMASS 7300 C**
- Coriolis mass flowmeter for liquids and gases
- Single straight measuring tube, easy to clean
- Negligible pressure loss
- Certified to EHEDG and 3A

**OPTIMASS 8300 C**
- Coriolis mass flowmeter for liquids and gases
- Two parallel bent measuring tubes with flow splitter

**OPTIFLUX 6300 C**
- Electromagnetic flowmeter for conductive liquids
- Special sealing concept prevents product build-up on sealing ring
- FDA-conforming materials
- Certified to EHEDG and 3A

**H250**
- Variable area flowmeter for liquids and gases
- Also available with stainless steel housing for hygienic applications

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Determining flow and Brix in the production of fruit juices

- Mass flow measurement for dosing additives
- Concentration measurement to determine sugar content
- Automated control for consistent product quality

1. Background

A European food manufacturer produces fruit juices (including pears, apricots and peaches). Besides fruit juice concentrate, vitamins and other additives are added to the mixing tanks during production. The correct dosage of each respective medium is very important in this process step. Water is added afterwards, depending on the sugar content (Brix value). The finished product is then stored in buffer tanks.

2. Measurement requirements

The customer was looking for an appropriate measurement solution to monitor the dosing process and continuously determine the Brix value in the concentrate. As the media to be measured are slightly viscous, it was essential that the instrumentation had no constrictions or bends and that it caused only very little pressure loss.
3. KROHNE solution

The fruit juice producer decided to use several OPTIMASS 7300 mass flowmeters. These devices determine the mass and volume flow of additives that are added to the fruit juice concentrate. In addition, the KROHNE device also uses the integrated density measurement to calculate the sugar concentration in the fruit juice concentrate. As the OPTIMASS 7300 is a single straight tube device, flow measurement with a free cross-section is always guaranteed. This enables measurement with virtually no pressure loss.

4. Customer benefits

The OPTIMASS 7300 makes it possible for the fruit juice producer to properly dose all of the ingredients. At the same time, thanks to the Brix measurement, it is always possible to establish the right ratio of water to fruit juice concentrate and to adjust the sugar content in the finished product to the desired target value. Using the customer’s PLC, the dosing and mixing processes can be automatically controlled. Consistently high product quality is thus guaranteed. The customer benefits from a mass flowmeter boasting best in class accuracy.

5. Product used

OPTIMASS 7300 C

- Coriolis mass flowmeter to determine sugar content (Brix value) in juices and fruit juice concentrates
- Reliable measurement of mass and volume flow, density, temperature as well as liquids with solids content
- For hygienic applications requiring high performance
- One straight measuring tube: any installation position, self-draining, easy to clean, maintenance-free
- High degree of measuring accuracy even when process conditions change
- Certified to EHEDG and 3A
- Suitable for custody transfer (MID MI-005, OIML R117-1 etc.)

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1. Background

KHS GmbH is one of the world’s leading suppliers of filling and packaging systems as well as technical systems for the beverage industry. In addition to components for filling, cleaning and packaging liquids, KHS also supplies industry-specific process technology. This includes fully-automated systems to stabilize beer in container format.

2. Measurement requirements

For small and medium-sized breweries KHS manufactures the Innopro ECOSTAB B, a beer stabilization system for batch processing. The system removes the phenols that cause turbidity from the beer by way of renewable PVPP (Polyvinylpolypyrrolidone). This allows the beer to be stabilized accordingly and prevents turbidity during transport or long periods of storage. The PVPP suspension is provided in a stackable container. Since this system stabilizes the beer in small process modules, the mixing phases and product consumption are accordingly low.

Following successful stabilization the PVPP is regenerated in the modules and fed back to the dosage tank so that it may be reused for the next stabilization cycle. In order to dose the PVPP properly in relation to the overall volume flow of 50...240 hl/h (ca. 42.6...204.5 US beer bbl) and to enable automated operation, the system must be equipped with flowmeters.
3. KROHNE solution

KHS chose KROHNE’s OPTIFLUX 6300 as its flowmeter. For this plant manufacturer, KROHNE is the standard supplier of flow instrumentation. The two companies have enjoyed a long partnership. The electromagnetic flowmeters have been in use for a long time for other KHS products such as filling systems.

A total of two devices were used in the system. One compact version (C) and one version with a remote converter and wall housing (W). The PVPP is then either dosed in proportion to quantity using an OPTIFLUX 6300 W in a small size (DN 10) or the exact amount is added to the flow of beer on top while regulating the turbidity. An OPTIFLUX 6300 C (DN 40) also measures the overall volume flow of the beer to be stabilised.

Both device versions feature a state-of-the-art Profibus DP interface and use it to digitally transmit all of the measured parameters to the higher-ranking PLC.

4. Customer benefits

Dosing the PVPP is accurate and fully-automated when using the OPTIFLUX 6300. The higher-ranking PLC makes it possible for the plant operator to quickly measure and further process all parameters and operating states of the OPTIFLUX 6300 via the Profibus DP. The entire dosing process can be centrally adjusted and visualised along with the entire system.

The high accuracy of the measuring device with a deviation of <0.2% from the measured value ensures high plant safety and cost-saving operation. The PVPP is carefully dosed into the beer flow according to the dosing quantity in the formula.

5. Product used

OPTIFLUX 6300 C and W

- Electromagnetic flowmeter for the food and beverage industry
- For demanding mixing, dosing and filling applications with liquids
- Robust stainless steel housing and PFA liner
- DN 2.5...150 / 1/10...6”; process temperature up to 140 °C / 284 °F
- All industry-specific process connections
- On-site verification of flowmeter with OPTICHECK
- FDA, EC 1935/2004, 3A, EHEDG
- HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP, Modbus etc.

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Please visit our website for a current list of all KROHNE contacts and addresses.
Equipping a filling machine with Coriolis mass flowmeters

- High filling accuracy at little or no conductivity
- Filling of both carbonated and still liquids with a single filling machine
- High level of repeatability, even in the case of variable quantities

1. Background

For precise control of the filling quantity, filling machines (rotary filling machines or linear filling machines) are equipped with flow measuring devices. Particularly when PET bottles, pouches and cans are filled with water, lemonade, tea and milk products, it is typically electromagnetic flowmeters that are used.

2. Measurement requirements

Krones AG, based in Neutraubling, Germany, designs, develops, manufactures and installs machines and complete systems for process, filling and packaging technology as well as intralogistics. Information technology and factory planning complete the company’s product portfolio. The company won a contract from a soft drink producer for a rotary filling machine with 112 filling stations for the filling of different products in one filling line. In addition to carbonated products, it had to be able to fill still products as well. The meters used must not only have superior accuracy but also good repeatability (long-term stability).

3. KROHNE solution

As water from osmosis installations is increasingly used in place of well water in the production of beverages, the conductivity of the water is between 5 and 10 µS/cm or µmohs/cm. As a result, the accuracy of the electromagnetic flowmeters deteriorates to such a degree that the standard accuracy of the complete filling system also becomes worse. Coriolis mass flowmeters can be used as an alternative to electromagnetic meters.
They measure regardless of viscosity, conductivity or inlet runs and can also determine precise volume or mass flow in extremely short filling times. Krones decided to equip the filling stations with the OPTIBATCH 4011 C with the nominal size DN 15 / (approx.) ½". The flowmeters were supplied with hygienic flange connections conforming to DIN 11864-2.

4. Customer benefits

Using Coriolis mass flowmeters makes it possible to fill different products with varying conductivities. OPTIBATCH 4011 C was specifically developed for use with filling machines and features superior accuracy through direct measurement as well as measurements that are stable over the long term. The filling processes can take place both with and without pressure. Depending on requirements, both carbonated and non-carbonated products can be filled using the meters. The mass pulses are transmitted directly from the OPTIBATCH 4011 C to the total control system via a multi-pole connector. A separate evaluation unit is not required. The entire electronics of the measuring device are integrated into a fully welded stainless steel housing. A PC-supported programme is used to record filling processes or adjust settings on the meters.

5. Product used

OPTIBATCH 4011 C

- Coriolis mass flowmeter, specifically designed for use with filling machines
- High measuring accuracy and repeatability, even with non-conducting and fatty liquids
- Compact dimensions, short installation length, low pressure loss
- A variety of hygienic connections available
- Fully welded stainless steel housing with integrated electronics
- Multi-pole connector to transmit mass and volume pulses
- Certified to 3A and EHEDG

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Flow measurement for the filling of fruit preparations

- Highly accurate product filling into special containers for customer delivery
- Mass flow measurement of fruit products with whole fruit chunks
- Addition of hanging scales to automate the filling process with PROFIBUS® DP

1. Background

Zentis GmbH & Co. KG is one of Europe’s largest fruit processing companies with over 2000 employees around the world. The company’s product range includes fruit preparations and raw mixtures for the dairy and baking industries as well as jams and desserts for the retail sector. Zentis produces around 200,000 t of fruit products per year at the main factory in Aachen, Germany, alone. The products are then delivered to milk processing plants as additions to quark and yoghurt products.

2. Measurement requirements

The products are delivered in special transport containers. Depending on the order, the containers have different capacities of 1000, 500 or 250 kg (approx. 2205, 1102 or 551 lb). The containers must be filled differently according to weight and customer specifications. To guarantee this, Zentis relies on the highly accurate filling of its fruit preparations.

Up until now the customer has been using a hanging scale for filling. The filling process was thus costly and prone to error. As the supply line must always be connected to the container when filling, this measuring process always runs the risk that the weight of the line is added to the scale. The customer decided to replace the hanging scale with a flowmeter in order to minimise the risk of error and automate the filling process using a control unit. The purpose of the flowmeter is to directly measure the mass of the lightly viscous product full of chunks of fruit. The pipe geometry of the measuring device had to be such that the fruits in the product flow could not be destroyed. In addition, the pressure loss resulting from the use of the measuring instrument should be kept to a minimum.

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<tr>
<td>Measuring range:</td>
<td>30…600 kg/min / 66…1323 lb/min</td>
</tr>
<tr>
<td>Minimum measured quantity:</td>
<td>200 kg / 441 lb</td>
</tr>
<tr>
<td>Pressure:</td>
<td>+25 °C / +77 °F</td>
</tr>
<tr>
<td>Density:</td>
<td>1.2 kg/m³ / 2.02 lb/yd³</td>
</tr>
<tr>
<td>Viscosity:</td>
<td>500 mPas</td>
</tr>
</tbody>
</table>
3. KROHNE solution

Due to the measuring parameters, a Coriolis mass flowmeter without flow splitter was the instrument of choice for this application. The OPTIMASS 7300 W fulfills this requirement and impressed the customer with its superior accuracy. The mass flowmeter has a single straight measuring tube particularly well suited to measuring product flow containing chunks of fruit without causing great pressure loss in the process.

Zentis installed two OPTIMASS 7300 units in the hygienic stainless steel version (DN50) and with industry specific threaded connection (as per DIN 11851) into the filling line in front of the containers. A pump now pumps the fruit preparation from the production tank, through the measuring device into the special containers. The OPTIMASS 7300 communicates with the filling system via its PROFIBUS® DP interface.

4. Customer benefits

The OPTIMASS 7300 W makes it possible to precisely control the automated filling of the containers. The mass flowmeter measures with a high degree of accuracy and independent of any changes in viscosity or solid-type fruit chunks in the medium.

Its single straight measuring tube design means that it can be installed in confined spaces, is self-draining and easy to clean.

The OPTIMASS 7300 W measuring results are continuously calculated in the transport line and made available in the control room. If necessary, Zentis could also transfer other parameters such as volume and density, which the mass flowmeter also measures directly, via the PROFIBUS® interface into the control room.

5. Product used

OPTIMASS 7300 W

- Coriolis mass flowmeter for extremely demanding food applications
- Single straight tube design without flow splitter for minimal pressure loss
- DN10...100 / ½...4"; flow rates up to 560,000 kg/h / 20,576 lb/min
- Best in class for accuracy and zero stability
- Measuring tubes available in 4 materials (stainless steel, titanium, Hastelloy®, tantalum)
- Modular electronics concept
- Optional heating jacket
- EHEDG, 3A, FDA, EC 1935/2004
- HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP etc.

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Inline aromatisation of foam in the manufacture of confectionery

- Continuous inline dosing of flavour and colouring to foam base mass
- Stable composition of the product
- High level of repeatability, even in the case of fluctuating consumption

1. Background

As well as licorice, products made from fruit gum, such as jelly babies, are firm favourites in sweet shops. Depending on the type however, such sweets either contain sweet foam or even are made entirely of sweet foam. This is the case with many of the products from the MEDERER Sußwarenvertriebs GmbH Company in Fürth, which markets its products under the brandname Trolli. The sweets can consist of several layers where typically, the lower layer is made of foam and the top one of fruit gum. One example of this is the well know “Sour apple rings” from Trolli.

2. Measurement requirements

To start with, the fresh foam is produced in a special mix machine and then aerated. Following this, the foam is given its taste and colour through the inline dosing of additives. Then, the foam leaves the machine and is formed into the required shapes, e.g. bears, frogs or rings in the so-called Mogul machine, by being dosed into starch filled mould boards.

3. KROHNE solution

In order for the foam to have the required flavouring and colouring, various flowmeters have been deployed on each line. An electromagnetic flowmeter OPTIFLUX 6000 (DN 25 / 1”) measures the volume flow of the fresh, still tasteless foam as it comes out of the mix machine. At the same time, various additives, namely the colouring, citric acid and aromas are metered in.
Three of these products are measured using an OPTIFLUX 6000 with smaller diameters (DN 2.5 / 1/10" and DN 4 / 1/8"). One medium does not have sufficient conductivity and for that reason is measured using a small Coriolis mass flowmeter OPTIMASS 3000 (DN 3).

Because of the difficult installation conditions in the dispensing system, the measurement systems were delivered as a remote version. The signal converters were installed as 19" rack versions in a separate cabinet. The connection to the control system was realized through a Profibus DP communication.

4. Customer benefits

Two systems of this type were built by the Hansa Industrie Mixer Company and installed and commissioned at Mederer in Fürth. Even though measuring foam with a high air content is not easy, the flowmeters are working to the complete satisfaction of the customer. In spite of the very restricted space available for the installation of 16 measuring devices, the system offers high levels of repeatability and accuracy.

5. Products used

OPTIFLUX 6300 R
- Electromagnetic flowmeter for hygienic applications
- Separate signal converter for installation in a 19" rack
- Nominal width range: DN 2.5...150 / 1/10"...6"
- Vacuum-resistant liner, even with high temperature changes

OPTIMASS 3300 R
- Coriolis mass flowmeter for very small quantities
- Records mass flow volumes of just a few grams per minute
- Secondary pressure containment for high safety

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Dosing liquid chocolate in the production of ice cream

1. Background

At one of its locations in Germany, a milk processing company also produces milk ice cream. Ice cream in a waffle cone is one of the company’s ice cream creations.

2. Measurement requirements

To help the waffle cones maintain their consistency over a long period of time and prevent them from getting soggy, a liquid plug is inserted before filling the cones with ice cream. Therefore, a filling machine fills each waffle cone with 4...6 gr / 0.13...0.2 US fl.oz. of liquid chocolate.

The amount of chocolate used was not continuously measured in the past. The company had simply started up production and then taken random samples to gradually see when the desired filling level was attained. This resulted in a significant waste of product that could no longer be used due to quality issues.

For this reason the customer was looking to find a technical solution to better control the filling process. Due to the specifications, a Coriolis mass flowmeter was the instrument of choice for this application. The possibility of entrained gas in the product flow meant that increased requirements were placed on the reliability of the measuring instrument. To enable smooth communication with the existing control unit, the measuring device needed to have a PROFIBUS® DP interface.

<table>
<thead>
<tr>
<th>Medium</th>
<th>Liquid chocolate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate</td>
<td>100 kg/h / 3.67 lb/min</td>
</tr>
<tr>
<td>Density</td>
<td>1.09 kg/m³ / 0.68 lb/ft³</td>
</tr>
<tr>
<td>Pressure</td>
<td>1 barg / 14.5 psig</td>
</tr>
<tr>
<td>Temperature</td>
<td>+33...+37 °C / +91.5...+98.5 °F</td>
</tr>
<tr>
<td>Viscosity</td>
<td>130 mPas</td>
</tr>
</tbody>
</table>

APPLICATION NOTE Food & Beverage

Dosing liquid chocolate in the production of ice cream

- Filling waffle cones with a chocolate plug
- Coriolis mass flow measurement to control a filling machine
- Incorporation into the control system via a PROFIBUS® DP interface
3. KROHNE solution

The ice cream producer decided on the OPTIMASS 6400 F. The Coriolis mass flowmeter was supplied in stainless steel (316 L) with measuring tube size DN 8. It was installed with a hygienic process connection (milk thread as per DIN 11851) in the customer’s horizontal dosing line. Because the flow of the chocolate depends on the temperature, the OPTIMASS 6400 was supplied with a heating jacket. This way the medium maintains the desired temperature range (+33...+37 °C / +91.5...+98.5 °F) and cannot solidify.

Unlike other mass flowmeters on the market, the OPTIMASS 6400 is immune to any negative effects gas bubbles in the chocolate may have. It has been designed for applications with entrained gas thanks to the patented functionality of the “Entrained Gas Management” (EGM™).

The measuring tube for the device is EHEDG-certified and thus guarantees simple cleaning. The OPTIMASS 6400 is connected to the customer’s control unit via its PROFIBUS® DP interface.

4. Customer benefits

With the help of the OPTIMASS 6400 the ice cream producer can now automate the dosing process, controlling the amount of chocolate used much more accurately. The result is not only consistently high product quality. Waste is also significantly reduced, allowing the customer to save on both resources and costs on a permanent basis.

The measuring device is very reliable and continuously maintains the mass measurement even in the case of entrained gas of up to 100%. This saves the customer expensive process interruptions. The ice cream manufacturer is thus extremely satisfied with the technical advice, the design of the application and the performance of the KROHNE measuring device.

5. Product used

OPTIMASS 6400 F
• Coriolis mass flowmeter for liquids and gases with V-shaped twin measuring tube
• Entrained Gas Management (EGM™): Continuous measurement even at gas concentrations from 0...100% and sudden changes in gas content
• Optimised flow divider for minimum pressure loss
• Suitable for hygienic applications (EHEDG, 3A; FDA, EC 1935/2004)
• HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP, Modbus etc.

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Mass flow measurement of liquid chocolate

• Dosing chocolate to refine desserts
• Accurately determining the amount of chocolate for consistent product quality

1. Background

An international food manufacturer produces a variety of types of chocolate among other things. Some of these white and dark chocolates are then used to refine cakes, puddings and yoghurt.

2. Measurement requirements

To maintain the consistent appearance and taste of these desserts, it is necessary to dose the various types of chocolate very precisely. This had previously been done using dosing pumps. However, the accuracy of the pumps was not in keeping with the high quality standards of the food manufacturer. The company thus went in search of a suitable flowmeter for this application. Liquid chocolate is not electrically conductive. Its viscosity is about 150 mPas [at 10 bar / 145 psi and 55 °C / 131 °F]. The mass flow from the storage tanks to the mixing containers is 1400 kg/h (approx. 51.5 lb/min) at overall low flow velocities. The new measuring solution had to be easy to clean. The measuring instrument could cause no blockages in the pipeline. In addition, it had to be manufactured in accordance with the hygienic requirements of the food and beverage industry.
3. KROHNE solution

KROHNE supplied 6 OPTIMASS 7300 W mass flowmeters for this application. The measuring devices were installed with hygienic connections into the dosing lines [DN 25] in front of the mixing containers. Unlike U-shaped mass flowmeters, the space-saving straight tube design of the OPTIMASS 7300 made it possible to install in limited space. Vibrations in the pipeline have no impact on the measurement. Process control is completely automatic via the 4...20 mA current output.

4. Customer benefits

Now the food producer can automatically add the desired amount of chocolate and attain consistent quality in the end product. With the OPTIMASS 7300 the customer benefits from a mass flowmeter with best in class accuracy. A change in the viscosity of the chocolate does not affect the measuring performance of the OPTIMASS 7300. Since the KROHNE device features just one single straight measuring tube without a flow splitter, blockages and unnecessarily high pressure losses can be reliably prevented.

5. Product used

OPTIMASS 7300 W
• Only mass flowmeter with a straight measuring tube in stainless steel, Hastelloy®, titanium or tantalum
• For hygienic applications requiring high performance
• Reliable measurement of mass and volume flow, density, temperature as well as liquids with solids content
• Easy to clean, maintenance-free
• Approved according to OIML R117-1 for mass and volume with accuracy class 0.3

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6 Edible Oil & Mustard

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measuring devices ........................................................................ 98
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Flow measurement in an oil mill

- Determining the quantity of vegetable oil in production
- Mass flow measurement of a non-conductive liquid
- Control via PROFIBUS® PA interface

1. Background

A food producer in Switzerland operates an oil mill for the manufacture of vegetable oil. The company extracts the oil by pressing the pulp of oil plants (olives, sunflowers, rapeseed). After pressing, the oil is cleaned and refined. The finished end product is then used in the food industry or for the manufacture of biofuel.

2. Measurement requirements

To measure the flow of the vegetable oil, the customer needed a flowmeter that could measure the volume of the non-conductive medium. The pressure loss caused by the measuring device had to be negligible in order to keep pump output low. The devices also had to be maintenance-free, easy to drain and easy to clean. As the PROFIBUS® PA was to take care of the entire process control, the measuring device also had to have an appropriate interface.

<table>
<thead>
<tr>
<th>Medium</th>
<th>Vegetable oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process temperature</td>
<td>approx. 20 °C (max.: 90 °C) / 68 °F (max. 194 °F)</td>
</tr>
<tr>
<td>Pressure</td>
<td>2 bar / 29 psi</td>
</tr>
<tr>
<td>Density</td>
<td>0.88...0.93 kg/l / 55...58 lb/ft³</td>
</tr>
<tr>
<td>Viscosity</td>
<td>approx. 160 mPa•s</td>
</tr>
<tr>
<td>Measuring range</td>
<td>0...30000 kg/h / 1102.3 lb/min</td>
</tr>
</tbody>
</table>
3. KROHNE solution

KROHNE supplied the OPTIMASS 1300 C. This mass flowmeter is designed to measure the flow of non-conductive, slightly viscous liquids. The OPTIMASS 1300 is self-draining and, thanks to its twin straight measuring tube, causes only very minimal pressure loss. Compared to U-shaped mass flowmeters, the OPTIMASS 1300 features a compact design. The measuring device’s PROFIBUS® PA interface transfers the measuring results to a control room.

4. Customer benefits

With the help of the OPTIMASS 1300, the oil mill operator can control his production processes. At the same time he benefits from a low-priced mass flow measuring device that features a space-saving design and comparatively high accuracy. There were no additional requirements when it came to installing the straight measuring tube device and no special knowledge was required on the part of the customer.

5. Product used

OPTIMASS 1300 C

- Coriolis mass flowmeter in twin straight tube design for standard applications in the food and beverage industry
- Optimised flow divider for minimum pressure loss
- Can be used up to 130 °C / 266 °F
- Self-draining and easy to clean
- Options: heating/cooling jackets, purge ports, hygienic connections
- Modular electronics with data redundancy

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Continuous inline measurement of FFA in frying oil

• Automated fresh oil dosing in the production of stacked chips
• Spectroscopic analysis of free fatty acids without laboratory measuring methods
• Significant savings of fresh oil with little energy expended

1. Background

A snack manufacturer produces stacked chips at one of its European locations. The company uses sunflower oil (HoSo) with no additives to fry the chips. When selecting, the food producer pays special attention to consistently high quality. However, the oil is obtained from different producers and the point of origin and type of oil can vary.

2. Measurement requirements

Production at the company runs Monday through Friday, 24 hours per day. To fry the chips, the oil is heavily heated directly in front of the fryer and pumped into the line (60–70,000 l/h / 15850–18490 US gal/h). Even though the fresh oil consumption of the stacked chip plant is theoretically calculated at 150 l/h (39.6 US gal/h), the actual consumption in the production process is about 30 litres / 6.6 US gal higher. The cause of this is the runaway phase of the free fatty acids (FFA) in the oil. These free fatty acids occur when fatty acids are split off from the fat molecule which consists of the trivalent alcohol glycerin and fatty acids. This ageing process is controlled by measuring the FFA value. Thus, in practice and starting at a pre-determined FFA value, fresh oil must be added in order to guarantee constantly high product quality. It has always been necessary to have several regulating interventions per day based on laboratory tests (titrations). The stacked chips producer was looking for an alternative analysis technology that could fully automate the supply of fresh oil using valves and obtain a constant FFA value.
3. KROHNE solution

KROHNE recommended the installation of the OPTIQUAD-EOF 4050 W for the continuous inline measurement of FFA in deep fried oils. The Analyzer Unit was installed at about 4 m / 13.1 ft in a descending, thermally isolated pipe behind the heat exchanger and above the fryer.

Unlike quantitative laboratory methods, the OPTIQUAD-EOF continuously measures the FFA value in the pipeline. There is no contact with the product as analysis is carried out through an optical window by way of spectroscopy in a standard VARINLINE® measuring section. As the sunflower oil at the point is about 180° C / 356° F, the Analyzer Unit is also water cooled to protect the OPTIQUAD-EOF optoelectronics. The measurements are continuously transferred via the 4...20 mA output of the Operating Unit to a measuring station and made permanently available.

4. Customer benefits

With the OPTIQUAD-EOF’s help, the customer is now in a position to reduce the amount of fresh oil added. The customer has been able to keep the FFA value consistently below the defined limit. Thanks to the increased stability of the production process, the chips manufacturer has been able to get the actual fresh oil consumption closer to the theoretically calculated consumption value, resulting in significant cost savings. The customer also benefits from consistently high product quality.

The snack specialist can now intervene in the production process much more quickly as the OPTIQUAD-EOF provides accurate measurements in a matter of seconds. The high long-term stability of the instrument and long maintenance intervals work in the customer’s favour in terms of cost-effectiveness. Use of the device represents an important step towards automated control of the fresh oil supply, making sampling as well as costly and inconvenient laboratory measurement methods completely superfluous.

Sample calculation: Savings potential by using the OPTIQUAD-EOF
Reduction of a 20% additional requirement of sunflower oil by half:
15 l/h x 24 h x 4.5 days [production time per week] x 46 weeks [year] x 1.20 EUR/Litre*
= 90,000 EUR/year (approx. 100,000 USD/year)

5. Product used

OPTIQUAD-EOF 4050 W (Successor product to OPTIQUAD-FFA 4050 W)

- Inline measurement of free fatty acids (FFA), total polar material (TPM), peroxide value (POV), moisture, dirt and other values
- For use in dynamic control loops
- Eliminates the need for costly sampling, sample transport and preparation
- No operating costs for chemicals, reagents and cleaning agents
- High precision and long-term stability

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Equipping a linear filling machine for olive oil with flow measuring devices

- Hygienic volume flow measurement of olive oil
- Dosing of electrically non-conductive liquids
- Automated filling of different types of bottles

1. Background

The Italian company Fimer produces filling systems for the food and beverage industry. For an olive oil producer, the company manufactured a linear filling machine as a series filler with 6 filler heads. The filling machine was to be able to fill a variety of bottles of different types and sizes.

2. Measurement requirements

In order to adapt to the changing dosing requirements, the filling machine had to be equipped with reliable and precise flowmeters. Since olive oil is a non-conductive medium, Coriolis mass flowmeters were suited to meet the demands. As the linear filling machine is quite small, the measuring devices had to be very compact in size.

Technical data for the application

- Density of the olive oil   \(920 \text{ kg/m}^3 / 57.5 \text{ lb/ft}^3\)
- Max. flow rate   \(12 \text{ kg/min} / 26 \text{ lb/min}\)
- Bottle size   1 and 1.5 litre / 33.8 and 50.7 US fl.oz.

The installation of the measuring devices had to be simple and possible without additional equipment. This also applied to the electrical installation. It was also required that the filling process be automatically controlled in a measuring station.
3. KROHNE Solution

For this application, KROHNE supplied 6 OPTIBATCH 4011 C mass flowmeters (DN 15 / 1/2”). The devices have been integrated into the linear series filling machine without additional equipment. The mass flowmeters require no inlet/outlet segments. The filling process runs automatically and can be controlled at any time. The integrated electronic system simplifies electrical installation. No special settings are required for initial operation. Zero point adjustment is also not necessary.

4. Customer advantages

Installing the meters onto the linear filling machine was simple and quick. No special knowledge was required for initial or subsequent operation. Due to the complete presetting of all data and the calibration by KROHNE, the only thing left to do on site was to set the pulse output with the number of pulses for the quantity to be filled. Another advantage of the OPTIBATCH 4011 C is that the device can be easily used for CIP and SIP cleaning of up to 120 °C / 248 °F. Fimer has been extremely satisfied with the entire performance of the devices.

5. Product used

OPTIBATCH 4011 C
- Coriolis mass flowmeter for process batching
- Compact design; integrated electronics
- Excellent long-term stability, accuracy and repeatability
- Hygienic design for food, beverage and pharmaceutical application
- CIP / SIP to max. 120°C / 248°F
- Welded housing, protection class IP 67

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Inventory of mustard using non-contact level measurement

- Continuous level monitoring, no risk of overfilling the vessel
- Correct amount of product supplied at the correct time
- Maintenance-free measuring devices

1. Background

Inventory must be checked regularly to ensure that the finished product is continuously supplied to the filling area. The minimum or maximum levels of mustard in the tanks were previously detected using limit switches. Mustard production only started once the minimum limit had been reached which often resulted into shortages.

2. Measurement requirements

A mustard producer in France was looking for a suitable measurement solution for his new warehouse. This included the installation of several non-pressurized buffer tanks that were 4-5 m / 13-16 ft high. The task was to continuously measure the level of different varieties of mustard in these tanks. Continuous measurement would permit the operators to study usage trends and make sure that the finished product is ordered at the appropriate time and supplied in the correct amounts. The customer requested non-contact measurement.
3. KROHNE solution

KROHNE delivered several OPTIWAVE 7300 C FMCW radar level meters with DN 80 / 3” Drop antennas made of plain PP. One device was fitted on each tank roof. This contact-less, 2-wire transmitter continuously measures the level and thereby calculates the product that remains in each tank.

4. Customer benefits

This solution allows measurement of the product level in the tank at any time, enabling the user to optimize supply inventory and reorder batches in a timely manner, without the risk of overfilling the tank. Measurements can also be taken during the filling process. No costly aiming kit is required to install these devices due to their compact design and exceptionally high signal dynamics – an advantage of using FMCW radar technology. Deposits on the antenna are prevented thanks to the ellipsoidal shape, smooth polypropylene surface and completely encapsulated design. This eliminates the need for purging systems or periodic cleaning. The meters come pre-configured; at the time of their commissioning, only a few parameters such as tank height and blocking distance need to be programmed into the transmitter. The OPTIWAVE 7300 gives stable and reliable measurement results while being simple to set up and use.

5. Product used

OPTIWAVE 7300 C radar level meter
• 2-wire FMCW 24...26 GHz radar
• Continuous, non-contact level measurement
• Maintenance-free
• Calibrated at the factory
• Wizard driven setup
• DN 150 / 6” Drop antenna for measuring range up to 80 m / 260 ft
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Automated filling of mixing tanks for bird food

- Non-contact level measurement over a very small measuring range
- Stable measurements on extremely agitated surfaces
- Continuous measurement to optimise mixing capacity

1. Background

Suet cakes are part of the product range of a manufacturer of animal food. In winter they are hung out as a food source for wild birds.

Suet cakes are made of a mixture of different grains, meal, lime, sunflower seeds and additives. The ingredients are mixed in tanks using two augers turning in opposite directions. Once they are extracted they are pressed into a ball and flash frozen.

2. Measurement requirements

The operator wants to automatically fill the mixing tanks with the raw products. This requires continuous monitoring of the level in the open mixers. Up until this point, the level had been determined manually or using visual judgement.
3. KROHNE solution

First, as a test installation, an OPTISOUND 3010 ultrasonic level meter was installed on a mixing tank. The device measures the level from the top continuously and without contact and indicates the value via a 4...20mA output.

In addition to the small measuring range, this application was particularly challenging due to the extreme agitation of the surface as the mixture is constantly being thrown up by the augers.

4. Customer benefits

The test installation was successful: Despite the agitation of the product, the OPTISOUND provides reliable and stable measurement, enabling automated filling. Continuous measurement means the added amount can always be accurately controlled. Hence the mixer is used at optimal capacity. The operator was satisfied with the solution and plans to equip all of the mixing tanks with OPTISOUND devices.

5. Product used

OPTISOUND 3010
- Ultrasonic level meter for liquids and bulk goods
- Continuous, non-contact measurement without process interruption
- Measuring range from 0.25...2 m / 0.8...6.5 ft for solids, 0.25...5 m / 0.8...16.5 ft for liquids
- Process temperature -40...80 °C / -40...176 °F
- Variants available for measuring ranges up to 15 m / 50 ft

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Silo monitoring in a pet food production facility

- Continuous, non-contact level measurement of 24 silos
- Improved silo efficiency
- Uninterrupted production supply

1. Background

A variety of types of grain and vegetables are stored in silos as finely ground flour and granulate used in the production of dry dog food. The size of the silos is large enough to ensure a continuous supply for production.

2. Measurement requirements

A dry dog food manufacturer has built a new production facility with a silo system consisting of 24 silos of different sizes (up to 20 m / 66 ft). The manufacturer was looking for a suitable measurement technology solution to ensure the continuous monitoring and automation as well as better utilisation of the silo cells. In the old plant, the level was sounded out manually.
3. KROHNE solution

For this application, KROHNE provided a total of 24 OPTIWAVE 6300 C radar level meters, each with DN 80 / 3" drop antenna and dust Ex approval. The measuring devices are designed as blind devices without display, the configuration of the devices is done via PC using PACTware. For several reasons, the customer decided on non-contact measurement; on the one hand, unlike the guided radar TDR, it is accessible at any time and can be removed without great effort. On the other hand, there is no cable to tear off and fall into the gear.

One challenge with this application is the poor reflection property of the different raw materials due to the low dielectric constants as well as the high dust formation when filling the silos. The shape of the silos, typically tall and extremely narrow in animal feed production, presents another challenge. In this case it is important that the radar lobe is finely focused, which is made possible by the special shape of the drop antenna. Due to its high dynamic range, the OPTIWAVE 6300, an FMCW radar, is in a position to reliably meet these requirements.

4. Customer benefits

The measuring requirements are fully met using the OPTIWAVE 6300: continuous measurement informs the operator at any time of the supply in the silos, thus ensuring a continuous supply of flour types for production and improved silo efficiency. This also prevents mathematical errors and the incorrect level calculation that can occur with manual measurement. All of the data from the OPTIWAVE measuring devices are directly available by way of visualisation in the control system.

Another advantage for the operator comes in the shape and deposit-free property of the drop antenna, meaning that it requires no purge air. If features no moving parts and is thus wear and maintenance-free.

5. Product used

OPTIWAVE 6300 C
- Radar level meter for solid applications
- 2-wire FMCW 24...26 GHz radar
- Software specifically developed to measure solids
- Continuous, non-contact level measurement
- Various ATEX approvals available
- Pre-configured ex-works
- Simple start-up thanks to installation wizard
- Basic version with DN 80 / 3" drop antenna measures up to a height of 30 m / 98 ft
- Also available with DN 150 / 6" drop antenna for a measuring range up to 80 m / 263 ft or products with very low reflectivity

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8 Utilities

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Energy management for a sustainable beer production

- Flow measurement of steam, compressed air, CO₂ and water
- Detecting measurement deviations to avoid losses
- Managing energy to reduce consumption
- A tailored technical proposal

1. Background

Established in France since the 70s, Heineken chose a unique business model as both brewer and distributor.

Heineken has sold 5.7 million hectolitres of beer, including the brands Heineken, Desperados, Pelforth, Affligem and many others such as Fisher and Edelweiss. More than 4000 employees working all over France and the 1.66 billion euros in revenue generated in 2014 illustrate the success of the company’s strategic positioning.

To maintain its market position and become the most sustainable brewery in the world, the company invested in the BABW programme [Brewing A Better World] in 2008. The goal is a 40% reduction in CO₂ emissions by 2020.

2. Measurement requirements

The group faced the facts and started replacing old equipment such as water heaters and air compressors. In order to move on with the BABW approach and to make further progress, it was necessary to retrofit the process instrumentation used for operating their EMS [Energy Monitoring System]. The company focused on 3 priorities: electricity, heating and water. The heating part involved the distribution of compressed air, cold and steam. There were some orifice plates and thermal mass flowmeters installed which, however, dated back to the 1980s and were completely obsolete.
3. KROHNE solution

Measurements are done on utility fluids: steam, compressed air, CO₂ and water. Having taken an inventory of the key points of measurement, specifications were established and sent to different suppliers on the market. After the analysis of the various technical proposals it was the KROHNE solution that was chosen. It came closest to meeting Heineken’s needs in terms of standardising measurements so that they can be compared to one another, the dynamics of the broadest measuring ranges and considerable accuracy when detecting anomalies. The customer chose the OPTIFLUX 4300 W electromagnetic flowmeter for water networks, alcoholised water (the alcohol is an antifreeze that retains the food properties) and chilled water. The OPTISWIRL 4070 vortex flowmeter was selected for compressed air and steam and the OPTIMASS 6400 Coriolis mass flowmeter for measuring CO₂. A total of 28 KROHNE sensors were installed. Heineken recognised that KROHNE proposed the best technological solution at the best price.

4. Customer benefits

“Energy is everybody’s business” states Heineken’s project manager for energy and utilities. Today, these measures help manage investments, e.g. to implement regulations. All employees are to be involved in energy monitoring because it’s the best way to reach objectives. When it comes to energy consumption, all relevant information is visualised on a dash board in the control room. The site consists of approximately 250 flowmeters and these new points of measurement generate alerts at the earliest sign of deviation in consumption, enabling immediate intervention to resolve the problem. The French sites have the same equipment and that applies to Eastern Europe as well. Heineken’s internal procedure is 90% identical to the ISO 50001 standard and the company has decided to go for this certification.

5. Products used

OPTIFLUX 4300
- Electromagnetic flowmeter for highly accurate bi-directional flow measurement of liquids
- Wide measuring range DN2.5…3000 / 1/10…120”

OPTISWIRL 4070
- Vortex flowmeter for measurement of saturated steam, superheated steam, gases and wet gases with varying process conditions
- Available with integrated pressure/temperature compensation and flow calculation

OPTIMASS 6400
- Coriolis mass flowmeter for liquids and gases with V-shaped twin measuring tube
- Wide measuring range [DN 10…300 / ½…12”]

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Energy balancing in utility and supply processes at the Krombacher Brewery

- 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.
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. 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.

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.
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.

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
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Measuring quantity of heat produced in the heating system in the “Weisses Bräuhaus, G. Schneider & Sohn”

- Heat flow volume output for custody transfer measurement
- Invoicing of combustible used according to energy output
- Complete measurement solution: Flow measurement with two temperature sensors

1. Background

In 1607, Duke Maximilian I of Bavaria founded the Weisses Bräuhaus in Kelheim. Since 16 April 1608, Weissbier has been brewed here. The Schneider family has owned the brewery since 1927.

The “Weisse Bräuhaus” constructed a new heating station to supply the brewery and the administration building with high temperature water (165 °C / 329 °F) and hot water (90 °C / 194 °F). The boiler generates a total of approx. 5400 kilowatts of heat output. At the core of the system is a wood chip furnace with a high temperature boiler. In addition to the basic load, a 4000 kilowatt peak load boiler running on heating oil was installed to handle energy peaks.

For increased efficiency, a waste-gas heat exchanger was installed to generate the low temperature hot water (90 °C / 194 °F).

2. Measurement requirements

It is not the quantity of wood chips but rather the quantity of heat produced that is used when invoicing the wood chips used in firing the boiler. The basis for calculation is the heat energy generated at the boiler outlet. Since it is a custody transfer measurement, it was necessary to use an approved heat volume system.

In addition to the flow rate of the water, the temperature in the supply line and the return must be measured in both heating circuits to determine the heat energy.
3. KROHNE solution

To measure the quantity of heat produced, a UFM 3030 ultrasonic flowmeter and two paired and calibrated temperature sensors were used in each circuit. For better instrument read-out, the UFM 3030 devices were supplied with separate signal converters. Along with the temperature sensors, the flowmeters are connected to separate "CALEC" energy calculators featuring the required approval as per EN 1434. These calculators display the current heat quantity gained for each heating circuit as well as the cumulative kilojoule value, which is then transferred to the overriding control system.

4. Customer benefits

The Schneider brewery can determine and invoice the wood chips necessary for firing based on the quantity of heat produced. The following factors were crucial in the process:

• Complete custody transfer hot water energy balancing was achieved for both circuits with minimal effort
• The available heat quantity in the circuits can be determined at any time
• The technology installed is practically maintenance-free
• The system complies with EN 1434

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 assembly with extension tube for screw-in
- High measuring accuracy
- Paired design

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Differential pressure measurement to regulate a vapour compressor

• Heat recovery for the thermal treatment of wort
• Measuring the differential pressure between the vapour chamber and the atmosphere
• Long-term reduction in costs and CO₂ emissions thanks to better automated process steps

1. Background

The König Brewery in Duisburg, Germany, produces the alcohol-free beer König Pilsener Alkoholfrei and the beer-lemonade mix König Pilsener Radler in addition to its namesake, the premium beer König Pilsener. The long-established company stands for both high standards when it comes to product quality as well as the sustainable and cost-saving use of energy sources. To achieve this, the production facilities need to be appropriately designed. The need for heat energy is particularly great when it comes to wort boiling. Generating steam to thermally treat the wort is extremely energy-intensive. In order to sustainably reduce energy costs, the brewery relies on the heat recovery process when boiling wort.

2. Measurement requirements

The vapours generated when boiling wort are collected and compressed. When compressed, the temperature of the vapour increases from 100 °C / 212 °F to about 120 °C / 248 °F, which means that it can then be used again immediately to boil wort.

The König Brewery uses a mechanical vapour compressor to compress the steam. It is only activated when the vapour pressure above the wort reaches a minimum gauge pressure of 25 mbar / 0.36 psi. Until now the company has been using a U-tube manometer to determine the differential pressure. However, as part of the continued modernisation and automation of the plant, this device had to be replaced. A state-of-the-art differential pressure transmitter that could directly transfer its measuring signal to the central control room was required.
3. KROHNE solution

The OPTIBAR DP 7060 C differential pressure transmitter was chosen. The KROHNE device measures the vapour pressure above the wort compared to the atmospheric pressure outside of the tank. The extremely compact measuring cell provides the measurements with step response times of just 125 ms to the programmable logic controller (PLC). This guarantees reliable and stable process control. Once the predetermined minimum differential pressure has been reached, the control system activates the vapour compressor.

4. Customer benefits

Thanks to the use of the OPTIBAR DP 7060 C, the heat recovery works smoothly via the PLC. The brewery has been able to considerably reduce the energy requirements for this energy intensive process step. Now, considerably less primary energy is required to produce steam for the boiling process. That means that in the long term König reduces both energy costs and CO₂ emissions in beer production. König also benefits from the long service life of the OPTIBAR DP 7060. The sturdy design of the measuring device ensures a reduction in the cost of maintenance and replacement parts.

5. Product used

OPTIBAR DP 7060 C

- Differential pressure transmitter for the measurement of flow, level, differential pressure, density and interface
- Very good repeatability and long-term stability of the measuring signal
- Extremely quick step response times <125 ms
- Measuring ranges up to 30 mbar / 0.44 psi even without electronic spreading
- Turn down up to 100:1, higher on request
- Universal modularity of the entire OPTIBAR process series
- Comprehensive diagnostics and configuration

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Vortex flow measurement of carrier air in a sterilisation facility

1. Background

NSM Packtec GmbH, based in Ahaus, Germany, designs, manufactures and installs high-performance packaging machinery for international companies in the dairy and beverage industry according to customer specifications. NSM’s portfolio includes pot molding, filling and closing machines (FFV). These facilities are designed according to an integrated aseptic concept and use hydrogen peroxide \((\text{H}_2\text{O}_2)\) for the inline sterilisation of all of the packaging materials.

2. Measurement requirements

NSM manufactured a packaging machine with just such a sterilisation system using the \(\text{H}_2\text{O}_2\) spray method for a milk processing operation in the USA. In this procedure, the materials to be sterilised are sprayed with a heated \(\text{H}_2\text{O}_2\) aerosol that is versatile and non-destructive. Heated, sterile carrier air is fed to an aerosol lantern in order to convey the \(\text{H}_2\text{O}_2\) aerosol generated there to a spray chamber. It is then sprayed on to a heat sealing film for sterilisation. The heat sealing film is then applied as a seal for the yogurt pots in the packaging machine. The carrier air must be supplied in a defined quantity to guarantee a consistent, even coating. The plant manufacturer was looking for a suitable flowmeter to accurately monitor the flow of the carrier air even at fluctuating pressures [6...8 bar / 87...116 psi] and temperature conditions [approx. 40 °C / 104 °F].

\[\text{Ste}r\text{ilisation system}\]
3. KROHNE solution

NSM decided on the OPTISWIRL 4200 C. The DN 25 vortex flowmeter was installed in the non-sterile area of the sterilisation facility. The device measures the standard volume flow of the carrier air for the aerosol lantern. The air is reduced or regulated to the plant operating pressure, cleaned using sterile filters, heated up and conveyed to the aerosol lantern.

Due to fluctuating process conditions, KROHNE recommended using the device with integrated pressure and temperature compensation. This puts the OPTISWIRL 4200 in a position to take into account fluctuating process conditions when calculating the standard volume while guaranteeing correspondingly high accuracy.

4. Customer benefits

The OPTISWIRL 4200 C guarantees continuous sterilisation of the heat sealing film used to seal the yogurt pots. As the vortex flowmeter measures pressure and temperature in addition to volume flow, there are no additional installation costs for separate pressure or temperature sensors. In addition, familiar measuring errors are eliminated as the OPTISWIRL 4200 measures all parameters at one single position.

Along with increased accuracy and process reliability, the end customer in the dairy industry also benefits from the possibility of quantity balancing for the measuring device. This makes it possible to flexibly adapt sterilisation and sealing in the face of changing requirements. This way, for example, the sealing of the yogurt pots can be adjusted according to changing film materials and dimensions.

5. Product used

OPTISWIRL 4200 C

- Vortex flowmeter for conductive and non-conductive liquids, gases and steam
- Integrated pressure and temperature compensation for auxiliary and supply circuits with changing process conditions
- Advanced technology for signal filtering
- Measuring range: DN15...300 / 1/2...12"
- Also available with integrated nominal diameter reduction
- Developed according to IEC 61508, Edition 2, for SIL2
- ATEX, IECEx, QPS, NEPSI etc.
- HART®, FOUNDATION™ fieldbus and PROFIBUS® PA

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Inline measurement of the COD value in dairy wastewater

- Checking the wastewater quality between production process and wastewater treatment plant intake
- Continuous measurement of chemically oxidizable substances in wastewater loads
- Cost and time-saving alternative to manual sampling processes and laboratory analyses

1. Background

With 850 million kilograms of milk processed annually, the Rücker dairy is one of Germany’s largest private dairies. At its locations in Aurich and Wismar the company produces around 20,000 tonnes of butter, 20,000 tonnes of milk powder and 60,000 tonnes of cheese annually.

Since organic wastewater loads are created during production, the dairy is connected to the intake of a municipal wastewater treatment plant following the production process. To keep disposal as environmentally friendly as possible, the wastewater must be pre-cleaned prior to its transfer to the municipality and the concentration of chemically oxidizable substances in the water must be checked.

2. Measurement requirements

In dairies and cheese dairies, the quality of the wastewater is determined by measuring the chemical oxygen demand (COD). At Rücker, the COD value has always been determined by manual sampling and measuring the COD in the laboratory several times every day. To make this labour-intensive process more efficient and to optimise wastewater loads, the dairy decided to test an alternative analysis technology at their Wismar location. The goal was to continuously monitor the COD value in the process tank shortly after the flotation and prior to draining into the wastewater treatment plant. In this application, the COD value is between 1000 and 3000 mg/l. Around 70 m³ / 2471 cft of wastewater are discharged from the process tank every hour.
3. KROHNE solution

Rücker decided to use the OPTIQUAD-WW 4050 W. The spectroscopic analysis system was installed directly in the wastewater flow at the end of the process tank.

The KROHNE measuring device uses up to four optical principles and up to twelve wavelengths. This makes it technologically superior to conventional COD methods which typically only use one optical principle and one wavelength. The optical measurement takes place through a measuring window. The OPTIQUAD-WW does not use a measuring gap to prevent wastewater blockages. The Operating Unit of the OPTIQUAD provides measurements in seconds.

4. Customer benefits

Now, with the help of the OPTIQUAD-WW, Rücker can check the COD value in much less time and with considerably less effort. Manual sampling and laboratory COD measurements are no longer necessary. The device even measures very high COD loads at least as accurately as the laboratory tests. No longer having moving parts means that measuring performance is also stable. When installing the Analyzer Unit, the customer did not have to create a bypass line, which could have been negatively affected by blockages. Another advantage for the dairy is the reduced need for maintenance for the KROHNE device. No daily cleaning is necessary as an integrated compressed air purge keeps the OPTIQUAD-WW measuring window free of deposits.

5. Product used

OPTIQUAD-WW 4050 W

- Spectroscopic analysis system for the continuous measurement of organic wastewater loads
- Can measure extremely large COD loads
- Reduced costs for laboratory COD measurement
- Reduced maintenance costs
- Compressed air rinses the measuring window to eliminate the need for daily cleaning
- Impressive price/performance ratio

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Mass flow measurement of spinach sauce

1. Background

Iglo GmbH is Germany’s and Europe’s leading brand of frozen food, specialising in fish, vegetables and poultry. The company is known for its sustainable production methods and use of local produce. In its factory in Reken, Germany, Iglo produces frozen food using vegetables and herbs harvested by farmers in the direct vicinity of the facility. The most well-known product produced here is the spinach with the “blub”. For this creamed spinach, the freshly harvested spinach is blanched, chopped and seasoned with a herb sauce mixture. Once the spinach is ready to serve it is frozen.

2. Measurement requirements

Adding the seasoned sauce mixture requires a high degree of accuracy and stability to keep a consistent ratio of sauce to chopped spinach. Many quality factors (including flavour, consistency and look) as well as production costs depend on this.

The spinach sauce is a challenging product which, as expected, is difficult to measure accurately. It is a non-Newtonian, non-conductive, viscous liquid with a viscosity of >10,000 mPas and sporadically occurring entrained gas. The customer had already been using mass flowmeters from different market competitors to measure the mass flow of the sauce even when the density fluctuated. Iglo’s goal is to lower application-linked measurement errors in practice to well below ±2%.
3. KROHNE solution

Iglo made the decision to test another Coriolis mass flowmeter, the OPTIMASS 7400 C. The high-performance device boasts a single straight tube design and EGM™ [Entrained Gas Management] functionality and is designed for demanding applications where gas bubbles may be an issue.

The test setup consisted of:
- 1 OPTIMASS 7400 with Titanium (DN 25) measuring tube,
- 1 test plate,
- 1 four-stage mono pump,
- 1 pressure-sustaining valve and
- 1 calibrated scale with a resolution of 100 gr (ca. 3.4 US fl.oz.).

Once heated, the sauce was first pumped in a circuit to obtain a good mix and even consistency. Due to the low flow, KROHNE then calibrated the zero point of the OPTIMASS 7400 C in three test runs. This optimised efficiency so that the measuring device achieved an error of measurement of just ±0.6% under operating conditions.

4. Customer benefits

The OPTIMASS 7400 C makes it possible to dose the spinach sauce much more accurately. Measuring accuracy is significantly higher, ensuring more constant product quality and lower production costs. In addition, pump output can be permanently reduced as there is much less pressure loss with the OPTIMASS 7400 C’s large single straight tube. This further reduces costs. Compared to the measuring devices previously used, the KROHNE device featuring the EGM™ function enables better signal processing and guarantees considerably higher measurement stability in the case of entrained gas in the product.

Iglo was won over by the improvements and savings made possible. When it comes to the upcoming system expansion, the company is relying on the OPTIMASS 7400 C. The KROHNE mass flowmeter is designed both for sauce measurement and the subsequent measurement of the spinach/sauce mixture.

5. Product used

OPTIMASS 7400 C

- Coriolis mass flowmeter with straight measuring tube
- For challenging applications with liquids and gases
- Measurement of mass, density, volume and concentration
- Entrained Gas Management [EGM™]: Continuous measurement even at gas concentrations from 0...100% and sudden changes in gas content
- DN 10...100 / ½...4”, all hygienic standard connections available
- EHEDG, 3A; FDA, EC 1935/2004
- On-site testing of converter electronics and sensor with OPTICHECK
- HART®, FOUNDATION™ fieldbus, PROFIBUS® PA and DP, Modbus

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- Flow
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