






APPLICATIONS COMPENDIUM

For the Water and Wastewater Industry

KROHNE

PREFACE

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

CONTENTS

Water

- Water abstraction 4
- Water treatment 16
- Water supply 32

Wastewater

- Public sewage network 50
- Mechanical pretreatment 64
- Biological treatment 74
- Effluent 82
- Sludge treatment 90

CONTENTS

Water abstraction

- Flow measurement in the abstraction of drinking water from dunes 6
- Maintenance and regeneration of water wells 8
- Measurement solution for monitoring water abstraction wells 10
- Remote monitoring of groundwater abstraction points in city of Jakarta 12

APPLICATION REPORT

Water & Wastewater

Flow measurement in the abstraction of drinking water from dunes

- Environmentally friendly alternative for the abstraction of water without chemicals
- Burial installation with short-term flooding, maintenance-free measurement
- Reliable and accurate drinking water flow measurement for monitoring purposes

dunea DUIN & WATER

1. Background

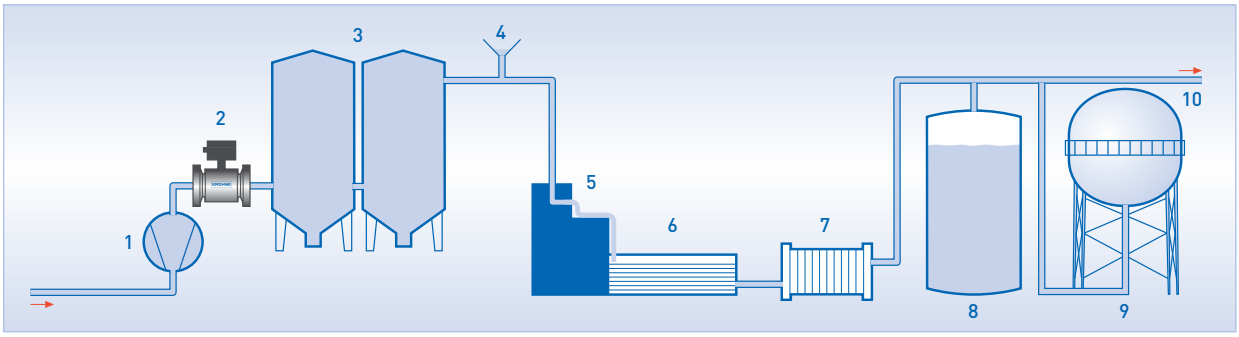
Water utility company dunea supplies approx. 1.2 million Dutch residents with high quality drinking water. Dune passage is a natural treatment method that forms an environmentally friendly alternative to the purification of water with chemicals. The method for preparing drinking water is unique and not used anywhere else in the world. The water reservoir in the dunes is sufficient for months but must be constantly monitored to comply with environmental criteria.

2. Measurement requirements

The process of extracting water from the dunes must be constantly documented so that counter-measures may be implemented in a timely manner to prevent any environmental damage. For one pipeline (DN 900), dunea required a reliable and accurate volume flow measurement with an electro-magnetic flowmeter. dunea was looking for a device that could be installed in the ground and could also be used during short-term flooding. The measurement solution also had to be maintenance-free because digging the device out of the ground would involve considerable cost.

KROHNE

Process of natural purification of drinking water



1 Water pumped from dunes, 2 Flowmeter, 3 Water softening, 4 Carbon dosage, 5 Cascades,
6 Filters, 7 Slow filters, 8 Clean water basements, 9 Water tower, 10 Supply line to consumers

3. KROHNE solution

KROHNE supplied the OPTIFLUX 2300 F electromagnetic flowmeter for this application. F stands for remote version, i.e. sensors and converters are connected to one another via signal and field current lines. The stainless steel housing for the sensor is in protection category IP68. The fully welded construction is 100% water tight and leak free. Special burial ('bitu') tape is not needed. The connecting lines were firmly connected to the stainless steel connection box in the factory in the length specified by the customer and potted and sealed in accordance with the protection category. There were no plastic parts used, which can age and wear permanently, if installed underground. The flow sensor was provided with a ground coating especially developed for buried installations.

Burial installation of flow sensor

4. Customer benefits

dunea decided on KROHNE's solution because the maintenance and wear-free design of the OPTIFLUX 2300 F minimises the risk of having to dig out the sensor for repairs, for example. On top of that, the easy installation of the device, already tried and tested in many burial applications, was a huge plus. The measuring device boasts many different maintenance and diagnostic functions, informing dunea staff early on about potential problems in drinking water production.

5. Product used

OPTIFLUX 2300 F

- Electromagnetic flowmeter for advanced water and wastewater applications
- All relevant approvals for potable water
- Liner: PP, PO or hard rubber
- Cost-saving option without grounding rings, variant for burial installation and constant flooding (IP68) etc.
- Flange: DN25...3000 / 1...120", max. PN40 / ASME Cl 300

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Maintenance and regeneration of water wells

- Accurate flow measurement for water well testing and inspection
- Battery powered measurement solution for remote locations
- Water meter with high turndown ratio for varying flow rates

1. Background

Q-FLOW International, founded in 2002, is an independent well regeneration and maintenance company. It builds new wells, performs camera inspections and maintains existing water wells and water treatment installations. The maintenance of wells involves for example the exchange of pumps and pipes, the cleaning of filters and the regeneration of complete wells. Q-FLOW has several teams on the road. Each team is equipped with a crane of 18 m / 59 ft height as well as a maintenance skid for the treatment of wells up to 300 m / 985 ft deep.

2. Measurement requirements

At many locations where Q-FLOW operates, like meadows and forests, mains power is often not available. Any savings on the use of power and aggregates is preferred. Q-FLOW requires accurate flow measurements for well maintenance activities and for building new wells. To check the result of a well treatment, the calibrated volume of water abstracted from a well is an important measure for how much the water level is reduced. Local regulations are in place to ensure that the water balance is maintained at its target level. As a result, the amount of water to be abstracted is often limited. In addition, Dutch regulations on water discharge demand that in case of well maintenance, such as cleaning under high pressure and chemical regeneration, the volume of water that is pumped and discharged during the treatment is to be measured accurately.

Maintenance skid with crane



Maintenance skid with WATERFLUX 3070 for well maintenance

3. KROHNE solution

Q-FLOW decided to equip its maintenance skids with the WATERFLUX 3070 water meter. The battery powered electromagnetic flowmeter is designed for water abstraction applications. Its measuring tube with a rectangular and reduced cross-section enables a stable measurement even at low flow rates. Due to its optimized flow profile, the WATERFLUX 3070 can be installed in the confined space of a maintenance skid without straight inlet or outlet runs. At locations, where the piping cannot be removed or where there is no space to install a flowmeter, KROHNE's clamp-on ultrasonic flowmeter OPTISONIC 6300 P is used.

4. Customer benefits

The customer benefits from a water meter that can be used without mains power supply. This makes it the perfect choice for maintenance skids that are used at many different locations. Unlike mechanical water meters, the WATERFLUX 3070 is maintenance-free and offers a much larger turn down ratio (1000:1). This turned out to be a great advantage to the customer as the measured flow rates of a well under test can vary from high to very low. It is another benefit that large pressure drops during testing are also no longer an issue with the WATERFLUX 3070.

5. Products used

WATERFLUX 3070

- Electromagnetic flowmeter for all potable water applications
- Battery- or mains powered, with battery backup option (incl. Modbus)
- Bi-directional flow measurement over a wide dynamic range
- Unique rectangular sensor design for good low flow performance
- Up to DN600 / 24", no inlet/outlet runs needed

OPTISONIC 6300 P

- Ultrasonic clamp-on flowmeter for temporary flow measurement of liquids
- Portable, battery-powered meter for use at any location
- For pipes DN15...1500 / ½...60"

Contact
Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Measurement solution for monitoring water abstraction wells

- Energy self-sufficient flow and pressure measurement for long-term well monitoring
- Combined solution for efficient groundwater management

1. Background

The water utility company Leipziger Wasserwerke operates four large water plants in Germany that supply about 75 percent of the drinking water for the city of Leipzig and its surrounding area. Two of these water plants mainly abstract raw water from the bank filtrate of an adjacent river.

2. Measurement requirements

Depending on their location and integration into the hydrogeological environment, the wells are subject to an ageing process (e.g. iron ochre sedimentation). In order to anticipate this ageing process, the development of specific well yield in operation is monitored over time. Monitoring is an important control tool when planning ahead for well rehabilitation.

Given the technical conditions in the water catchment galleries, only a solution that could reliably measure without a direct power supply and could be used in confined spaces was worth considering.

KROHNE

3. KROHNE solution

KROHNE recommended the use of a combined solution made up of the WATERFLUX 3070 C water meter, the OPTIBAR LC 1010 C submersible level probe, the OPTIBAR P 1010 C pressure transmitter and the GSM/GPRS data logger KGA 42.
The battery-powered WATERFLUX 3070 water meter is perfectly designed to measure in confined well shafts without inlet and outlet run. As the wells may be flooded, the IP68 rated version of the water meter has been supplied. It continuously measures the flow volume and transmits the data via its pulse output, either once every hour or once every minute. Configuration is flexible. When limit values (MIN/MAX) are exceeded, the water meter emits an alarm which, with the help of the data logger KGA 42, is transmitted to the operator's mobile device and into the control system.
In addition, the OPTIBAR P 1010 pressure transmitter measures the negative pressure for the water delivery. The OPTIBAR LC 1010 submersible level probe uses a gauge pipe to monitor the groundwater level. This data is also transmitted to the KGA 42. The GPRS module features two analogue inputs which are used to supply the 2-wire pressure sensors and guarantee transmission.

Top left: Data transmission with KGA 42;
Top right: OPTIBAR P 1010 C and WATERFLUX 3070

4. Customer benefits

The customer is able to efficiently monitor the wells on an ongoing basis with the help of this solution combining water meters and pressure sensors. They are now able to better predict the effects of ageing than in the past, making it easier to plan for well rehabilitation in a timely manner.
The KROHNE solution satisfies the increasing customer demand for big data. Water withdrawal is more reliably secured and the entire system can be operated as cost efficiently as possible. As a full-service provider for the water and wastewater industry, KROHNE was able to supply the entire solution.

5. Products used

WATERFLUX 3070 C
- Battery-powered electromagnetic water meter for drinking water applications
- Installation without inlet and outlet runs

OPTIBAR P 1010
- Ultra-compact pressure transmitter for absolute and relative pressure measurements

OPTIBAR LC 1010
- Submersible level probe with ceramic measuring cell

KGA 42
- Data logger and GSM antenna for remote transmission of readings
- For installation sites with no power supply (Inputs: 4 digital, 2 analogue)

Contact
Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Remote monitoring of groundwater abstraction points in city of Jakarta

- Test and evaluation of a one-stop-solution for water metering, wireless transmission and remote monitoring of readings
- Retrofitting of mechanical water meters to charge customers for abstracted water from wells
- Comparison of operability and data security of two remote monitoring systems

1. Background

It is quite common in emerging countries that major water consumers like residential parks, hospitals, hotels, industrial companies, golf clubs or shopping malls abstract their raw water directly from deep water wells. The lack of financial funds forces the governments to build wells instead of constructing new or maintaining the existing pipelines. This way, the risk of illegal tapping is also minimised. The water wells are up to 300m deep and often located directly on the consumer's property. The groundwater is either used for utility purposes or it is treated and used as drinking water. In Jakarta, Indonesia, the water wells are operated by Jakarta city government.

2. Measurement requirements

To charge the customers for the amount of abstracted water, dedicated water meters are needed. Up to now mechanical meters are used. As the abstracted water often contains a high percentage of minerals and solids, these meters are subject to serious wearing and clogging, leading to high maintenance expenses and a limited lifespan.

For retrofitting of the operated abstraction points, Jakarta city government started a project to test and evaluate possible solutions. Next to robust, non-wearing and low maintenance metering instruments, a remote data transmission of meter readings and alarms was asked for. In addition, the whole solution should be self-sufficient regarding power supply to keep on-site installation costs as low as possible. The water meters must fit into the existing pipeworks, no additional piping should be carried out. Although each measuring point is different with regards to flow conditions, pump capacities and installation restrictions (e. g. a 90° bow before/after the meter), the initial start-up, configuration and operating of the meters need to be easy and user-friendly.

KROHNE

As part of the project, a PC- or Web-based solution for remote monitoring of the readings was also asked for. Emphasis was put on the security of remote transmission as well as a clear and user-friendly analysis and visualisation of values at customers' control room.

3. KROHNE solution

KROHNE was the only supplier to match the given requirements and was choosen for the first field test in 2010. KROHNE delivered a one-stop-solution of stand-alone water meters with wireless data transmission together with remote monitoring system. Field and office personnel were trained on-site by two KROHNE engineers.

WATERFLUX 3070 C and KGA 42 installed at different sites

For the local measurements, five WATERFLUX 3070 C battery powered electromagnetic water meters (DN50 to DN80) were installed on five randomly selected abstraction wells together with KGA 42 GSM antennas (also battery-powered). All devices are sealed tamper-proof.

WATERFLUX water meters are not sensitive to flow conditions or installation restrictions on site. This is due to their design: the rectangular cross section of the measuring tube allows for an accurate measurement of high and low flows. As it optimises the flow profile, there is no need for straight inlets and outlets or flow straighteners. The pressure loss resulting from necking is negligible, especially when compared to mechanical meters. Being electromagnetic meters, there are no moving parts or obstructions in the measuring tube that are subject to wearing or maintenance. All five WATERFLUX meters were equipped with two integrated batteries, providing for up to 15 years of operation (depending on ambient temperatures and frequency of measuring).

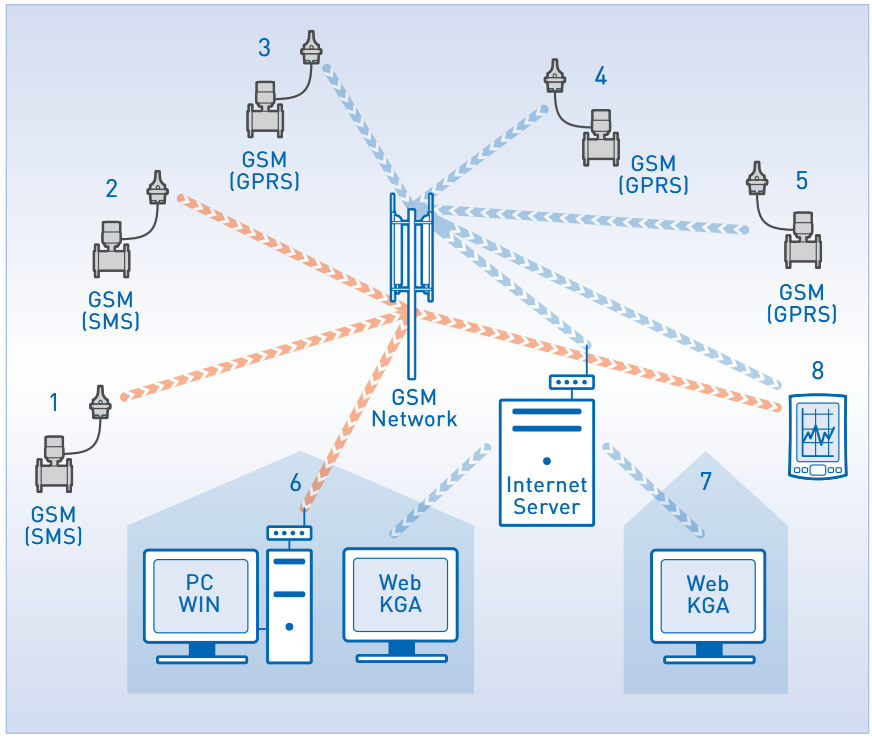
For remote transmission of the readings, each water meter was connected to a KGA 42 GSM antenna. For access to local GSM network, a SIM-card for every device was provided by the customer. Next to transmitting the readings, the KGA 42 can also store them for several weeks in case the network is down. The device also has programmable alarm functions: when pre-set thresholds are reached, the KGA 42 will send an alarm message to a given phone number, e. g. mobile phone of a service engineer.

For remote monitoring of readings, KROHNE offered two different solutions: PC Win and WebKGA. On customer's request, both were installed and configured for testing. PC Win is a "Mini-SCADA" system that is installed on a local computer together with a GSM modem, requiring another SIM card for GSM network access. A personal computer (PC) workstation equipped with PC Win can monitor up to 250 metering points/antennas. Although they were planning far more than 250 metering points (which would require additional workstations), Jakarta government wanted to test the PC Win system.

WebKGA is a server-based remote monitoring solution. It is set up by KROHNE on a remote secure server infrastructure with direct connection to GSM network. WebKGA can be accessed via any standard internet browser. Requiring only a valid login/password, operation is very user-friendly and can be compared to an online e-mail account. No additional hardware or specific knowledge is needed. The WebKGA server can connect to an unlimited number of metering points/antennas.

For a direct comparison of the two systems at a government control room, two of the five abstraction points were set up to be monitored with PC Win, the others were monitored with WebKGA. PC Win was installed on one computer, another PC with internet connection was used to connect with WebKGA server. For testing web server access from different locations, a third PC at a second office was used.

Schematic diagram of the test installation:



Measuring points:
1 Hotel, South Jakarta
2 Residential Park, North Jakarta
3 Hospital, North Jakarta
4 Factory, East Jakarta
5 Golf Course, East Jakarta

Remote monitoring points:
6 Government control room with PC Win workstation and WebKGA access
7 Government office with WebKGA access
8 Mobile phone of service engineer

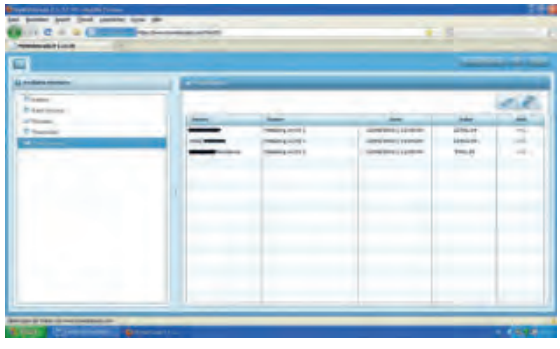
4. Customer benefits

The measurement requirements were fully met. At all metering points, the installation of the water meters together with the GSM antennas did not present any problems. On-site tests included response of the meters to variations in flow rates as well as the alarm functions.

At control room, personnel were able to operate both remote monitoring systems after a short training. Next to the meter readings, also trend analysis, total consumption, average flow rate, night time flow rates or customised time periods, etc. can be displayed. Both solutions can also provide additional information about the status of each metering point, e. g. power status and need for battery change is indicated for water meter and antenna.

On-site training at the office

Remote monitoring of meter readings at the PC Win-workstation



Access to WebKGA server via internet browser

Flow rates and trend analysis of each meter is visible online

Next to operability of the systems, officials were focusing on installation effort and data security:
- Installation: For setup of PC Win, the GSM modem needed to be installed and connected before installing the software. As internet connection and a standard internet browser were available, there was no installation effort for WebKGA (Server was pre-setup by KROHNE).

- Data communication security: with PC Win, the GSM antennas are set to send the readings via Short Message Service (SMS). For WebKGA, they are set to send the readings via General Packet Radio Service (GPRS). A GPRS connection requires that the receiver responds to the sender before the data is send: the local device will only send data when the receiving device confirms standby.

- Data storage security: with PC Win, any received data is stored locally on the dedicated workstation. In case of a PC-crash, a computer virus any physical damage to the hard drive, the stored data will be lost. With WebKGA, the received data is stored on a secure web server infrastructure with disk mirroring, eliminating the risk of loss.

During the test phase customer expressed his satisfaction with the solution. Next to the products, the quality of technical services, training and support provided by KROHNE was very appreciated. As some of the measuring points can be temporarily flooded due to monsoon, the project will include a compact IP68 protection class version of the WATERFLUX.

5. Products used

WATERFLUX 3070 C

- Battery-operated stand-alone water meter
- Suitable for custody transfer according to OIML R-49 and MI-001
- No wear, no deposits
- Precise measurement without (straight) inlet/outlet lengths
- Bi-directional measurement from 0...12 m/s / 0...40 ft/s
- Compact IP68 version available
- Sizes DN 25...600 / 1"...24", Rilsan polymer coating

KGA 42

- Data logger and GSM antenna for remote transmission of readings
- 4 digital and 2 analogue inputs
- Strong GSM signal specially designed for manholes
- For installation sites with no power supply
- Standard protection category IP68

WebKGA

- Server-based remote monitoring system for large networks
- Access via any PC with internet browser
- High data security through mirrored disks
- Unlimited number of measuring points can be monitored

PC Win

- PC based remote monitoring software with local GSM modem
- Easy installation and setup
- Up to 250 measuring points can be monitored with one workstation

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Water treatment

- Measuring the sludge blanket in a groundwater treatment plant 18
- Measuring sedimentation in raw water treatment 20
- Turbidity measurement for monitoring the quality of potable water in waterworks 22
- Standard volume flow measurement to increase the efficiency of the compressed air system in a water treatment plant 24
- Measuring the chlorine content in the emergency chlorination of waterworks 26
- Measurement of free chlorine in a drinking water system 30

APPLICATION REPORT

Water & Wastewater

Measuring the sludge blanket in a groundwater treatment plant

- Cleaning groundwater using flocculating agent
- Direct, optical monitoring of sludge blanket level in 16 sedimentation tanks
- Energy cost savings thanks to automated control of sludge removal

WATER CORPORATION

1. Background

As the main water supplier of Western Australia, the Water Corporation in Perth operates many groundwater treatment plants. Once such treatment plant is Gwelup WTP which draws its raw water from Gwelup Well field, part of Perth's coastal groundwater system.

The raw water is generally of good quality with the exception of iron and turbidity. This water is clarified, filtered, dosed with polyelectrolyte and hydrochloric acid, chlorinated and fluoridated prior to being released into the distribution network.

2. Measurement requirements

During clarification, the final step of the coagulation/flocculation process, the water is stored in clarifier basins for a period sufficient to allow the floc and other suspended material to settle on the bottom and the clarified water to outflow over weirs and continue onto filtration.

If the sludge interface rises too high it can carry over the weirs and contaminate the filtration process. If there is insufficient sludge in the tank the settlement process cannot operate correctly and the solids will tend to remain in suspension.

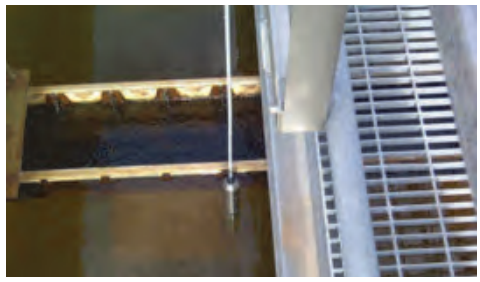
The sludge level was originally being monitored using ultrasonic type sensors which were unable to clearly define the interface levels. Echo return from the walls and separating zones or signal damping as a result of flocculation and floating sludge was also noted as an issue.

KROHNE

3. KROHNE solution

16 OPTISYS SLM 2100 sludge level monitors were installed on the hand rail of the bridges between the sedimentation tanks. The sludge level monitor makes it possible to directly measure the concentration of the suspended solids content. In the process the system also measures substances that trigger turbidity at very low suspended solids content and can thus visually distort the actual concentration. For this reason the OPTISYS SLM 2100 features an optical sensor that moves up and down in the sedimentation tank. Based on the light absorption method, the system can accurately measure the suspended solids content in the sedimentation tank regardless of the colour of the sludge. Measurements are transferred to the control room in the treatment plant via 4...20 mA signal. If the sludge blanket reaches a defined level, pumps are activated to completely free the bottom of the tank from sludge.

The sensor only travels up to the water surface and then assumes the new start position from there. This way the sludge particles separate from the sensor in the upper clarified water zone, thereby cleaning it. The formation of a salt crust is the result of the sensor being in regular contact with air and can be effectively prevented in this way.



Sensor of OPTISYS SLM 2100

Sludge level monitor installed on sedimentation tank

4. Customer benefits

The OPTISYS SLM 2100 sludge level meter permanently monitors the level sludge allowing the operator to optimise their control of sludge removal. The pumps, one of the greatest cost factors for the operator, are now only activated when they are really needed, constantly saving the customer on energy costs. Manual monitoring of sludge level is eliminated for the customer.

The KROHNE solution is significantly more reliable and accurate than the previously carried out manual and ultrasonic measurements. Compared to ultrasonic technology, the analytical measurement technology of the OPTISYS SLM 2100 is considerably less susceptible to faulty measurements. The typical weaknesses of ultrasonic technology is not an issue with the OPTISYS SLM 2100.

5. Product used

OPTISYS SLM 2100

- Optical measuring system for the measurement of sedimentation profiles, sludge blankets and fluff level
- Continuous level measurement of sludge blanket (zone tracking)
- Operating and service concept (GDC) in common with other KROHNE devices
- Built-in heater

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Measuring sedimentation in raw water treatment

- Monitoring of flocculation and sedimentation process in the flocculation tank of a water works
- Dynamic tracking of sludge blanket and monitoring of floc loss
- Improved safety in the treatment of drinking water

1. Background

A public utility company operates a water treatment plant in north west Germany. The raw water, which is extracted from well fields, is treated at the water works using the sedimentation flocculation process with upstream ventilation followed by filtration to produce drinking water. The water treatment plant can treat 650 m³ / 171,711 US gal per hour. At full capacity, the plant can treat 15,600 m³ / 4,121,083 US gal of water per day. The raw water treatment plant has over six flocculation tanks, in which iron and manganese flocs form when chemicals are added. Most of the substances to be removed are agglutinated in these solid particles. The flocs settle at the bottom during the treatment process. The sludge is extracted from the tank at specified intervals via six hoses in the flocculation tank.

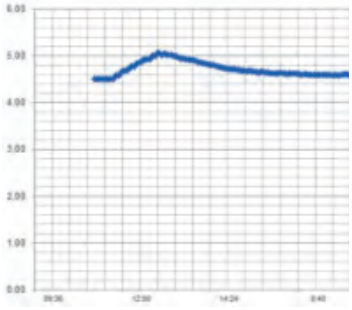
2. Measurement requirements

The utility company currently just uses turbidity sensors to monitor the sedimentation of precipitate. The sensors only control the maximum and minimum sludge levels using preset limit values. The problem with this static measurement, however, is that if the composition of the precipitation zone changes or fluff ends up in the filters, this is identified too late. If unsettled floc gets into the filtration plants, this reduces the processing capacity, and could even bring the plant to a standstill. The risk of floc loss into the filtration plants is much higher when more water is abstracted in the summer months, as the sludge blanket no longer moves between the two turbidity sensors, but is rather sometimes just a few centimetres below the water table. In order to improve monitoring of the current operating method and significantly minimise the safety risks associated with rising sludge blanket and floc loss, the utility company decided to try a sludge level measuring system. Initially this was to continuously measure the sludge level in one of the flocculation tanks while taking into account the
raw water feed and the sludge extraction.

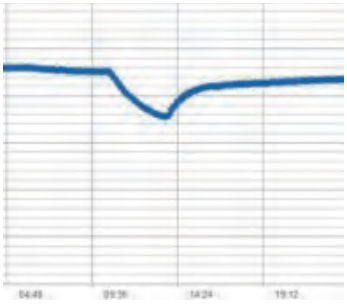
KROHNE

3. KROHNE solution

The company chose the OPTISYS SLM 2100 optical sludge level measuring system for the trial. The optical sensor of the KROHNE system can measure the concentration of the solids content in all layers of the flocculation tank. This enables dynamic monitoring of the sludge level with the flocculation tank under varying loads, the addition of chemicals and sludge extraction.



Sludge level progression (height/time) when flow rate decreases from 44 to 20 m³/h (11,624 to 5283 US gal/h)

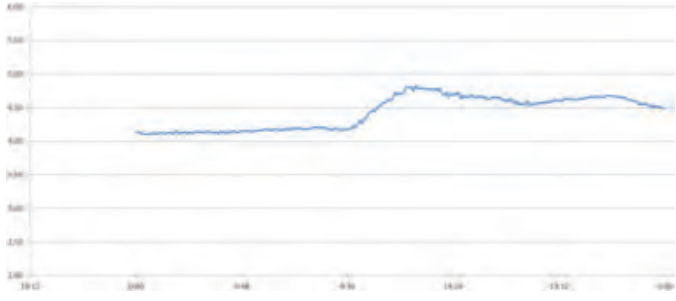


Sludge level progression (height/time) when flow rate increases from 44 to 68 m³/h (11,624 to 17,964 US gal/h)

The system can pinpoint the transition from the clear phase to the sludge phase. The zone tracking function continuously monitors the defined concentration (suspended solids content) of 1g/l - thus a specific "zone" - so as to control the sludge extraction intervals. In particular, the OPTISYS SLM 2100 can always determine the sludge blanket, even at different flow rates, as the measurements in the flocculation tank show (see diagrams).

4. Customer benefits

The OPTISYS SLM 2100 allows the utility company to continuously monitor the sludge level and control the extraction of sludge accordingly. Both failure to add important chemicals (see diagram right) and a costly overdose can be identified early on thanks to the dynamic measurement. The sludge level measuring system also significantly improves safety. Any floc loss into the downstream process stage can be identified early on, thus effectively preventing clogging of the filters. The customer can respond to changes in the sludge composition sooner, especially at times of heavy utilisation and the respective associated flow rate. This means that a reduction in processing capacity due to clogged filters can be averted beforehand, thereby improving the security of supply with the sludge level measuring system. The customer is very satisfied with the KROHNE system.



Change in sludge level of flocculation tank when polymer is omitted (simulation)

5. Product used

OPTISYS SLM 2100

- Optical measuring system for the measurement of sedimentation profiles, sludge blankets and fluff level
- Continuous tracking of sludge blanket (zone tracking)
- Direct measurement by an optical sensor
- Measuring range: 0...10 m / 32.8 ft; 0...30 g/l
- Built-in heater, 2 x rake guard switch
- 2 x 4...20 mA current outputs / 2x relays (limit value or status)

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses..

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Turbidity measurement for monitoring the quality of potable water in waterworks

- Continuous turbidity measurement in accordance with ISO 7027
- Easy to calibrate thanks to cuvette technology
- Minimal maintenance thanks to ultrasonic cleaning

1. Background

In accordance with the German Drinking Water Ordinance (2001), the 1 NTU turbidity limit at the outlet of the waterworks must be adhered to and any sudden or continuous increase must be immediately reported to the responsible authority. To guarantee this, online measurement technology which continuously measures turbidity and then transfers the values to a control system is used in most cases nowadays. The compulsory measuring technique in Europe, as per ISO 7027, is the 90° scattered light method using an NIR light source with a wavelength of 860 nm (+/-30nm).

Because mineral deposits and other contaminants can negatively affect the optical measuring system, the accuracy of the system must be regularly checked and corrected if necessary. Calibration is performed to so-called liquid secondary standards which are traceable to formazin. These calibration liquids are extremely expensive. With conventional systems, the liquids must be filled directly into the device and then disposed following calibration. Multiple use is not possible due to the possibility of cross-contamination. In addition, the contaminated optics must be regularly cleaned. Accordingly, the calibration and maintenance of the turbidity systems is extremely time-consuming and expensive. A reduction in the amount of maintenance as well as the possibility of multiple usage of the calibration standard is thus desirable.

KROHNE

2. Measurement requirements

In addition to measuring the turbidity at the outlet of the waterworks in order to monitor limits, additional turbidity measurement points are often located at the inlet and outlet of the sand filter to monitor the filter and initiate back-flush processes. It is important to ensure that these measuring points operate automatically and as continuously as possible with minimal maintenance.

3. KROHNE solution

The OPTISYS TUR 1050 turbidity measurement system is used to monitor turbidity values before and after the sand filter and during the process. The measurement is to be done as a bypass measurement with an open outlet. The system features automatic ultrasonic cleaning of the measuring cuvettes and is calibrated using reusable calibration cuvettes which contain a traceable secondary standard.

4. Customer benefits

Unlike comparable turbidity measuring systems, the measuring liquid in the OPTISYS TUR 1050 flows through a glass cuvette. The measurement is done through this cuvette and the optical measuring system does not come in contact with the sample. This almost completely eliminates any contamination of the sensitive optics. The measuring cuvette itself is independently cleaned via the built-in ultrasonic cleaning feature in the OPTISYS TUR 1050. Maintenance is thus minimal at approx. 4 services per year, each lasting 5 minutes (including calibration).

Short maintenance times can also be attributed to the innovative calibration of the device. To calibrate, the measuring cuvette is simply replaced by a calibration cuvette containing the liquid secondary standard and the calibration routine is started at the touch of a button. The included calibration kit contains three liquid standards (0.02 FNU, 10 FNU, 100 FNU) to calibrate the entire measuring range. Filled once, these cuvettes can be used to calibrate several systems (without the risk of cross-contamination). Calibrating the OPTISYS TUR 1050 is thus not only faster and easier, it is also significantly cheaper than for conventional systems.

5. Product used

OPTISYS TUR 1050 turbidity measuring system

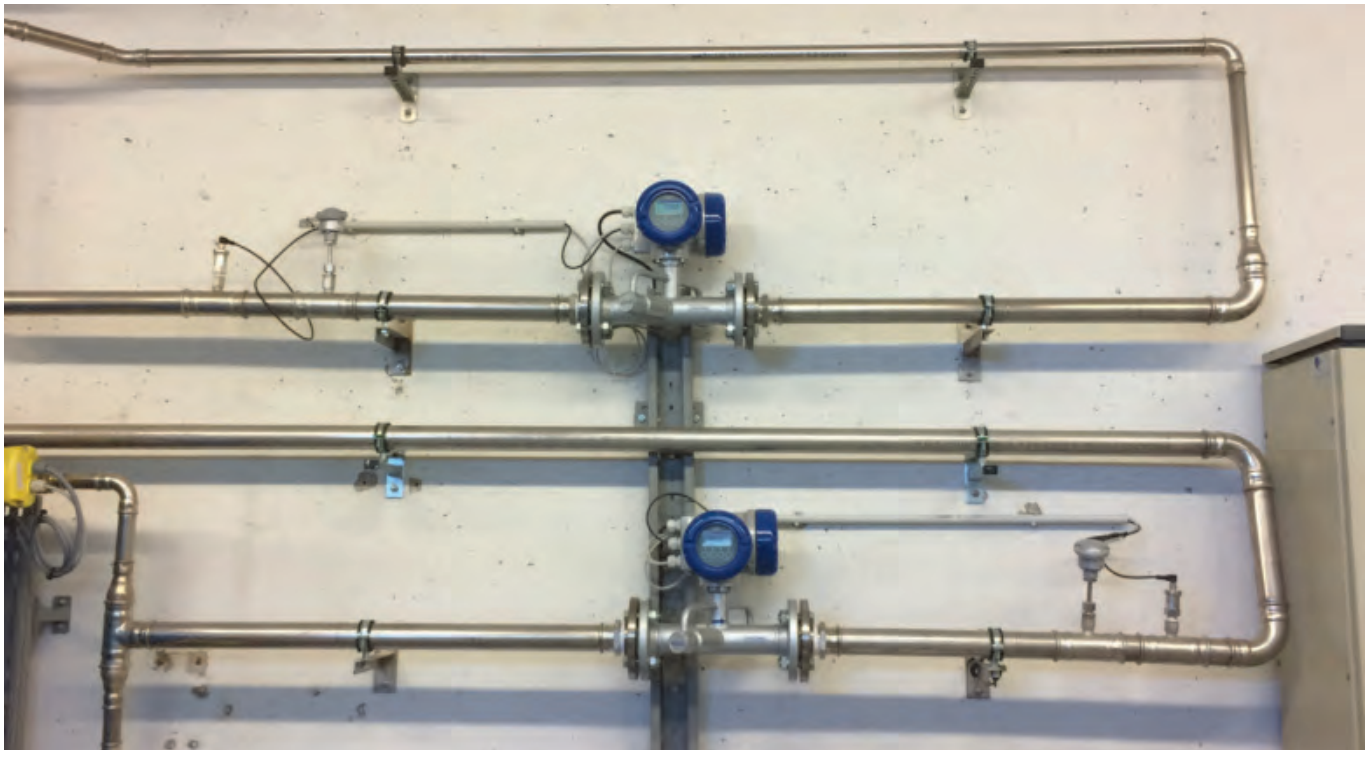
- Turbidity measurement using a 90° scattered light technique (ISO 7027 / EPA 180.1)
- Measuring range 0...100 NTU/FNU
- Compact device with 1x 4..20 mA current output, RS485 interface and 2 alarm relays
- Cuvette technology makes it easy to calibrate and isolates the optical measuring system from the sample flow
- Integrated ultrasonic cleaning

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com



APPLICATION REPORT

Water & Wastewater

Standard volume flow measurement to increase the efficiency of the compressed air system in a water treatment plant

- Creating consumption profiles to save energy
- Pressure and temperature-compensated flow measurement of compressed air
- Accurate determination of compressed air flow rates over a broad meauring range

Société Eau de Marseille Métropole

1. Background

Groupe des Eaux de Marseille is one of the leading group of companies in the Provence and Mediterranean regions in southeast France. Comprised of 18 companies, the Group specialises in water supply in addition to its services in the fields of environmental protection, engineering and energy management.

Eau de Marseille Métropole is responsible for managing the drinking water distribution networks in the municipal association of Métropole d'Aix-Marseille-Provence. As part of an energy and environmental strategy, the company has been carrying out an energy assessment of its facilities over the past few years. The company had its energy management system certified according to ISO 50001 at the beginning of 2016.

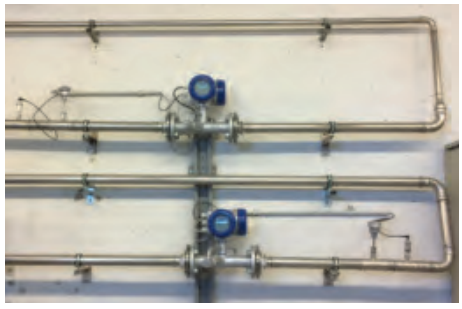
2. Measurement requirements

Management at the drinking water treatment plant in Saint-Barnabé in Marseille wanted to determine the compressed air flow produced by the compressors. The goal was to create consumption balances and calculate the efficiency of the compressors. This, in turn, was to optimise energy costs and consequently the entire process.

At the time no measuring point existed for this. The operator required a measurement of pressure (6...7 bar / 87...101.5 psi), temperature (approx. +25°C / +77°F) and flow to determine the standard volume (between 100...585 Nm^3/h / 62.3...364.5 SCFM). They wanted as accurate a measurement as possible – starting from a flow of zero and over the entire measuring range. At the same time the customer wanted to comply with ISO 50001.

KROHNE

3. KROHNE solution



Ultrasonic flowmeters with pressure transmitters and temperature assemblies

A solution made up of a combination of the OPTISONIC 7300 C ultrasonic flowmeter (in DN50, with flange connection), the OPTIBAR P 1010 C pressure transmitter and the OPTITEMP TRA-P10 temperature assembly including OPTITEMP TT 22 C head-mount transmitter was used a total of four times. One of the devices is located at the output of the main compressors, two others are installed in the supply line of two ozone plants. One more device is located behind that to measure the compressed air consumption. A horizontal stainless steel pipe with the recommended inlet and outlet runs was installed (inlet: ≥20DN, outlet: ≥10DN). The ultrasonic flowmeter enables accurate flow measurement starting at the minimum flow. It also feeds the pressure and temperature transmitters. The OPTISONIC 7300 calculates the standard volume flow (Nm³/h) with the help of pressure and temperature measurements.

4. Customer benefits

Compressed air measurement

Compressed air consumption balances were created in real time according to the ranges. The standard volume flow measurements are accurate, repeatable and can be compared over time. Ultrasonic flow measurement now makes losses in the compressed air supply visible. Using the consumption analysis, the customer was able to improve energy efficiency: the operating pressure was lowered from 6 or 7 bar / 87 or 101.5 psi to 5.5 bar / 79.7 psi. The power consumption of the compressors was thus reduced by 15%.

Thanks to the installation, Eau de Marseille Métropole was also able to optimise the process of air production. This allowed the customer to achieve a further 20% in energy savings. The measuring instrumentation paid off quickly. The customer complied with the ISO 50001 standard.

5. Products used

OPTISONIC 7300 C

- Ultrasonic flowmeter for natural gas, process gas and utility gas applications
- Large dynamic range

OPTIBAR P 1010 C

- Pressure transmitter for basic pressure and level applications
- High accuracy (±0.25%)

OPTITEMP TRA-P10

- Temperature assembly for standard applications
- Plug-in RTD sensor assembly with a straight welded multipart thermowell

OPTITEMP TT 22 C

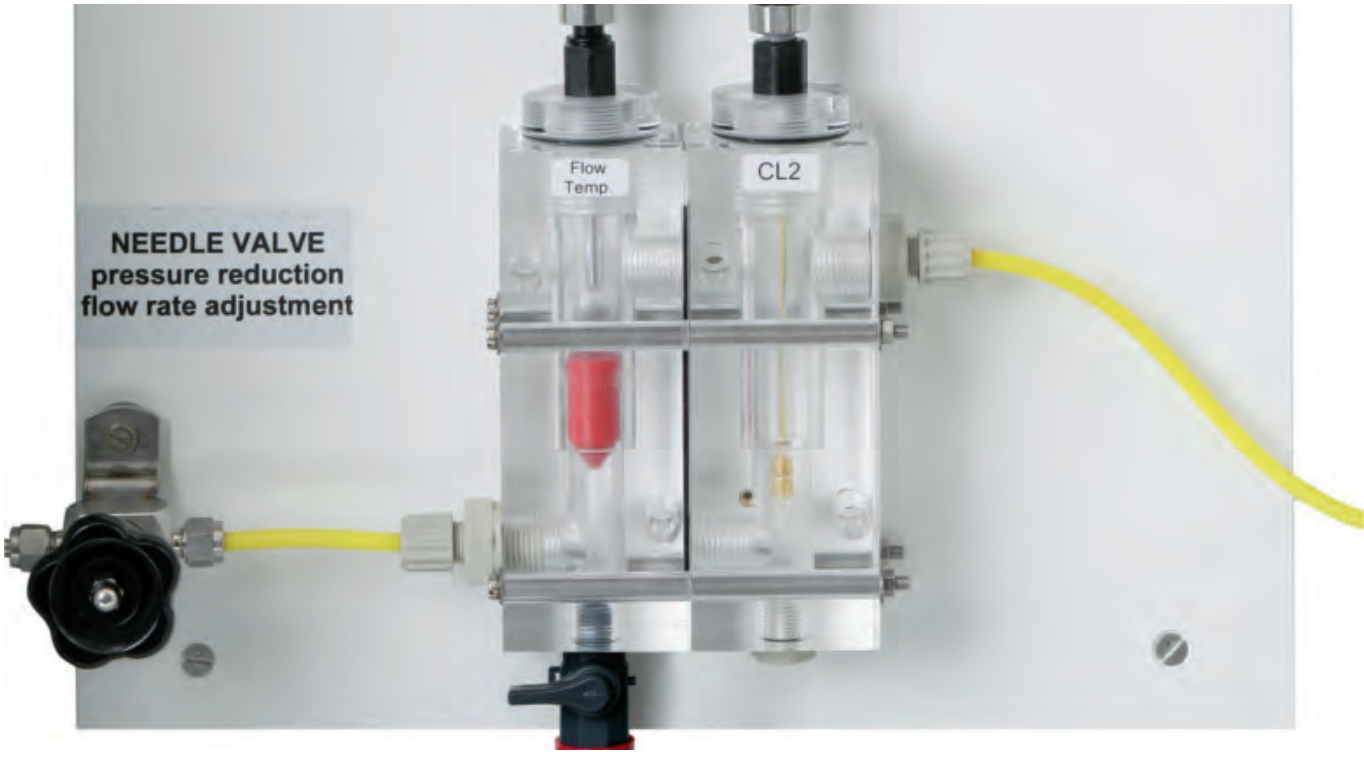
- Programmable head-mounted temperature transmitter with RTD input
- Input: 1 x Pt100, 3-wire; Output: 2-wire, 4...20 mA

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com



APPLICATION NOTE

Water & Wastewater

Measuring the chlorine content in the emergency chlorination of waterworks

- Determining the chlorine content in drinking water for measuring free chlorine in the emergency chlorination of a waterworks
- 100% measurement availability thanks to low-maintenance, membrane-free sensor and automatic sensor cleaning
- Uninterrupted calibration by comparison to the laboratory value after DPD

1. Background

Many municipal waterworks perform no permanent disinfection of drinking water. However, in many cases a process known as emergency chlorination takes place. The process is switched on in case of need, adding chlorine to the drinking water as a disinfectant.

2. Measurement requirements

Emergency chlorination is special in that it is only very rarely required, which means that non-chlorinated water usually flows through the measuring systems. Conventional measurement technology is now often faced with the problem of biological fouling covering the membrane, making the sensor inoperative over time. For this reason, some operators use extra doses of chlorine from time to time in order to keep the instrumentation clear of such biological fouling, even though it is not actually necessary from the standpoint of drinking water quality. If no extra chlorine is added the sensors in the system must be regularly checked and mechanically cleaned. In some cases, it may be necessary to replace the membrane and then recalibrate the system.

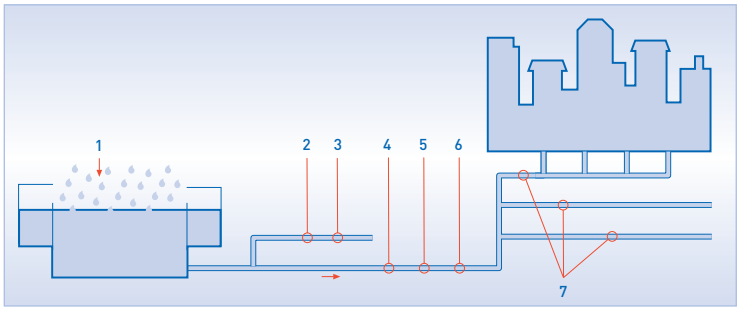
A particularly critical situation arises if the gradual deterioration of the sensor goes unnoticed and the membrane is only replaced when the metering system does not start properly when needed for emergency chlorination.

KROHNE

As soon as chlorine is added to the water, the legal limits must be monitored in the effluent (in Germany 0.1 mg/l according to the Drinking Water Ordinance). In order to monitor these limits as well as to ensure accurate measurement of the chlorine, online measuring technology is used in many instances. Unlike conventional sampling and laboratory evaluation, this technology continuously monitors measurement values.

In addition, conductivity, ph value, turbidity and flow rate of the water are measured at the outlet of the waterworks along with the chlorine content.

Schematic presentation of typical measuring points at the outlet of a waterworks

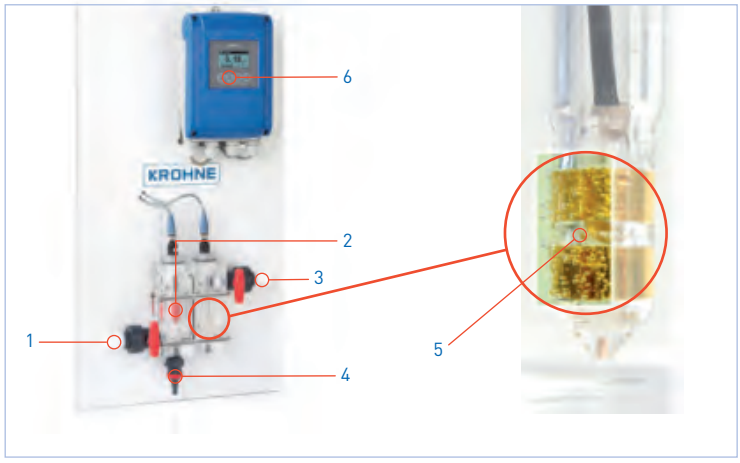


1 Adding chlorine to the fresh water tank
2 Chlorine content
3 pH
4 Conductivity
5 Flow rate
6 Turbidity
7 Water meter

Only measuring station 2 is described in this example. In addition to the measuring system monitoring the chlorine values in the process, in some cases a second measuring system can be used to control the dosing of the disinfectant (measuring station 1). To complement this, the typical measuring points at the outlet of the waterworks have been drawn in.

3. KROHNE solution

The OPTISYS CL 1100 measuring system with automatic sensor cleaning system and a membrane-free potentiostatic sensor at the outlet of the waterworks was used to monitor the chlorine values in the process. The measurement was done as a bypass measurement with an open outlet.



OPTISYS CL 1100

1 Inlet
2 Measuring cell with chlorine electrode, temperature measurement and flow monitoring
3 Outlet
4 Sampling point for system calibration
5 Automatic sensor cleaning system
6 Converter

4. Customer benefits

Unlike comparable sensors, the potentiostatic sensor in the OPTISYS CL 1100 measuring system has no membrane and thus no pores to get clogged by biological fouling (naturally-occurring in non-chlorinated water).

The sensor used in the OPTISYS CL 1100 features two gold electrodes on the outside, whose metallic surfaces are not affected by biological fouling. In addition, these electrodes are automatically cleaned on a daily basis, without the use of chemicals, thanks to automatic sensor cleaning.

The OPTISYS CL 1100 is thus always 100% ready to measure, even if no chlorine has been added for a longer period of time.

The measuring accuracy and suitability of the OPTISYS CL 1100 for measuring the chlorine content in drinking water has been certified by the IWW Rheinisch-Westfälisches Institut für Wasser (Institute for Water Resources Management) in Mühlheim, Germany.

5. Product used

OPTISYS CL 1100

- Measuring system for free chlorine, chlorine dioxide and ozon
- Ready-to-use measuring system for the measurement of free chlorine content featuring flow monitoring and automatic temperature compensation
- Automatic sensor cleaning system
- Flow-independent measurement above 30 l/h
- Simple calibration through comparison with laboratory value according toDPD
- Optional pH compensation with fluctuating pH values above 7.5 pH

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Measurement of free chlorine in a drinking water system

- Adding chlorine to disinfect drinking water from wells
- Monitoring the chlorine content prior to network supply
- Automated disinfection control using a control system

1. Background

The Association for Water Supply and Sewage Treatment Geiseltal (ZWAG) operates a water supply network for around 10,000 households in Mücheln, Saalekreis, Germany. The company abstracts the drinking water through regional filtration wells from a surface spring. From there it is pumped into a central high-level tank and then fed into the network as needed. Compared to groundwater from deep wells, spring water has a slightly higher, natural bacteriological makeup and must thus be disinfected. As this application requires an extended disinfecting effect (sustained efficacy) right up to the supply point into the drinking water system, free chlorine is the only permitted disinfectant. Unlike UV and ozone which according to the Drinking Water Ordinance are only permitted for spot disinfections, free chlorine (Cl_2) can kill off the organic material contained in untreated water along the entire transportation route.

2. Measurement requirements

To disinfect, the company adds chlorine bleach (sodium hypochlorite) at the outlet of the well at 0.3 mg/l. The upper limit for free Cl_2 prescribed in the Drinking Water Ordinance is 0.3 mg/l and is not to be exceeded at the supply point. The ZWAG thus depends on reliable chlorine content control downstream from the high-level tank. At the same time the measurement proves a sustained effect after the high-level tank (Cl_2 content above the lower detection limit of 0.1 mg/l).

The operator had so far measured free chlorine photometrically by way of random checks. This process requires labourious manual sampling. To automate chlorine analysis and the transfer of measurements to a control system in the future, the ZWAG decided to retrofit the existing infrastructure using appropriate measurement technology.

KROHNE

3. KROHNE solution

The ZWAG decided on the OPTISYS CL 1100, a completely pre-installed measuring system used to determine the amount of free chlorine in the drinking water. It consists of the membrane-free OPTISENS CL 1100 sensor in combination with a MAC 100 converter, a flow controller, valves, a temperature sensor and a pH sensor.

OPTISYS CL 1100 with measuring and flushing circuit

The product to be measured is taken downstream from the high-level tank and transported to the measuring system via a copper bypass line. The OPTISYS CL 1100 takes the measurements and then makes them available via a 4...20 mA output in the ZWAG control system. As samples may not be returned to the drinking water circuit, they are disposed of in a sink behind the measuring circuit. To keep the measuring cell free of deposits such as algae, the measuring system is connected to a flushing circuit. Shock cleaning is carried out using a chlorine bleach solution. In addition, the sensor is automatically cleaned once a week thanks to the self-cleaning function. The customer can use a relay output at any time to control when the cleaning of the sensor takes place.

4. Customer benefits

The ZWAG is now in a position to monitor chlorine analysis fully automatically using the control system, significantly reducing manual effort. With the help of the OPTISYS CL 1100 the supplier ensures that a constant average free chlorine content of about 0.1 mg/l is maintained even at the supply point. This allows the customer to guarantee reliable and economic operation of the drinking water system. The legally prescribed limit is observed and/or not exceeded.


Automated transfer of measurements to control system

When operating the OPTISYS CL 1100, the ZWAG also benefits from the standardised user concept of the MAC 100 converter. Since the customer is already using several KROHNE measuring devices, he already knew how to operate the device. There was thus no need for staff training and he could start using the fully operational measuring system immediately.

5. Product used

OPTISYS CL 1100

- Ready-to-operate measuring system for free chlorine, chlorine dioxide and ozone in water applications
- Membrane-free sensor with 2 gold electrodes for long-term stability and easy maintenance
- Optionally available with automatic sensor cleaning (ASR) and pH compensation

Contact
Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com


KROHNE

CONTENTS

Water supply

- Custody transfer flow measurement in water distribution network 34
- Flow measurement for the drinking water supply in the City of Emden 36
- Bi-directional flow measurement and metering in a main water line 38
- Drinking water flow metering at remote distribution stations 40
- Leak management system with GPRS remote monitoring in the Rio de Janeiro drinking water network 44
- Flexible flow measurement, no process interruption 48

APPLICATION REPORT

Water & Wastewater

Custody transfer flow measurement in water distribution network

- Battery powered stand alone solution
- Custody transfer of potable water subject to MID MI-001 for water meters

evides waterbedrijf

1. Background

Evides Waterbedrijf N.V., one the largest water companies in the Netherlands ordered Visser, Smit and Hanab to build a drinking water pipeline from De Staart in Dordrecht, the peninsula where also KROHNE Altometer is located, to Zwijndrecht. Visser & Smit Hanab develops, builds and maintains connections, networks and installations for water and energy. Evides sells so-called soft water to another Dutch water company, as part of a project to solve the hard-water problem of Zwijndrecht. For the transport of the potable water, a new pipeline was needed between the distribution networks of the two water companies. The building of the pipe was not an easy task as it runs trough a densely populated area and it crosses the very busy river Merwede. Over a length of 1450 m / 0.9 mi the pipe has been installed at a depth of 26 m / 85.3 ft under the river.

2. Measurement requirements

Accuracy has been an important selection criterion for selecting a flowmeter, because it concerns the custody transfer of potable water between two companies. The flow measurement is subject to fiscal regulations and therefore requires a certification according to the Measuring Instruments Directive 2004/22/EC MI-001 for water meters.

At the location of installation there is no mains power available, so a battery powered, stand alone, water meter was preferred. Other requirements of the customer for the water meter included the availability of approvals for drinking water, protection against submersion in water (IP68), and a high turndown ratio. The maximum flow rate in the pipe is 650 m3 / 171,711 US gal per hour.

KROHNE

Pipeline crossing the river Merwede


Final installation of the meter

WATERFLUX 3070

3. KROHNE solution

As a result of its innovative rectangular design, WATERFLUX 3070 has a very high accuracy over a wide turndown ratio, an improved flow profile allowing for very small inlet and outlet sections and low energy consumption. The stand-alone water meter has a long battery life time of up to 15 years, due to its very low energy consumption. The battery powered, stand alone, WATERFLUX 3070 offers water utilities opportunities for improving revenues because of high accuracies at high and low flow rates and because the water meter maintains its initial accuracy over a long period of time. The Rilsan® liner of the flow sensor is widely accepted and approved by the water industry for potable water applications. The WATERFLUX 3000 sensor is suitable for IP 68 mounting, allowing the meter to be temporary or continuously submerged in water. KROHNE's WATERFLUX is superior to mechanical water meters in terms of maintenance, long term stability and pressure loss as it has no internal moving parts, no wear and is obstruction free. Electromagnetic water meters maintain their accuracy over time and due to their robust construction the time spent on routine maintenance and service activities can be reduced to a minimum.

4. Customer benefits

"Our partner KROHNE, with whom we already have a good cooperation for many years, has developed a new product that met our needs", says Werner Boom, Business Change Manager Metering of Evides. "We have decided to install the WATERFLUX, because the KROHNE products have a high degree of reliability and this new meter completely fitted our needs and demands. This flow meter does not require an external power supply; the battery provides enough power for 15 years, and the data transfer takes place via a GSM module. The rectangular design provides a unique homogeneous magnetic field. This ensures a high accuracy within the measurement range and virtually has no pressure loss. It is an innovative and durable meter with a high degree of reliability."

5. Product used

WATERFLUX 3070

- Battery-powered electromagnetic water meter
- Approved for custody transfer (OIML R49, MID MI-001)
- Suitable for burial installation (IP68)
- Wide range of drinking water approvals
- Excellent performance in low flow conditions and over a wide flow range
- No inlet and outlet runs required

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & wastewater

Flow measurement for the drinking water supply in the City of Emden

- Measuring device with drinking water approvals
- Polyolefin measuring tube liner with proven hygienic suitability in accordance with the UBA [Federal Environment Agency] and microbial suitability in accordance with DVGW W270

1. Background

The Emden municipal energy supply company operates a waterworks in the town of Tergast to supply the City of Emden with drinking water. The groundwater obtained is of good quality, however it must be treated as it contains significant amounts of soluble iron and manganese. The treated water goes unpressurised into a 2000 m^3 clean water tank. The clean water pumps convey the drinking water via two redundant, almost 12 km long transport pipes to the pressure and tank station in Emden. The tank station performs two tasks simultaneously; it evens out peaks in consumption and equalises delivery in the transport pipelines from Tergast to Emden. This way of operating saves both resources and costs.

2. Measurement requirements

The clean water pumps in the Tergast waterworks convey the drinking water through two transport pipelines, DN 500 and DN 700, to Emden. To measure the delivered volume of drinking water in the transport pipelines, the Emden municipal energy supply company was looking for a suitable flow measurement system. The flowmeters provided must be approved for use with drinking water.

KROHNE

3. KROHNE solution

Two OPTIFLUX 2300 electromagnetic flowmeters with polyolefin (PO) lined measuring tubes were used for this application. They feature drinking water approvals in accordance with the UBA liner guideline as well as DVGW W270 approval. This two-part drinking water approval corresponds to the requirements for materials that come into contact with drinking water. It is divided into hygienic and microbial tests. The hygienic test in accordance with UBA guidelines contains the hygienic assessment of organic liners in contact with drinking water and ensures that the material used does not transfer to the drinking water any substance that presents a health hazard.

The microbial test is the test in accordance with DVGW W270 `Protection against biological contamination through the increase in microorganisms on non-metallic materials`. Whereas in the past hard rubber was frequently used as a liner for flowmeters, it is now increasingly common to use the further developed polyolefins. Polyolefins are sturdy, flexible plastics featuring good chemical resistance. Their surface is smooth and non-porous, making it less susceptible to biological growth.

OPTIFLUX 2300 C with PO-lined measuring tube prior to installation

Measuring device in operation

4. Customer benefits

The customer was extremely satisfied with the measuring solution. The devices used meet all the prerequisites as they feature hygienic approval in accordance with the UBA as well as microbial approval in accordance with DVGW W270.

5. Product used

OPTIFLUX 2300 C

- Electromagnetic flowmeter
- PO-lined measuring tube
- Drinking water approvals in accordance with UBA, DVGW W270 (Germany), ACS (France) and WRAS (United Kingdom)
- Any mounting position, minimum requirements for installation
- Bi-directional flow metering
- Long-term reliability and no maintenance
- No moving parts, no wear and no obstruction in the flow

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Bi-directional flow measurement and metering in a main water line

- Modernisation of regulating and telecontrol technology for the water supply in Duisburg North
- Electromagnetic measurement of actual water transport between feed-in and high-level tank
- Virtual reference without grounding of liquid

1. Background

The Stadtwerke Duisburg AG is a municipal supplier for about 250,000 households in the Rhine-Ruhr region, Germany. The company provides over 35 billion litres (9.3 billion US gal) of drinking water every year. The municipal utility services the Försterberg high level tank to ensure the supply of safe drinking water to Duisburg North. This tank functions as storage during the night to cover the fresh water requirements during the day. The drinking water is transported via a large main water line (DN 800 / 32") and is regulated along the route between the feed-in and the high level tank by way of a booster station (DEA).

Welding work on the M960 from 1981

2. Measurement requirements

To manage the drinking water network and high level tank more efficiently as well as to optimise the supply of potable water, the municipal utility is investing in the electronic regulation and telecontrol of the booster station as a part of their modernisation strategy. Flow measurement is a control variable in the electronic control of the booster station. To modernise the control, the supplier needed a flow measurement solution in keeping with the latest technical requirements. The solution was to enable actual in-use measurement and counting in both flow directions and feature virtual grounding. For this reason, the municipal utility made the decision to replace the previously used flowmeter with a new instrument. The old electromagnetic flowmeter, a KROHNE M960, was in commission for over 30 years.

KROHNE

3. KROHNE solution

Nameplate of old flowmeter KROHNE M 960

KROHNE supplied an OPTIFLUX 2300 W, nominal size DN 800 / 32". The latest generation electromagnetic flowmeter was flange-mounted onto the main water line. It measures in both directions and controls the amount of water delivered to the high level tank at night and then supplied by the tank throughout the day. The sensor features a virtual reference, making measuring mode possible even without additional grounding rings. The input amplifier records the potentials of both measuring electrodes and creates a voltage which corresponds to the potential of the ungrounded medium. This voltage is then used as the reference potential for signal processing – without interfering potential differences between the reference potential and the measuring electrodes. The convential analogue output (4...20 mA) of the IFC 300 wall-mounted version provides measurements to the control unit of the booster station.

4. Customer benefits

The OPTIFLUX 2300 can fully meet the requirements of modern flow measurement, metering and control. The Duisburg utility benefits from a considerably higher measuring accuracy, especially in the lower flow range. The water supply to the high level tank can be more accurately determined and the water quantity in storage can be better adapted to suit the actual daily use. The installation of the OPTIFLUX represents a further step for the supplier towards standardised measuring technology, in terms of operation as well as maintenance and documentation.The patented technology of virtual reference means that the OPTIFLUX 2300 provides the customer with far-reaching cost savings in terms of procurement and installation. That is because the virtual grounding of the electromagnetic flowmeter is not affected by the nominal size. That means there is no need for grounding rings or grounding electrodes, whose procurement costs increase with each nominal size. In addition, the device requires no maintenance.



The flange-mounted OPTIFLUX 2300 with virtual reference

5. Product used

OPTIFLUX 2300 W

- Electromagnetic flowmeter for all water and wastewater applications
- Bi-directional flow measurement with comprehensive diagnostic options
- Suitable for underground installation and continuous spillage (IP68)
- Drinking water approvals including KTW, KIWA, ACS, DVGW, NSF
- Compliant with requirements for custody transfer (MID MI-001, OIML R49, ISO 4064, EN 14154)
- No grounding rings required (with Virtual Reference option on IFC 300)
- Standard in-house wet calibration of sensors up to DN 3000 / 120"

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Drinking water flow metering at remote distribution stations

- District measurement for supplying three municipalities with drinking water
- Decentralised location of distribution station with no connection to power supply
- Precise measurement of drinking water consumption and minimisation of loss

1. Background

The water utility WWAZ (**W**olmirstedter **W**asser und **A**bwasser **Z**weckverband [Wolmirstedt Water and Wastewater Association]) operates an extensive drinking water and wastewater network which now comprises 26 member municipalities (prior to area reform from 1991 subdivided into 32 municipalities). The WWAZ has independently supplied approximately 55000 consumers (15000 households and businesses) with drinking water since 1991. The ailing drinking water networks have been undergoing continual improvements and repairs since 1991. As a result, the pressure ratios in the supply lines have stabilised and the quality of the drinking water has also improved. Drinking water losses were significantly reduced with gradual renovations. Highly skilled employees and their cautious handling of damages to the pipeline network also played a role.

Entrance to a distribution shaft

There are approximately 14000 water meters to measure drinking water consumption, including all large and domestic water meters. Mechanical impeller flowmeters are currently in use in the extremely remote distribution stations not connected to a power supply. The disadvantage of these meters is that they feature a measuring error of 2...5 %. They also require significant maintenance. According to a study performed by a renowned bulk supplier, the errors per year could even increase as much as 5 %. For this reason, the WWAZ would like to replace all of the mechanical meters used by its member communities with more precise electromagnetic water meters.

KROHNE

2. Measurement requirements

The first three measuring stations to be replaced are located at the Eichenbarleben distribution station. At this location, the main drinking water line is split into three lines to provide 3 municipalities with drinking water. Each of the 3 lines is to be fitted with its own flowmeter to replace the mechanical impeller flowmeters used to date. Two of the lines are DN 150 and one line is DN 200.

An extremely remote distribution shaft: there is no chance of supplying the measuring devices here with an external power supply

Splitting the main water line into 3 supply lines

As there is no external power supply available, only measuring devices equipped with their own power source can be used. The life cycle of the battery packs or batteries must be at least 1 year. The devices must also be maintenance-free. The flow data are sent to the control station via wireless remote transmission to eliminate on-site data queries and keep operating costs low. And, because under certain circumstances water may penetrate the distribution stations, the electronic devices used must be flood-proof with a minimum protection category of IP67 or, even better, IP68. An additional float switch sends out a signal should any water get in. The low flow rates here are only approx. 1-10 m^3/h. Minimal flow velocities in the range of less than 0.1 m/s can also occur. Even with these sometimes very low flow rates (that can occur at night for example) the devices must be capable of measuring with a maximum error of 1.5 %.

3. KROHNE solution

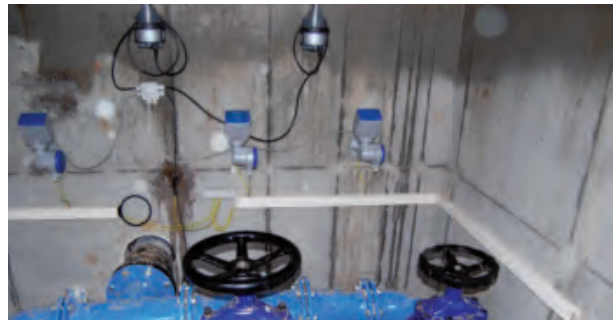
For this application, KROHNE supplied 3 WATERFLUX 3070 F electromagnetic, battery-operated water meters in the sizes DN 200 and DN 150. The 3 meters are each equipped with 2 high-performance batteries. The drinking water lines supply small municipalities of 100-300 inhabitants. In order to precisely measure the extremely rapid and non-continuous flow changes, the default setting of the measuring frequency on the WATERFLUX meter must be increased as illustrated in the following table.

Setting	Measuring frequency	Number of measurements per unit of time	Battery life approx.	
			... with 2 batteries	... with an external battery pack
Standard	1/15 Hz	1 every 15 seconds	15 years	20 years
modified	1 Hz	1 every second	1½ – 2½ years	3 – 5 years

As there is no loop network, only the forward flow must be metered. WWAZ uses two battery-operated KGA 42 devices from KROHNE to wirelessly and remotely transmit the measuring data. KGA is the acronym for the **K**ROHNE **G**SM **A**ntenna, GSM stands for **G**lobal **S**ystem for **M**obile Communication. Each of the two KGAs is equipped with 4 digital and 2 analogue inputs. Of these 8 digital inputs, 3 are for the measuring signals, 3 for error messages (such as self-monitoring or battery almost dead) and 1 is for the external float switch that sends out a signal if water gets into the distribution shaft. The 4 analogue inputs are used later to monitor the pressure.

Even with the minimal flow rates of <10m³/h here with flow velocities of 0.01...0.1 m/s, the water meters measure with a measuring error of less than 0.5 % of the measured value.

3 WATERFLUX 3000 F sensors



3 WATERFLUX 070 F converters and 2 KGA 42

The WATERFLUX water meters require no separate grounding because it comes with a reference electrode as standard. The KGAs used to wirelessly transmit the measurement data to the control centre are configured onsite by a KROHNE technician via bluetooth. It is possible to exchange the mechanical impeller flowmeters directly without the need for any conversion. WATERFLUX water meters require no inlet or outlet segments. For this reason, the devices are particularly well-suited to crowded spaces.

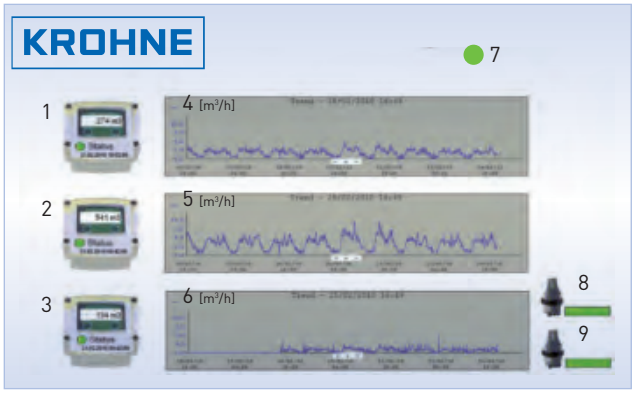
KROHNE technician configures KGA 42

Float switch

4. Customer benefits

The water utility WWAZ is now in a position to monitor all up-to-the-minute meter readings and flow values for these three municipalities from the control station and to immediately detect errors. The visualisation and evaluation software PCWin is used to present the remotely transmitted data. This eliminates all onsite queries. The only time anyone actually has to be on site is to change the battery. This means that operating costs and ongoing costs can be considerably reduced over the long term and are then manageable for the operator: for example, operators can take advantage of reasonable flat rates for businesses for SMS data transmission offered by mobile phone providers. The supply of replacement batteries has been secured over the long term by the manufacturer. The water meters are absolutely wear-proof and maintenance-free. By determining defined levels at specific times, damages and leaks can be detected immediately. For example, deviations from known night flow rates between 2 and 4 am are used to detect leakage in practice. The WATERFLUX battery capacity is transferred to the measuring station as an alarm message. With the measuring frequency set here, the life cycle is 1½ to 2½ years. The first message is sent 1 year prior to the end of the battery life and the second message is sent at approx. 1% prior to the life cycle end. The battery life of the KGA 42 is approx. 2 to 4 years and its residual life cycle can be read in the measuring station. The installed WATERFLUX 3070 water meters have a lifetime of up to 25 years and do not have to be replaced prematurely due to wear and tear, which was a significant cost factor with the mechanical water meters previously used.

Monitoring the measured data in the control centre



Screen shot of meter readings, current flow values and status messages

Meter readings from ...

1 Mammendorf
2 Eichenbarleben
3 Ochtmersleben

Flow values from...

4 Mammendorf
5 Eichenbarleben
6 Ochtmersleben

7 Float switch alarm
● = All OK ● = Water penetration

8 Battery status KGA 1
9 Battery status KGA 2

Cost reduction (example)

Thanks to the improved accuracy of the WATERFLUX water meter compared to the mechanical water meters, costs may be significantly reduced, as shown in this example. The mechanical water meters replaced measured with a measuring error of up to 5 %. This means that based on the maximum flow rates occurring here of 10 m^3/h, some 12 m^3/day flowed unmetered through the water meter. That amounts to a projected loss in one year of approx. 0 8500, at an assumed water price of approx. 0 1.90/m^3. Under the same measuring conditions, the WWAZ can reduce losses by ten times to about 0 850 by using WATERFLUX water meters. This is because the measurement error of the WATERFLUX at a nominal size of DN 150 and a flow rate of Q = 10 m^3/h is only 0.5 % of the measured value.

5. Products used

WATERFLUX 3070 F

- Battery-operated stand-alone water meter with remotely installed converter
- Up to 15 years of battery life
- Suitable for custody transfer according to OIML R-49 and MI-001
- Right-angled measuring tube to optimise flow profile
- Extremely precise measurement without inlet/outlet segments
- Bi-directional measurement from 0...12 m/s / 0...40 ft/s
- Subsurface installation possible (protection category IP68 with subsurface paint)
- Sizes: DN25...600 / 1...24", Rilsan® coating, no wear, no deposits

KGA 42

- Data logger and GSM antenna for remote transmission of readings
- 4 digital and 2 analogue inputs
- Strong GSM signal especially designed for shafts
- For installation sites with no power supply
- Standard protection category IP68

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Leak management system with GPRS remote monitoring in the Rio de Janeiro drinking water network

- Flow measurement rated to IP68 to check water consumption
- GPRS wireless transmission of readings to create consumption profiles
- Integrated pressure measurement for redundant leak detection

1. Background

In light of the 2016 Olympic Games, expanding the infrastructure in the Brazilian city of Rio de Janeiro is extremely important. Modernising water supply and wastewater disposal is also a focal point. In this context, the Technische Universität Darmstadt (Darmstadt University of Technology) is overseeing a pilot project focusing on improving the ecological efficiency in the Brazilian water industry. The objective is to pinpoint measures to increase energy efficiency when it comes to the supply of water, in cooperation with partners in science and economy. Leak detection is the focal point of the pilot project. Leaks mean water loss – water loss means energy loss – energy loss means high but avoidable additional costs. This was one of the main starting points. The campus of the University of Rio de Janeiro, located on an island near the mainland, was chosen as the venue for the pilot project.The municipal provider made the local water supply system available for the purpose of analysis. This system supplies around 2000 residents in a selected neighbourhood with drinking water.

University of Rio de Janeiro campus

KROHNE

2. Measurement requirements

The pilot project will involve investigating how flow technology can be used to determine the actual water consumption as well as any potential water loss caused by leaks. This application required a leading technological measurement solution suitable for continuous and highly accurate flow measurement and that features an integrated pressure sensor for redundant leak detection. The readings should also be provided via GPRS remote transmission to a control centre where exact consumption and supply pressure profiles are created. Since installation is to take place at freely accessible measuring points and the equipment will thus be exposed to environmental and other influences, the measuring instrument used had to be sturdy and feature an integrated GPRS module and maximum water tightness as per IP68.

WATERFLUX with GPRS module KGA 42 in aboveground part of the pipeline

3. KROHNE solution

KROHNE was selected as the technology partner for the pilot project. They supplied two WATERFLUX 3070 C electromagnetic water meters and two KGA 42. The devices were provided in the IP68 version in order to operate them under water. The measuring instruments were installed in the aboveground, easily accessible parts of the main supply line (DN 100 / 4") and in a bypass (DN 50 / 2") of the water network in the neighbourhood. Both water meters are equipped with integrated pressure and temperature sensors.

Based on flow and pressure measurements, the WATERFLUX provides continuous information about the daily and nightly water consumption as well as the supply pressure in the water line. An external GPRS module KGA 42 serves to wirelessly transmit the readings for the pilot project. To analyse and visualise the readings both the internet-based system WebKGA as well as the software-based mini SCADA system PCWin will be tested at the same time. Possible errors, critical battery levels and preset thresholds trigger an alarm in the control room via SMS or email.

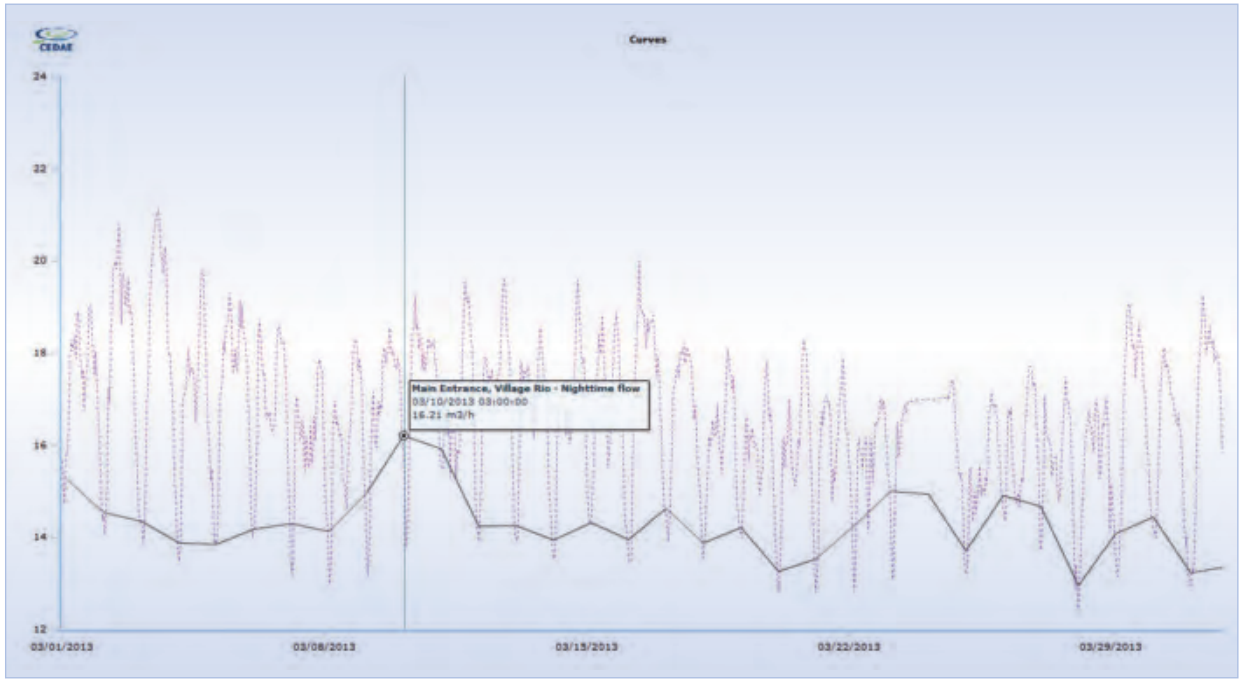
Replacing the WATERFLUX later for safety reasons with a device variant featuring an integrated GPRS module was defined as a milestone for the project. In addition to accurate flow measurement, the fully compact measuring device in protection category IP 68 offers an integrated pressure and temperature sensor, an integrated data logger and a GSM module. The readings are then transferred to the control room via GPRS. Wiring outside of the measuring device is now no longer necessary. Sealing options and a software menu lock provide protection against manipulation or unauthorized access.

Schematic layout of measuring points with GPRS module

GPRS transmission with WebKGA

4. Customer benefits

The WATERFLUX 3070 C can be used to accurately analyse water consumption during the day and overnight. The KROHNE device helps properly determine usage patterns for about 450 households. For example, after just a short time using the WATERFLUX readings it was possible to create accurate consumption profiles, which pointed to unusually high but constant night consumption. Using the WATERFLUX integrated pressure measurement it is possible to check for connections to leaks or other process interventions. In this way, the WATERFLUX indicates how to efficiently manage the water supply network, detecting water losses quickly. This permits resource protection and permanent cost reductions.



Load curve (consumption profile) in a month (Day = red / night = black)

Use of WATERFLUX in partially flooded areas

Measuring tube supported by gravel bed

5. Products used

WATERFLUX 3070 C

- Battery-operated stand alone water meter with integrated pressure and temperature measurement
- Suitable for custody transfer according to OIML R-49 and MI-001
- No wear, no deposits
- Bi-directional measurement; no inlet and outlet runs necessary
- Compact version in protection class IP68
- Sizes DN 25...600 / 1"...24", Rilsan polymer coating
- Remote monitoring with integrated GSM module or external KGA 42 (GPRS)
- Data analysis by way of web-based system WebKGA or software-based mini SCADA system PCWin

KGA 42

- Data logger and GSM antenna for remote transmission of readings
- 4 digital and 2 analogue inputs
- Strong GSM signal specially designed for manholes
- For installation sites with no power supply
- Standard protection category IP68

WebKGA

- Secure server-based remote monitoring system for small and large water networks
- Access via any PC with internet browser
- High data security thanks to redundantly secured data processing centre
- Unlimited number of measuring points can be monitored

PC Win

- PC-based remote monitoring software with local GSM modem
- Comprehensive mini SCADA system
- Up to 250 measuring points can be monitored with one workstation

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Flexible flow measurement, no process interruption

- Automatic leak monitoring of water consumption overnight
- Easy to install from outside without interrupting the process
- On-site data storage and reading

1. Background

A Swiss water supply company wanted simple flowmeters to monitor for leaks in the pipelines that lead to the end consumers. Some of these lines are very old cast iron pipes, which makes it extremely costly to install modern flowmeters. For this reason, the only flowmeters that were considered for these applications were the ones that could be installed from outside without interrupting the process.

2. Measurement requirements

Flow measurements must start automatically at 1 a.m. and stop at 6 a.m. Since consumption during this period is normally minimal, errors such as ones caused by leaks are easily detected. The total flow during the night is counted and this total is then saved. During the day, the counters can be read easily and then compared to the readings taken on previous nights.

KROHNE

3. KROHNE solution

For these applications, KROHNE supplied the OPTISONIC 6300 W ultrasonic measuring device and the micromec® data logger. The rails and sensors are installed on the pipelines from the outside. The sensors are easy to position on the tracks using the easy-to-operate converter installation program. The micromec® data loggers automatically control the measurements. In other words, the beginning and end of the measurements and the recording of the flow measurements. micromec® measures the current flow via the current output of the UFC 300 W converter and the volume for the specified time period via the pulse output. Because they are so easy to install, these measuring devices can easily be used to check other pipelines.

Clamp-on measuring device

Installed converter

4. Customer benefits

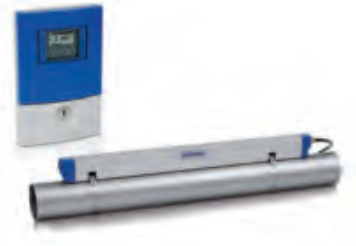
It is now very easy to monitor main lines to end consumers for leaks. The investment and follow-up costs for this measuring equipment are very low. The systems are maintenance-free and can easily be used for other pipelines.

5. Products used

OPTISONIC 6300 W

- Robust industrial clamp-on construction
- Simple installation and start-up thanks to Installation Wizard
- All in one system
- Diameter ranges:

small	DN 15...DN 100 / 1/2"...4"
medium	DN 50...DN 400 / 2" ...16"
large	DN 200...DN 4000 / 8"...160"



micromec® data logger

- Simple to operate and configure all data using 4 keys, can also be remotely controlled from the PC
- Large, clear 20 x 4 character LCD screen
- Indicator suited to quantity being measured thanks to scaling and calibration function, input of sensor name, dimensions and data points

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Public sewage network

- Measuring sewage quantities from municipalities 52
- Measurement solution for monitoring and controlling water amounts discharged from a storm overflow basin 54
- Flow monitoring in the partially filled discharge of a rainwater retention basin 58
- Distance measurement in a wastewater pumping station 60
- Simultaneous measurement of flow and electrical conductivity 62

APPLICATION REPORT

Water & Wastewater

Measuring sewage quantities from municipalities

- Flow measurement of partially filled pipes
- Integrated non-wetted capacitive level measurement
- Measurement in closed piping system enables safe and clean working environment

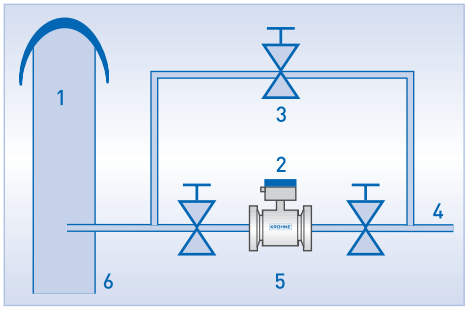
1. Background

The Käppala Association was formed in 1957 for processing sewage from municipalities north and east of Stockholm. An expanded, modernized plant was inaugurated by the King of Sweden in April 2000. Today it serves 11 municipalities and is regarded as one of the world's most environmentally friendly and advanced water purification plants. The plant is situated in Käppala, Lidingö, an island east of Stockholm in the inner part of the famous Stockholm Archipelago. Wastewater coming from 11 different municipalities, approximately 550.000 people, hospitals, offices and industries travels a 60-kilometer system of tunnels and three pumping stations before its enters the treatment plant, where it takes only 24 hours before it leaves the plant as pure water.

2. Measurement requirements

The wide stretched area of Stockholm is divided into 24 sub areas from where effluent is taken in. The quantities coming in from these sub areas have to be measured very accurately. The customer required a measurement accuracy of better than 1% of full scale in a partially filled pipe. The flow rate fluctuates strongly during the day. The filling rate can be as low as 10% from the pipe size. In the winter season the temperature of the waste water can be low and as fat builds up easily at low flows, creating flow disturbances which can result in a lower accuracy. The tunnels through which the wastewater runs is from natural rocks. A lot of strongly corrosive H_2S is formed, putting restrictions on the materials that can be used, particularly for the electrodes when they are not always wetted. Another customer requirement with regard to the H_2S has been that the measurement should take place in a closed system in order to arrange for a safe and clean working environment for the maintenance engineers. An open channel measurement solution has therefore been rejected.

KROHNE



1 Wastewater tunnel system
2 TIDALFLUX flow meter
3 Bypass
4 Region inlet
5 Clean and safe maintenance area
6 Outlet

3. KROHNE solution

The customer has chosen KROHNE's TIDALFUX flow meter, because it meets all his requirements. In total the customer has installed 24 TIDALFLUX meters with various diameter sizes, ranging from DN 600 up to DN 1000. The TIDALFLUX has an abrasion resistant liner and uses wetted electrodes mounted at a height of 10% from the pipe bottom. This is a major advantage, because a competing flow meter that can be used for partially filled pipes has multiple electrodes. In partially filled mode, most of the electrodes are in contact with the strongly corrosive H_2S environment. As a result the instrument broke down in a very short period.

With the TIDALFLUX the filling level is measured by means of capacitive plates and high frequency electronics. It uses a patented, non-contact level measurement. The integrated level sensors behind the liner have no contact with the liquid and are therefore insensitive to fat and oil floating on the surface. To prevent fat building up at the transition from customer pipe to the flow sensor, a thin walled reducer pipe was mounted to create a smooth passage. TIDALFLUX is designed to measure reliably with flows between 10% and 100% of the pipe cross section.

Outlet into wastewater tunnel system

4. Customer benefits

- Safe and clean operational area due to closed pipe design solution
- Accurate measurement with partially filled pipes
- Trouble free flow measurement
- High abrasion and chemical resistance
- No on-site calibration necessary

5. Product used

TIDALFLUX 2300 F

- Electromagnetic flowmeter for partially filled pipes
- Measurement possible down to 10% filling of pipe
- Diameters from DN 200 up to DN 1600 (8" to 64")

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Measurement solution for monitoring and controlling water amounts discharged from a storm overflow basin

- Overflow protection for a sewage treatment plant during heavy rainfall
- Flow measurement of wastewater loads in the partially filled pipeline of a combined sewer
- State-of-the-art rainwater management with coordinated measuring, control and drive technology

GWS GmbH
Gemeindewerke Schlangen

1. Background

Heavy rainfall increasingly poses challenges for operators of sewer systems and sewage treatment plants. Soil sealing due to sustained urbanisation increases existing risks. In combined systems, wastewater loads can lead to hydraulic overloading in the sewage treatment plants as inflow conditions change. The result is an increase in water pollution.

Stormwater tanks are used to temporarily store stormwater in sewer systems and to regulate the continuous inflow to sewage treatment plants. New legal framework conditions and the structural challenges facing many operators increasingly require these buildings to operate automatically to prevent overload and guarantee the reliability of treatment processes even during extreme rainfall. However, many smaller and mid-sized sewage treatment plants in particular are not designed to operate this way.

The German municipality of Schlangen, also faced this challenge. By way of the public utility company GWS, the municipality operates a combined system with a storm overflow basin in the downstream sewer system of the local sewage treatment plant. In the past, an intake control had been put into place to limit the amount of wastewater sent on to the sewage treatment plant via the sewer system. The excess amount of water is treated in the storm overflow basin. This prevents an overload of the sewer system in the undercurrent of the basin and restricts the inflow to the sewage treatment plant to the permissible amount.

KROHNE

2. Measurement requirements

The retention basin was equipped with a mechanical flow regulator during start-up. However, it was not possible to calibrate this regulator and it thus no longer satisfied the requirements of the regular inspections according to the self-monitoring ordinance regarding wastewater of the federal state of North Rhine Westphalia. The responsible water authorities required the discharge facility to be modernised accordingly.

The water utilities decided on intelligent rainwater management. Flow measurement, a control unit and a slide valve were to help completely automate the control of the water discharge into the sewer. The inlet sewer to the sewage treatment plant is an unpressurized gravity pipeline so using a typical flowmeter for process lines was out of the question. The measuring technology installed to replace the mechanical flow regulator did not comply with operating safety requirements and did not meet the legal requirements for the self-monitoring ordinance over the long term. For this reason, the operator was looking for a suitable alternative.

3. KROHNE solution

The operator relies on a measuring solution from partner companies KROHNE, PHOENIX CONTACT and VAG. The measuring solution was specifically developed and designed to meet the requirements of a state-of-the-art stormwater management system. It includes measuring technology (by KROHNE), instrumentation and process control (by PHOENIX CONTACT) and drive technology (by VAG).

Underground storm overflow basin in the Municipality of Schlangen

Ventilation shafts and control cabinets above the stormwater basin

Installation of the measuring technology

Measuring solution including flowmeter and slide valve

KROHNE

KROHNE's TIDALFLUX 2300 provides the required control variable for the automation. The electromagnetic flowmeter (EMF) features integrated level measurement and can thus measure even in partially filled pipelines - unlike usual EMFs.

The measuring tube of the TIDALFLUX 2300 comes with a polyurethane (PUR) liner for abrasion and chemical resistance. Its smooth surface prevents the build-up of fat and other deposits, reducing the need for regular cleaning to a minimum.

The control variable is the maximum flow set by the operator. The EMF transmits the currently measured flow to the control unit via 4...20 mA signal.

TIDALFLUX 2300 – Flowmeter for gravity pipelines

PHOENIX CONTACT

The small control system from the modular type ILC150 inline automation system by PHOENIX CONTACT regulates the outflow and transmits the data from the building to the superimposed control technology in the sewage treatment plant. Each measured flow value (actual value) is compared to the target value specified by the operator. If necessary, the slide position is adapted so that the target value is not exceeded and a continuous inflow is guaranteed, even during heavy rainfall.

Transfer of measuring signal to the control cabinets

VAG

The ZETA control knife-gate valve by VAG is used as an actuator. The knife-gate valve is controlled from the control room by way of an electric control actuator (for 1200 control commands per hour) via analogue signal (4...20 mA).

ZETA knife-gate valve

4. Customer benefits

The operator benefits from a tailored solution that significantly increases overload protection during heavy rainfall. The amount of discharged water as well as the capacity of the stormwater overflow basin can be permanently monitored and the inflow to the sewage treatment plant regulated accordingly. This ensures that the treatment process runs smoothly. This way, the measuring solution makes an important contribution to sustainable sewer system management and active water protection. It should be emphasized that the water amount released from the stormwater overflow basin can be reduced, lessening the burden on the recipient.

Another advantage for the customer: simple start-up. It paid dividends that the measuring, control and drive technology complement each other completely. The "Waterworx" library by PHOENIX CONTACT made integration simple because each KROHNE and VAG component is already stored in the system as a finished component.

In addition, the operator can largely avoid manual effort and service calls for the sewer system. Thanks to the networking with the control technology of the sewage treatment plant, all process data is gathered and recorded. All parameters can be adapted from the sewage treatment plant, optimising the cleaning performance of the systems.

The measuring solution is future-proof for the user. As an option, it can be expanded to include other measuring and control technology. For example, with a conductivity measurement both the quality of the stormwater and its load can be monitored. The industry solution of the three partner companies is thus already designed for future analytical measuring requirements. As a full-service provider for the water and wastewater industry, KROHNE can supply all of the necessary sensors.

5. Product used

TIDALFLUX 2300

- Electromagnetic flowmeter for applications with partially filled pipes and sewers
- With integrated capacitive level measurement for flow measurement of water, wastewater and sludge (≥10% pipe fill level)
- Accurate (±1%) and cost-saving alternative to open channel systems
- Flange: DN200...1600 / 8...64"
- Also for use in hazardous areas
- On-site verification of flowmeter with OPTICHECK service tool
- Integrated conductivity measurement
- PROFINET communication optional

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Flow monitoring in the partially filled discharge of a rainwater retention basin

- Managing water discharge into a mixed water drainage system
- Electromagnetic flow measurement of water loads in Ex zone 1
- Automated discharge control by way of a structure with overflow

1. Background

An operator of a municipal sewage system in southern Germany uses a mixed water drainage system through which both household water loads and rainwater are transferred to a municipal treatment plant via a mixed water collection system. The influent to the sewage treatment plant must be checked, especially when the rainwater load is high, and regulated accordingly because if the plant floods the peripheral areas, the wastewater can cause a great deal of environmental damage. In order to drain off excess precipitation loads as necessary, the municipal operator relies on several rainwater retention basins (RRB) for intermediate storage. To prevent the sewage treatment plant from hydraulic overload, the respective water authority requires that the discharge from the rainwater basin into the mixed water system does not exceed a specified flowrate (m^3/h).The storage capacity of the RRB can only be documented with simultaneous evidence regarding the discharge.

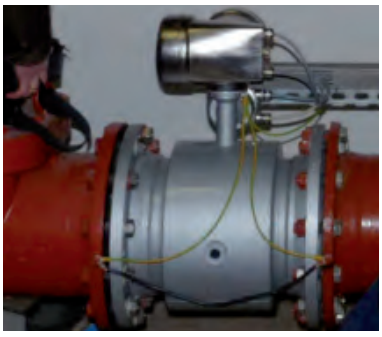
2. Measurement requirements

In order to check the quantity of precipitation flowing into the mixed water duct precisely, the operator required a new flowmeter for the discharge of this RRB. So that both the rainwater and the dry weather flow does not exceed an upper limit of 40 l/s, the quantity discharged must be controlled by means of gate valves. Because the rainwater basin discharge is an unpressurized, gravity pipeline (DN 250 / 10"), the only measuring device that could be used is one that can also be used in partially filled pipelines. Moreover, because fermentation processes can produce flammable methane (CH_4) and easily ignitable hydrogen sulphide (H_2S) in the wastewater, both the flow sensor and the converter had to be approved in accordance with ATEX for use in Ex zone 1.

KROHNE

3. KROHNE solution

Due to the high requirements for the measurement and the explosion protection, the only measuring device suitable for this application was the TIDALFLUX 2300 F. The electromagnetic flowmeter was installed in the discharge line of the RRB by means of a flange connection.



TIDALFLUX 2300 F in the discharge to the mixed water drainage system

The measuring instrument has a patented level measuring system. For this reason, it can perform reliable measurements even in partially filled pipelines starting at a level of 10 percent. The capacitive level sensors are integrated into the liner of the measuring device such that they do not come into contact with the wastewater. Therefore, the measurement is not affected by grease and oil floating on the surface. In addition, the polyurethane liner of the TIDALFLUX protects the instrument from abrasion and chemicals. All of the components of the measuring device are approved in accordance with ATEX for use in Ex zone 1.

4. Customer benefits

With the TIDALFLUX 2300 F, the operator was able to comply with the maximum upper limit for dry weather and rainwater discharge into the mixed water drainage system. The measuring results are transferred, respectively, to a gate valve or electrical gate valve located in the structure with overflow whereby the customer can control the flow automatically before and after the measuring device. The benefit here is that the measuring instrument can perform reliable measurements in partially filled pipelines and is the only device on the market at this time that meets the requirements for use in Ex zone 1 with respect to both the sensor and the converter.

In addition, thanks to the TIDALFLUX, the municipal operator can check the storage volume of its RRB and, in this way, also demonstrate efficiency to the water authority because, in contrast to a rain overflow basin, the RRB does not overflow into a body of water and must be able to store the entire amount of precipitation when it rains. For this reason, the investment in the TIDALFLUX pays off for the customer because with flow measurement, it can be regularly proven that the size of the basin is sufficient and that an expensive expansion or even the construction of another RRB is not necessary.

5. Product used

TIDALFLUX 2300 F

- Electromagnetic flowmeter with integrated capacitive level measurement
- Suitable for use with water and wastewater applications with partially filled pipes (starting at a 10% fill level)
- Large diameter range up to DN 1600 / 64"
- High abrasion and chemical resistance
- Calibrated at the factory; no on-site calibration necessary
- ATEX / IECex Zone 1 approved

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Distance measurement in a wastewater pumping station

- Reliable pump control for quick emptying of wastewater containers
- Effective pump dry run prevention
- Cost-effective measurement with non-contact radar (FMCW)

1. Background

The ZVO (Ostharz Association for Water Supply and Wastewater Disposal) operates a wastewater system with 11 wastewater treatment plants in Germany. The company operates an additional 150 pumping stations to transfer municipal wastewater loads to the wastewater treatment plants. One of these pumping stations is located in the town of Falkenstein in the Harz district, where pumps raise the wastewater loads by 7 m / 23 ft. The loads are then taken via a pressure line along the Selke river to the local wastewater treatment plant.

ZVO pumping station

2. Measurement requirements

At the pumping station, the wastewater is first collected in hoppers. Once the level has reached a defined level, or is below that level, the pumps must be activated or switched off by way of a PLC.

Up until now the ZVO has been using an ultrasonic sensor to detect the respective switching point using a distance measurement. Due to the increasing moisture in the shaft, however, condensation frequently built up on the antenna of the device, which in turn had a negative impact on the acoustic measuring signal. In addition, the measuring device proved to be extremely susceptible to larger temperature fluctuations. Despite temperature compensation, spontaneously occurring, intensive sunlight led to considerable measurement deviations. This meant, among other things, that frequently the only way to prevent the pump from running dry was to activate the emergency off float switch.

Originally, the ZVO had planned to replace the sensor with a hydrostatic pressure sensor. However, this would have made it necessary to install a protective tube. That is why the customer started looking for a reasonably priced alternative that could be installed easily during operation.

KROHNE

3. KROHNE solution

The ZVO is now using the OPTIWAVE 5200 C for distance measurement. The company was able to set up the non-contact radar (FMCW) level transmitter very quickly. No special knowledge was necessary thanks to the simple navigation. All that was required was a one-time adjustment of the tracking speed to the very quick emptying of the container.

The measuring device was originally supplied with a horizontal converter. However, the switch was made to a vertical housing position to make the values easier to read from above. Thanks to the quick coupling system, it was possible to remove the modular converter of the OPTIWAVE 5200 C under process conditions and simply rotate it by 360°.

Fast retrofit of the converter thanks to quick coupling system

4. Customer benefits

The OPTIWAVE 5200 offers the ZVO the desired cost-effective yet reliable distance measurement for the pump control. The radar device is perfectly designed for measuring foaming wastewater with temperature fluctuations outside.

Unlike the ultrasonic sensor or comparable radar level measuring device, the OPTIWAVE 5200 features a flat, non-peak signal feed. Condensation has thus hardly any effect on the measurement. Thanks to the OPTIWAVE 5200's slim antenna design, drops of condensation can also flow off quickly.device, the OPTIWAVE 5200 features a flat, non-peak signal feed. Condensation has thus hardly any effect on the measurement.

OPTIWAVE 5200 C above the wastewater container

5. Product used

OPTIWAVE 5200 C

- 2-wire FMCW radar level transmitter for the water and wastewater industry
- Cost-effective distance measurement in wastewater shafts and containers
- Innovative horn antenna design for wastewater applications with condensate formation
- Suitable for use outdoors
- Modular design of housing and antenna ensures suitability for a variety of mounting positions
- Quick coupling system for the removal of the converter under process conditions
- Measuring range up to 30 m / 98.4 ft

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Simultaneous measurement of flow and electrical conductivity

- Analysis of the quality of water and wastewater
- Indication measurement of electrical conductivity
- Additional costs for analytical conductivity measurement eliminated

1. Background

Electrical conductivity is one of the indicators that provides information about the quality of water and wastewater. As a rule, the wastewater from an indirect discharger or a communal inlet area has a known average electrical conductivity. If the measured electrical conductivity differs greatly from the average value, there is reason to assume an unauthorised discharge. This then leads to further tests.

2. Measurement requirements

Operators of sewage treatment plants and sewer networks use inductive sensors to measure electrical conductivity. This comes at considerable expense. In addition to the investment costs for the analytical conductivity measuring device, there are installation, wiring and maintenance costs to consider. Electrical conductivity is generally measured at pumping stations, gauge wells and sewage treatment plant intakes. Flowmeters are also usually installed at these locations to perform this task.

KROHNE

3. KROHNE solution

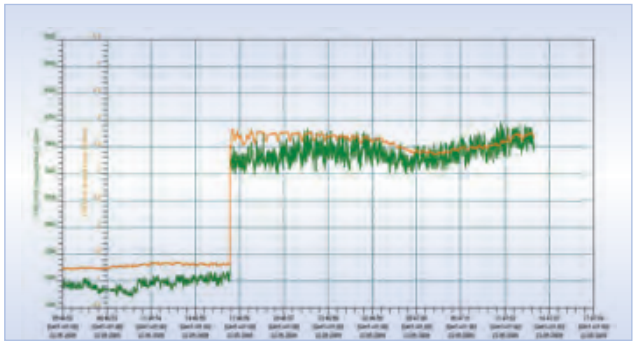
The OPTIFLUX 2300 C electromagnetic flowmeter (EMF) simultaneously measures volume flow and electrical conductivity. The integrated measurement of electrical conductivity was tested in practice using an OPTISENS 1050 W inductive conductivity measuring device as a reference in a variety of sewage treatment plants.

Test set-up at a sewage treatment plant

Downstream conductivity measuring device as reference

4. Customer benefits

Tests showed that in terms of accuracy, the EMF measurement did not come close to the precision of the conductivity meter. However, this is also not necessary because operators of sewage treatment plants and sewer networks do not use conductivity measurement as a controlled process variable. The response time of the measurement is comparable to the reference (see graph) and operators deemed the repeatability of the measuring results to be sufficient. As an indication measurement it is completely adequate in practice. With an optional additional current output on the EMF, the conductivity value can be continuously monitored and controlled in the control room.



Comparison of conductivity measurements:
green = OPTIFLUX 2300 C, red = reference measuring device

Thanks to the use of flowmeters with standard integrated conductivity measurement, operators of sewage treatment plants and sewer networks have other conductivity measuring stations at their disposal with no additional expense. When minimum and maximum limit values are set, deviations are automatically detected and countermeasures can be immediately implemented

5. Product used

OPTIFLUX 2300 C

- Engineered for the water and wastewater industry
- All relevant approvals for potable water (e.g. KTW, DVGW, WRc, KIWA, ACS)
- Unobstructed flow cross-section, no internal objects
- Also available with permanent operation in water or underground (protection category IP 68)
- Hard rubber or polypropylene liner for measuring tube

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Mechanical pretreatment

- Inlet flow measurement in the open channel of a sewage treatment plant 66
- Overfill protection for wastewater collection pits at a power plant 68
- Level measurement in a recycled sludge tank 70
- Monitoring the flow of rinse water in a grit washing plant 72

APPLICATION REPORT

Water & Wastewater

Inlet flow measurement in the open channel of a sewage treatment plant

- Flow measurement for controlling mechanical preliminary clarification
- Determining volumes of sewage in partially filled gravity pipelines
- Automated dosing of precipitants using a PLC

1. Background

AEGN (Association pour l'épuration régionale des eaux usées des bassins versants de la Glâne et de la Neirigue) operates a sewage treatment plant for treating municipal wastewater in Autigny, Switzerland. At the inlet of the sewage treatment plant the wastewater is first collected in a tank and then transported for mechanical preliminary purification via two screw pumping stations. The wastewater flows through a screen and grit chamber in an open, partially filled channel (gravity pipeline) before going on to preliminary clarification. This channel is designed for a maximum flow height of 400 mm / 5.7".

Open channel from grit chamber to preliminary clarification

2. Measurement requirements

By law, AEGN must conduct an inlet measurement of the volume of wastewater flowing into the sewage treatment plant. Up until now, the operator used a Venturi flow measurement for this. However, this kept resulting in backwater. Accuracy was, therefore, deemed to be very low. Following renovations to the channel, the measurement ultimately stopped working altogether. The failure of the application affected the entire purification process, because AEGN always dosed the precipitants for preliminary clarification according to the flow rate, and this was now virtually impossible. Due to the use of the screw pumping stations, flowrates in the channel fluctuate considerably (15...300 l/s or 237.8...4755 US gpm), and these cannot be accurately calculated without technical tools.

The operator, therefore, decided to install a flowmeter at the entrance to the preliminary clarification plant for the first time. The search proved difficult due to the prevailing parameters. As the channel could not be lowered, any suitable measuring instrument had to fit into the existing infrastructure. The gravity pipeline also required a measuring solution that could be used at different fill levels.

KROHNE

3. KROHNE solution

AEGN opted for the TIDALFLUX 2300 F for this application, an electromagnetic flowmeter for partially filled pipelines. Following intensive tests, the customer decided to use two individual instruments with a nominal diameter of DN350. The units were installed beside each other in the gravity pipeline of the inlet structure, which is located in the supply pipe to the preliminary clarification plant.

The TIDALFLUX features an integrated, non-contact capacitive level measuring system and is, therefore, designed for measurements in AEGN's unpressurized sewage channel. The KROHNE instrument can reliably determine the inlet flow rate from a fill level of 10%. The polyurethane liner protects the measuring instrument against the sometimes abrasive and aggressive components in the wastewater.

Installation of TIDALFLUX 2300 in sewage channel

4. Customer benefits

Thanks to the TIDALFLUX, AEGN now has a reliable and - compared to the Venturi measurement - much more accurate way of determining flow rates. Not only does the plant comply with the wastewater directives; the customer can also continuously document inlet flow, but most importantly he can optimise the purification processes using a PLC as well. The precipitants can now be added according to the wastewater freight. This means that only the precipitants that are actually needed are used, which will reduce costs in the long term. By using the TIDALFLUX, AEGN is now more flexible and can respond more quickly to fluctuating wastewater volumes, as plant manager Nicolas Pasquier confirms: "The invested time and planning have paid off. Now we can identify every cubic meter of flow and can thus very accurately control the purification process."

5. Product used

TIDALFLUX 2300 F

- Electromagnetic flowmeter for the water and wastewater industry
- Measurement in partially filled pipelines (from 10% fill level) up to DN1600 / 64"
- Patented, non-contact level measurement
- No on-site calibration necessary
- High abrasion and chemical resistance
- ATEX / IECex Zone 1

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Energy

Overfill protection for wastewater collection pits at a power plant

- Monitoring of collection wells containing power plant wastewater up to 80°C / 176°F
- TDR level measurement for automated pit emptying using pumps
- Cost-effective replacement for faulty pressure gauges

1. Background

A steel producer in the Ruhr region, Germany, runs its own power plant with an output of several hundred megawatts. Exhaust gases from steel production and the coking process are used as energy sources for power generation. The electrical energy produced in the process is then made available to a nearby metallurgical plant and coker unit or fed back into the public grid.

A variety of wastewater accumulates at the power plant. It is collected centrally and then fed to a wastewater treatment plant. To do this, the power plant has a drainage system which uses channels to direct the wastewater from different areas of the power plant to 4 collection pits.

2. Measurement requirements

The wastewater collection pits are between 2.5 m / 8.2 ft and 4 m / 13.1 ft deep. To prevent overflow, the pits must be pumped out at regular intervals. To control this process automatically via a PLC and to prevent the pits from overflowing, the customer needs to continually monitor the level.

At first the operator of the power plant tried to control the level using pressure gauges. However, this soon proved an unsuitable method for this application as the electronics were quickly destroyed in the 80°C / 176°F wastewater. The power plant operator then started to look for an alternative measuring technology that would be as cost-effective as possible for this simple application but that would also be stable and provide reliable measuring results.

KROHNE

3. KROHNE solution

The customer decided to use 4 OPTIFLEX 1100 C units. The guided radar (TDR) level meters were installed above the wells. The single probes (Ø2 mm / 0.08") were installed in existing 2-inch stilling wells that reach deep into the pits. A pipe collar was used to reduce the G ½ process connection of the measuring devices to the nominal size of the stilling well.

Using the quick configuration and by indicating 5 measuring parameters, the customer was able to start up the 2-wire level meters himself. The measured values of each OPTIFLEX 1100 are transmitted via 4...20 mA analog output to a PLC. As soon as the level exceeds a defined range, the PLC activates the pumps and the wastewater is pumped out of the wells.

OPTIFLEX 1100 with reduced process connection

4. Customer benefits

Using the OPTIFLEX 1100, the operator of the power plant can empty the wastewater wells automatically again. This level meter is a very cost-effective solution for such a simple application. Other measuring principles are too expensive or not adapted. Compared to the previously used pressure gauges, the level meter measures reliably and with sufficient accuracy. The electronics for the device are not located in the medium and are thus not affected by its temperature. Nor do fluctuations in pressure and density or varying dielectric constants affect the measurement.

The customer was also able to save money on the installation of the OPTIFLEX 1100 as it was possible to make use of the existing infra-structure, the stilling wells, for the level measurement. The fast start-up was another advantage for the customer. Each device was easy to set up using the display and the installation wizard, no training required. Unlike other measuring devices such as capacitive (RF) level meters, which require wet calibration, the OPTIFLEX 1100 does not need to be calibrated.

Installation in stilling well

5. Product used

OPTIFLEX 1100 C

- 2-wire level meter for liquids and solids
- All-purpose (in non-hazardous areas)
- Measuring range up to 20 m / 65.6 ft (liquids) and 10 m / 32.8 ft (solids)
- Simple navigation using menus without opening the housing
- Stainless steel probes and process connections
- For process temperatures up to 100°C / 210°F and pressures up to 16 barg / 232 psig
- Display in 9 languages including Chinese, Japanese and Russian

Contact
Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Level measurement in a recycled sludge tank

- Collecting sludge from septic systems at waste water plant
- 3,65 m / 12 ft deep underground tank with moving medium
- Pump control for the distribution of sludge to further treatment

1. Background

In the United States, many suburban and rural homes are still equipped with septic tank systems. Domestic wastewater is disposed of through these systems which also perform a degree of on-site waste treatment. However, the residual waste has to be periodically removed from these systems and transported to a waste water treatment plant by septic tank cleaning services (so called Honey Dippers).

An American waste water treatment plant operator in suburban Philadelphia, PA, collects the septic tank waste in a recycled sludge tank. From there it is routed via the main plant influent line to different sludge treatment systems for aerobic digestion, dewatering, lime stabilisation, thermal drying or incineration.

2. Measurement requirements

The sludge from the 3.65 m / 12 ft deep and 1.8 m / 6 ft wide underground tank is pumped to the different plant treatment systems via influent pipelines. The sludge level has to be continuously measured in order to control the pumps and to avoid drying up or overfilling of the tank. The customer had previously used a submersible pressure transducer to ensure a correct start or stop of the pump. However, the device failed to produce stable measuring results due to the constantly moving medium. Hence the customer considered the installation of a more reliable technology.

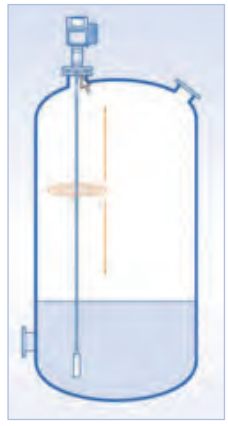
KROHNE

3. KROHNE solution

KROHNE fitted an OPTIFLEX 1100 C with single cable probe (Ø2 mm / 0.08") and a threaded ¾ NPT process connection on top of the tank.

The treatment plant's service technicians easily assembled the OPTIFLEX 1100 C probe by themselves, attached it to the threaded connection and screwed it directly into the metal plate that covers the sludge tank. They ran a quick set-up via the local display and the sensor adjustment was performed at 3.65 m / 12 ft.

The OPTIFLEX 1100 C level meter uses the Time Domain Reflectometry (TDR) technology. It transmits low-intensity electromagnetic pulses along the conductor in the cable probe. When the pulses reach the surface of the sludge, some of the pulse energy is reflected back to the signal converter. The time from when the pulse is transmitted to when it is received is measured by the instrument. The time value is then converted into a 4 to 20 mA analog output current equivalent to the level. This signal is sent to the plant PLC for process control and monitoring.



Mesuring principle of the Guided Radar (TDR) level meter OPTIFLEX 1100

4. Customer benefits

Since the measurement is unaffected by the moving medium as well as physical property variations such as density, the OPTIFLEX 1100 C is a preferred alternative to the pressure transmitter. It is an affordable device for this application that does not necessarily require an extremely high level of accuracy. The customer benefits from a continuous and reliable level measurement of the recycled sludge.

Thanks to the level meter, the pumps can now be effectively controlled and helps prevent serious damage to the pumps from the tank drying up. Even with a ladder or other metal parts installed inside the tank, the performance of the OPTIFLEX remains stable. Other leakage problems were also avoided from the start since the level meter was tank top mounted and the quick installation was another advantage to the customer.

5. Product used

OPTIFLEX 1100 C

- Guided Radar (TDR) level meter for liquids and solids
- For general-purpose use (non-hazardous areas)
- Measuring range up to 20 m / 65.6 ft (liquids) and 10 m / 32.8 ft (solids)
- For process temperatures up to 100°C / 212°F and pressures up to 16 barg / 232 psig
- Converter can be rotated and removed under process conditions
- Alternative to traditional level instrumentation such as RF Capacitance, conductive and DP transmitters
- Excellent price-performance ratio
- Display in 9 languages: including Chinese, Japanese and Russian

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Monitoring the flow of rinse water in a grit washing plant

- Safeguarding the water supply for organic separation using a grit classifier
- Early detection of a blocked rinse water supply pipe
- Cost-effective variable area flow measurement without power supply

1. Background

The ZWAG Association for Drinking Water Supply and Wastewater Disposal in Braunsbedra, Germany, operates a municipal central wastewater treatment plant. The plant is designed to clean the wastewater of up to 23,000 residents both mechanically and biologically and to have that wastewater undergo sludge treatment.

2. Measurement requirements

Before transitioning from the mechanical to the biological purification stage, the treated sand settled in the sand trap is removed from the process and fed into a grit washing plant. A grit washing classifier is used to wash down the sediment to an organic content that complies with legal requirements.

The grit washing classifier is adjusted once to an appropriate rinse water volume for the cleaning process. The rinse volume must remain constant throughout the operation but otherwise requires no other adjustments. However, if the volume flow drops or if there is no more rinse water at all, that indicates a blockage in the rinse water supply pipe that must be cleared. To guarantee that the grit washing plant would operate efficiently, the plant operator decided to monitor the rinse water flow continuously.

KROHNE

3. KROHNE solution

The ZWAG sewage treatment plant operator monitors the rinse water flow using the VA 40 variable area flowmeter. It is installed directly into the corresponding DN32 rinse water line in front of the grit washing classifier via a G2 thread connection. The customer operates the device thanks to the simple mechanical measuring principle without power supply. It has just one local display that the customer monitors from time to time. To do this, the VA 40 features a glass cone which enables direct reading of the flow. The KROHNE device is well protected by a metal cover with a sight glass. This makes it extremely robust and well suited for use in the harsh environment of the wastewater treatment plant.

Flow monitoring with the VA 40

4. Customer benefits

As this application is not process-relevant for the actual sewage treatment operation, the reliable and extremely cost-effective variable area flow measurement is completely adequate for the customer. Neither automation nor extremely high accuracy are required here, which means that the customer can operate the measuring point with the help of the VA 40 in a cost-saving and energy self-sufficient way. At the same time, the reliable and durable KROHNE device guarantees that the customer can detect the need for maintenance in the rinse water supply at any time.

If the customer needs to transmit the measuring results at a later time directly to the control room, a VA 40 with 4...20 mA analogue output could also be used. The use of a different variable area flowmeter with additional communication options such as Fieldbus would also be possible upon customer request. As one of the leading suppliers, KROHNE has contributed greatly to bringing variable area flow measurement technology up to today's standard and that is why it offers the option of digital data transmission for many of its variable area devices.

5. Product used

VA 40

- Variable area flowmeter for simple water and wastewater applications
- Simple, low-cost measuring principle without power supply
- With glass cone and readable display
- Stainless steel fittings, other materials optional
- Various connections (thread, flange, hose etc.)
- Also suitable for hazardous environments
- Optional with 4...20 mA output and two limit switches

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Biological treatment

- Measuring the sludge blanket level in a wastewater treatment plant 76
- Measuring ORP in the aeration basin of a wastewater treatment plant 78
- Level measurement of lime in a wastewater treatment plant 80

APPLICATION NOTE

Water & Wastewater

Measuring the sludge blanket level in a wastewater treatment plant

- Pumping sludge from primary sedimentation tanks
- Direct, optical monitoring of sludge blanket level in 8 primary sedimentation tanks
- Minimisation of pumping of water to digesters

1. Background

A major Australian wastewater treatment plant treats sewage using the following main processes: Grit removal, fine screening, primary sedimentation and finally sludge digestion. The plant is situated almost 40 m / 131 ft underground in large caverns excavated out of solid rock. Effluent is pumped 2.2 km / 1.38 mi out to sea. The raw sludge and scum from the sedimentation process are pumped up to four large steel tanks where they undergo anaerobic digestion. The digested sludge is then converted to sludge cake in centrifuges for biosolid production.

2. Measurement requirements

Monitoring of the sludge content is key to optimising the digestion process. The customer was searching for an alternative control process to the time based method or ultrasonic technology.

KROHNE

3. KROHNE solution

An OPTISYS SLM 2100 sludge level measuring system was mounted on each of the hoppers of 8 primary sedimentation tanks. The sludge level monitor makes it possible to directly measure the concentration of the suspended solids content.

In the process there is scum that is present on the surface. This scum can cause false positive as the sensor moves through this top layer. For this reason the OPTISYS SLM 2100 features a blind zone where by the optical sensor does not begin measuring until it has moved through this pre-determined scum layer.

OPTISYS SLM 2100 mounted on a hopper of a primary sedimentation tank

Primary sedimentation tank

Based on the light absorption method, the system can accurately measure the suspended solids content in the sedimentation tank regardless of the colour of the sludge. Measurements are transferred to the control room in the treatment plant via 4...20 mA signal. The solid and height measurements (in %) are used to calculate the volume of sludge. Along with the volume a maximum pumping time will be calculated.

The system incorporates a water flush cleaning system which is triggered after each sensor retraction. The cleaning system allows the system to monitor over lengthy periods without maintenance.

4. Customer benefits

The OPTISYS SLM 2100 permanently monitors the sludge level allowing the operator to maximise digester solids. The pumps, one of the greatest cost factors for the operator, are now only activated when they are really needed, constantly saving the customer on energy costs.

Manual monitoring of sludge level is eliminated for the customer. The KROHNE system is significantly more reliable and accurate than the previously carried out manual and ultrasonic measurements. Compared to ultrasonic technology, the analytical measurement technology of the OPTISYS SLM 2100 is considerably less susceptible to faulty measurements. The typical weaknesses of ultrasonic technology are not an issue with the OPTISYS SLM 2100.

5. Product used

OPTISYS SLM 2100

- Optical measuring system for the measurement of sedimentation profiles, sludge blankets and fluff level
- Continuous level measurement of sludge blanket (zone tracking)
- Accurate and colour-independent measurement at a depth of up to 10 m / 33 ft
- Built-in cleaning unit for wastewater
- Built-in heater and ventilation for temperature regulation

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Measuring ORP in the aeration basin of a wastewater treatment plant

- Determination of the oxidation-reduction potential for controlling the intermittent denitrification
- Replacement of an analogue measuring system with digital 2-wire measuring technology including standardised fieldbus
- Cost reduction and increased operating safety through direct communication between sensor and control system

1. Background

The Association for Water Supply and Sewage Treatment Geiseltal (ZWAG), in the Saalekreis district of Saxony-Anhalt, Germany, operates a central wastewater treatment plant which receives municipal wastewater from the administrative region. After the mechanical cleaning process, the wastewater flows through two aeration basins into a combined basin with integrated final treatment. During full biological wastewater treatment, the activated sludge process is applied with simultaneous aerobic sludge stabilisation. The micro-organisms in the activated sludge are exposed to a constant "hunger state", so that almost all usable substances are processed as nourishment. Technically, this works through a discontinuous supply of oxygen in the basin – referred to as intermittent denitrification. Nitrification and denitrification are controlled throughout the lifetime of the bacteria in the activated sludge. The activity of the bacteria is therefore significantly dependent on the oxidation-reduction potential (ORP).This redox potential is one of the most important values in order to correctly adjust the aeration and depletion control of the aeration basin.

2. Measurement requirements

The ZWAG has been using an analogue ORP measurement for some time. The measured voltage from the sensor is converted in the transmitter and transferred as a 4...20 mA signal to the control system. Recently, there have been repeated failures at the measuring point as the transmitter was no longer fully functional, which disturbed the communication between the sensor and the transmitter. The customer was therefore faced with the decision either to invest a multi-figure euro sum into an analogue measuring system from the same manufacturer, or to replace the entire measuring point.

KROHNE

3. KROHNE solution

The ZWAG decided on the SMARTPAT ORP 1590. The digital 2-wire ORP sensor communicates directly with the control system through the 4...20 mA/HART® signal, without the need for an additional transmitter. This is already integrated in the sensor head. The measured voltage is converted into the 4...20 mA/HART® signal in the sensor and the sensor communicates directly with the SCADA system.

SMARTPAT ORP 1590 with integrated transmitter technology

Although SMARTPAT allows off-line calibration in the laboratory – with direct storage of the calibration data in the sensor – the customer can also calibrate the sensor periodically on-site. Therefore, the sensor must not necessarily be removed from the assembly. Through the use of a suitable junction box (see picture right) the sensor can be accessed directly with a HART FSK modem. Thanks to the free of charge KROHNE DTM software, it is possible to communicate with the sensor on a laptop using an FDT frame application like PACTware™. The sensor remains in the current loop and after cleaning is immersed into the redox solution and calibrated. The calibration data is stored directly in the sensor, which is then reinserted into the basin.

Junction box SJB 200 W

4. Customer benefits

SMARTPAT ORP 1590 offers the customer significantly higher operating safety. The compact electronics which are built into the sensor reduce the risk of a measuring point failure, largely because an additional transmitter is no longer required. The signal processing on the low-ohm 4...20 mA/HART® is carried out directly in the sensor. With this new sensor concept, the problems experienced with the classical transmitter have been solved.

The ZWAG has benefited particularly from a much cheaper solution with significantly lower costs for acquisition, installation and ongoing maintenance. On the one hand, the cable connection no longer needs to protected by an expensive shield to prevent erroneous transmission of the weak voltage signal to the transmitter. On the other hand, the transmitter no longer has to be replaced every few years.

The standardised sensor design allows installation in virtually all assemblies available on the market. In addition, the SMARTPAT technology enables rapid on-site calibration of the sensor without transmitter. Offline calibration is also an option for the customer in the future. With the help of the appropriate SMARTPAT accessories the lifetime of the sensors can be increased under laboratory conditions through cleaning, regeneration and calibration.

5. Product used

SMARTPAT ORP 1590

- Digital ORP sensor for the water and wastewater industry
- 2-wire loop powered sensor with integrated transmitter technology
- Usable for aggressive media with offline calibration function

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Level measurement of lime in a wastewater treatment plant

- Automated stock management of fine powders in a high and narrow silo
- 80 GHz radar (FMCW) for accurate, continuous monitoring of lime consumption
- Optimized supply inventory

1. Background

An industrial wastewater treatment plant in France uses lime to adjust pH and alkalinity in coagulation, flocculation and biological treatment processes. The lime is stored in a conical, tall and narrow silo with a height of 12 m / 39.37 ft and a diameter of 3 m / 9.84 ft.

2. Measurement requirements

The silo level must be continuously monitored in order to ensure the uninterrupted supply of lime for the different treatment processes. Former measuring devices were struggling with the uneven product surface, dust and build-up of this low-reflective medium (ε_r value: 1.6). Hence, the customer was looking for a more reliable measurement solution and was looking to automate his stock management at the same time.

Wastewater treatment plant

KROHNE

3. KROHNE solution

KROHNE proposed the OPTIWAVE 6500 C. The 80 GHz Radar (FMCW) level transmitter for powders and dusty atmosphere was installed with DN100 flange and a flush-mounted DN70 / 2.75" PEEK Lens antenna. Fitted on top of the fibreglass nozzle (230 mm / 9" high) of the silo, it continuously measures the level of lime and transmits the values to the DCS in a control room.

Thanks to the small beam angle of the Lens antenna, this powerful device handles the high and narrow silo even in the presence of internal obstructions.

Flush-mounted Lens antenna

OPTIWAVE 6500 C installed on top of the lime silo

4. Customer benefits

The customer benefits from an optimized supply inventory of the plant. The OPTIWAVE 6500 provides accurate continuous level measurement of lime regardless of the dusty atmosphere, uneven product surface or low dielectric constant. The specific algorithms and high signal dynamics of the 80 GHz device are key to providing reliable readings despite these challenging conditions.

As an additional benefit, the level transmitter enables trouble-free installation, commissioning and operation, all of which results in a fast return on investment altogether. The Lens antenna is flush-mounted, meaning there is no intrusion into the tank. This way, the radar device considerably reduces the risk of build-up and keeps maintenance costs to a minimum.

5. Product used

OPTIWAVE 6500 C

- 2-wire 80 GHz non-contact FMCW radar level transmitter for powders and dusty atmospheres
- High dynamics for clear vision despite dusty conditions or low reflective media
- Flush-mounted PEEK Lens antenna with small beam angle (no tank intrusion)
- Unaffected by angle of repose – no need for antenna aiming kits
- Purging system for flange connection without antenna extension
- 112 mm; 4.4" antenna extension for long nozzles
- Extensive choice of process connections: threaded ≥1½" and flange ≥DN50 / 2"
- Measuring distances up to 100 m / 328 ft
- ±2 mm; ±0.08" accuracy
- Process conditions up to +150 °C / +302 °F, 40 barg / 580 psig
- Quick setup assistant for easy commissioning
- Empty tank spectrum function that eliminates false reflections
- Large backlit LCD display with 4-button keypad and text displayed in 12 languages
- Free PACTware™ DTM with full functionality

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

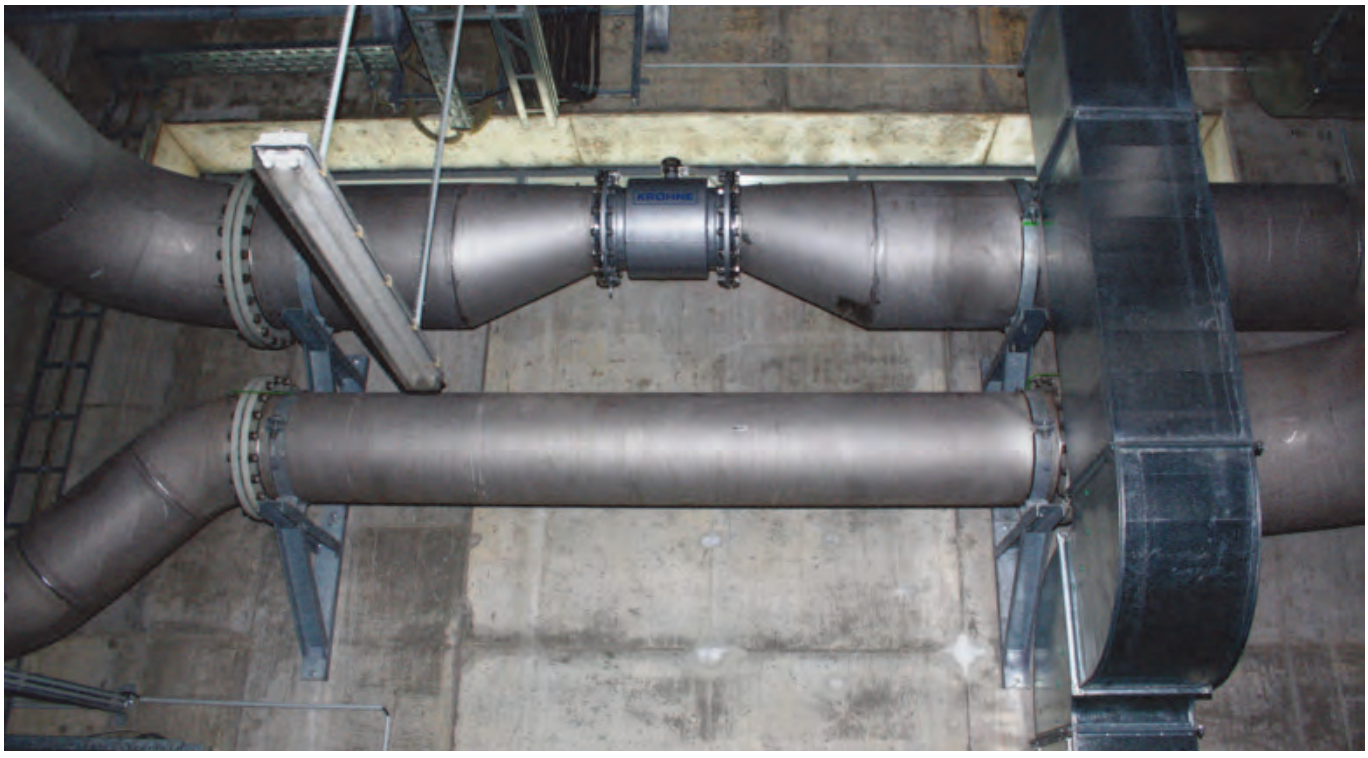
Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Effluent

- Flushing water measurement for filter regeneration in a waterworks 84
- Monitoring the wastewater quality in the effluent channel of a sewage treatment plant 86
- Equipping a watercourse protection facility with measuring technology 88



APPLICATION REPORT

Water & Wastewater

Flushing water measurement for filter regeneration in a waterworks

- Electromagnetic flow measurement in large pipelines (DN 700 / 28") without inlets/outlets
- Volume and flow velocity monitoring to control flush programs
- Protection of activated carbon and multi-layer filters through targeted adaptation of flush behaviour

1. Background

The Aschaffenburger Versorgungs-GmbH (AVG) in Germany operates a waterworks that treats well water to turn it into high quality potable water. The waterworks was thus equipped with sophisticated treatment technology. This enables a fully automated treatment process from decarbonization (softening) to denitrification (nitrate elimination) down to secondary cleaning through filtration and UV disinfection. The company supplies 130,000 people in the region with a total annual water volume of 7.3 million m^3 / 257 million ft^3.

2. Measurement requirements

Before the treated water passes to the clean water tanks and from there is fed into the drinking water network, multi-layer and activated carbon filters are used as part of the secondary cleaning to eliminate all herbicide and pesticide residue. As soon as the filters need to be flushed they are filled with flushing water. To guarantee optimal filtration, the rinse behaviour must be controlled (i.e. the volume of water per time unit determined by pressure and flow velocity, in accordance with the desired filter bed expansion and depending on the density and composition of the filter material).

Up to now the waterworks has been trying to control the flushing by measuring the level of the flushing water tank. They found, however, that it was not easy to control the flush behaviour of the water being pumped out of the tanks in this way and that flushing results were invariably poor or insufficient as a result of too high or too low flow velocities. So the customer started looking for a flow measurement solution in front of the 6 multi-layer and activated carbon filters that could control the volume of flushing water going through the pump as needed. Due to the extremely confined space for installation, the required measuring instrument could only be used in one area of the pipeline (DN 700 / 28") without sufficient inlets and outlets.

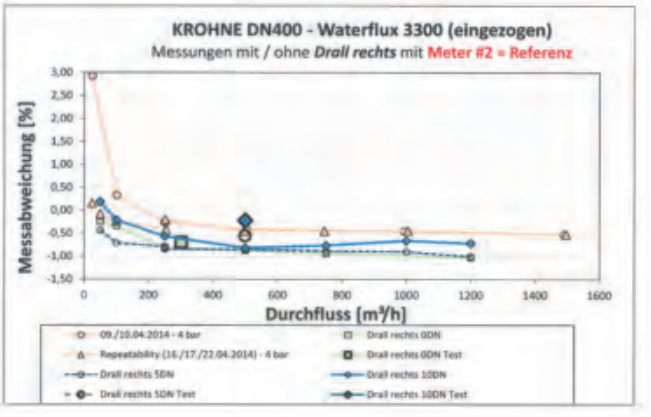
3. KROHNE Solution

AVG decided to use the WATERFLUX 3300 W. The electromagnetic flowmeter (EMF) features a flow-optimised pipe cross-section that enables installation without inlets and outlets. The measuring device was supplied in DN 400 /16" and installed at a height of 5 m / 16.4 ft in a tapered part of the pipeline in front of the filter systems. In addition to the volume, the WATERFLUX 3300 also measures the flow velocity of the flushing water. The measurements are then transmitted to a PLC to control the pump in accordance with the flush requirements.

Wall version of converter (left) and sensor (right) of the WATERFLUX 3300 W electromagnetic flowmeter

4. Customer benefits

The WATERFLUX 3300 helps with efficiently flushing and operating all 12 filters without the filling material being discharged during the flush process or the filter not having the desired throughput of water after flushing, resulting in further costs. AVG benefits from the use of an EMF which, compared to virtually all competitors' devices in this size, can be used without inlets and outlets. The DN 400 WATERFLUX used in this application was tested in 2015 by PTB (Germany's national metrology institute) under varying reference conditions and inhomogeneous flow conditions. The accuracy values for the EMF indicated by KROHNE when installing without inlets and outlets are hereby completely confirmed.



Test results for the reference measurements of the PTB

5. Product used

WATERFLUX 3300 W

- Electromagnetic flowmeter for water applications
- High accuracy and large measuring range (DN 25...600 / 1...24")
- Optimised flow profile thanks to rectangular pipe cross section
- No inlets or outlets necessary for installation in confined spaces
- Also suitable for custody transfer applications

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Monitoring the wastewater quality in the effluent channel of a sewage treatment plant

- Continuous turbidity measurement to control wastewater discharge
- Turnkey solution from delivery and installation to integration

CODAH
Communauté de l'Agglomération Havraise

1. Background

The municipal association CODAH (Communauté de l'Agglomération Havraise) is responsible for environmental, supply and disposal tasks in several municipalities in Normandy, France. Among other things, the association operates a sewage treatment plant in the city of Le Havre. Here, wastewater is treated and then discharged into the port of Le Havre.

2. Measurement requirements

For reasons of quality and safety, the water authority has ruled that the turbidity of the wastewater must be continuously monitored before being discharged into the port. In order to comply with these regulations, CODAH was searching for a method to measure turbidity (NTU or TSS measurement) in the wastewater discharge.

Port of Le Havre

The maximum flow rate in the effluent channel is very high (9000 m³/h / approx. 40,000 gal US/min). For this reason, the instrumentation had to be extremely sturdy and easy to install. The measuring results were to be transmitted to a SCADA system. The goal of the measurement is to stop the wastewater discharge as soon as the turbidity increases too much. Another requirement of the water authority was that the control room be warned via an additional error signal in case of a measuring point malfunction.

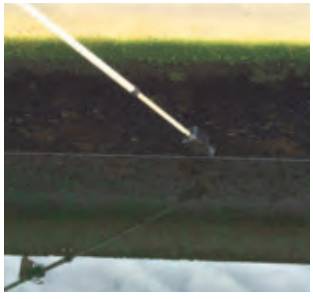
KROHNE

3. KROHNE solution

KROHNE recommended using a combination of products including the OPTISENS TUR 2000 turbidity sensor, the SENSOFIT IMM 2000 immersion assembly and the MAC 100 analytical transmitter. The immersion assembly was attached to the turbidity sensor outside on the effluent channel (concrete Venturi channel). To avoid causing disruptions on the water surface which would negatively influence the existing level measurement, the turbidity sensor measures downstream behind an ultrasonic level transmitter already in place.

The entire process instrumentation including sensor, immersion assembly and transmitter was installed, wired and then integrated into the SCADA system (with the help of a partner company).

Turbidity measurement in the effluent channel



OPTISENS TUR 2000 turbidity sensor with telescopic rod holder

4. Customer benefits

Now the customer can regulate the discharge of the water using the water quality in the effluent channel and shut it off if necessary. At the same time, CODAH benefits from a complete and immediately operational solution. The solution included the delivery and installation of the instrumentation and also covered the adaptation of the SCADA system to monitor the measuring point.

In cooperation with the partner company for the automation and system integration, the measuring point was wired to the control room over a distance of 300 m / 984.3 ft. This offered the customer a more efficient and economically sound alternative to the wireless connection suggested by competitors. In light of the thickness of the walls in the building, this guarantees increased reliability when it comes to data transmission.

5. Products used

OPTISENS TUR 2000

- Optical turbidity sensor for water and wastewater applications
- In combination with analytical transmitters or an integrated transmitter (2-wire, with 4...20 mA and Modbus) for connection to the control system
- 0...400 NTU/FNU; max. +50°C / +122°F

SENSOFIT IMM 2000

- Immersion assembly for general water and wastewater applications
- Telescopic rod with adjustable immersion length (up to 4 m / 13.1 ft)

MAC 100

- Analytical transmitter for liquid analytical measurements with sensors in the OPTISENS portfolio
- Output: 3 x 4...20 mA, 3 relays (mechanical)
- Input: max. 2 x sensor, 2 x temperature

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Equipping a watercourse protection facility with measuring technology

- Monitoring limit values for the discharge of wastewater from building sites
- Measurement of pH, turbidity, conductivity, level, flow and temperature for the operation of a watercourse protection facility
- Direct communication with the control system: Use of sensors with integrated transmitter

1. Background

The Austrian company GSA UMWELTTECHNIK KG specialises in the planning, development and manufacture of modular watercourse protection facilities. They are used on building sites to monitor and treat contaminated wastewater (e.g. from excavation, drilling and washing) so that it can be subsequently fed back into the sewer system or receiving waters (recipient) in compliance with existing legal limits. Among the system modules that the company offers is a component for neutralisation.

2. Measurement requirements

This type of neutralisation module helps regulate the pH value of the wastewater from the building site that has been increased through contact with cement or concrete. According to environmental regulations, the pH value may not exceed 8.5. If the pH value is above this threshold, the basic wastewater must be neutralised by adding acid and carbon dioxide.

GSA UMWELTTECHNIK was looking for suitable measurement technology to equip just such a neutralisation module for a construction project. In addition to the actual pH measurement, the customer also wanted to monitor the conductivity of the product and the turbidity, level and temperature of the wastewater from the building site. As the installation of separate transmitters at the building site is extremely expensive and unnecessary for a higher-level host system (for monitoring), the measurements were to be transmitted directly from the sensors to GSA's own control unit.

Building site wastewater

3. KROHNE solution

GSA UMWELTTECHNIK uses the SMARTPAT PH 2390 pH sensor to maintain the pH limit value. In addition, the SMARTPAT COND 5200 conductivity sensor monitors the conductivity of the wastewater, which is sometimes extremely elevated due to the presence of rock elements and/or building materials. To avoid suspended solids from the upstream settling tanks (sedimentation) getting into the discharge, the OPTISENS TUR 2000 also measures the turbidity. All three sensors feature an integrated transmitter, allowing them to communicate directly with the control system. The customer also uses the extremely compact OPTISOUND 1050 ultrasonic level transmitter to determine the level and flow via a measuring weir. To complement this equipment, the TRA-C30 compact resistance sensor monitors the temperature.

Measurement of pH, turbidity, conductivity and level

4. Customer benefits

All of the wastewater parameters can be centrally monitored, preventing the threshold values from being exceeded. All measurements are transmitted directly to the central GSA control system via 4...20 mA. There was no need to purchase and install separate transmitters, which avoided costs and saved space. In addition, with the SMARTPAT sensors, GSA UMWELTTECHNIK provided its end customer with analytical measuring technology that can be quickly maintained and calibrated via PC using a simple HART® interface. This reduces operating costs for the end user over the long term.

5. Products used

SMARTPAT PH 2390

- Potentiometric pH sensor for municipal and industrial wastewater
- With integrated transmitter (2-wire, 4...20 mA/HART®7)
- Low maintenance and expenditure thanks to offline calibration under controlled conditions

SMARTPAT COND 5200

- Conductive conductivity sensor for industrial wastewater
- With integrated transmitter (2-wire, 4...20 mA/HART®7)
- Measuring range: 10 µS...15 mS/cm; Max. +130°C / +266°F

OPTISENS TUR 2000

- Optical turbidity sensor for wastewater applications
- With integrated transmitter (2-wire, 4...20 mA or Modbus)

OPTISOUND 3010

- Ultrasonic level transmitter for simple wastewater applications
- Continuous, non-contact measurement up to max. 5 m level

OPTITEMP TRA-C30

- Compact sensor (RTD) for industrial process and OEM applications
- With integrated transmitter and M12 connector

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

CONTENTS

Sludge treatment

- Flow and concentration measurement for automated sludge thickening 92
- Flow measurement of fat for CO fermentation 94
- Checking the energy production of a sewage treatment plant 96
- Flow measurement of raw biogas 100

APPLICATION NOTE

Water & Wastewater

Flow and concentration measurement for automated sludge thickening

- Control loop for the efficient dosing of flocculants in the secondary clarifier
- Measurement of total solid content and flow with just one instrument
- Increased process stability thanks to effective prevention of sludge washout

1. Background

In biological wastewater treatment, floating sludge can form in the secondary clarifier in certain circumstances. In order to ensure that this does not get into the process and pollute the purified wastewater, the sludge must be treated quickly.

A wastewater treatment plant in eastern Switzerland relies on the targeted use of flocculants to prevent sludge washout.

2. Measurement requirements

In the past the operator used a laboratory analysis of the total solid (TS) content in combination with an electromagnetic flow measurement in order to determine the flocculant requirement. This was, however, a very laborious task. Sampling for the laboratory analysis required considerable manual effort. Furthermore, there was always a delay in obtaining the results. The conventional electromagnetic flowmeter (EMF), on the other hand, was too high-maintenance for this application, because the watery sludge settled on the electrodes like a layer of fat, which meant the EMF had to be cleaned regularly.

Medium:	Waste activated sludge
Flow rate:	approx. 20 m³/h / 706 ft³/h
TS content:	0.6...1.2 g/l

The customer wanted to automate the sludge treatment so as to be able to use the flocculants more efficiently. This required a continuous and maintenance-free flow measurement, as well as an inline concentration measurement in real time. The measured values needed to be sent directly to the programmable logic controller (PLC) for the control loop.

KROHNE

3. KROHNE solution

KROHNE recommended using the OPTIMASS 7400 C. The Coriolis mass flowmeter measures flow and density in a single instrument. The measuring device determines the TS concentration based on the density. This is done by identifying the ratio of water to sludge, i.e. the measured process density is checked against the initial density values of water and sludge that were programmed into the Coriolis meter. To compensate for changing densities of both media due to varying temperatures, the flowmeter also features an integrated temperature sensor.

A device version with titanium measuring tube was chosen to enable optimum density measurement. The measuring device was installed directly in a pipe tapered from DN80 to DN50. The size of the measuring device was DN40, which was below the flange size (DN50). The OPTIMASS 7400 sends the flow and concentration to the PLC via two current outputs.

The customer also uses the OPTIFLUX 1050 C electromagnetic flowmeter (EMF) to close the control loop. The EMF (DN15) transmits the flowrate of the flocculant to the PLC.

Installation in tapered pipe

Flocculant measurement with the OPTIFLUX 1050

4. Customer benefits

Thanks to the combined inline measurement of the TS content and flow, the customer can now optimally condition the sludge with flocculants. Optimal dosing means greater process stability, and sludge washout no longer occurs, which makes operation even more stable and efficient. In addition, savings can be made on the cost of flocculants as overdosing is now a thing of the past.

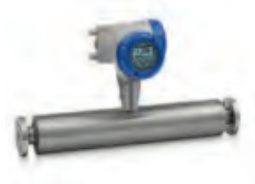
Measuring point with OPTIMASS 7400 C

Throughout the service life, the customer can also enjoy considerable cost savings thanks to the high process reliability and maintenance-free system. Compared to a conventional solution with two individual measuring devices for flow and TS, or one flow measurement and extra online analysis of the TS content at a laboratory, using the OPTIMASS 7400 is cost-neutral for the customer.

5. Products used

OPTIMASS 7400 C

- Coriolis mass flowmeter for mass and volume flow, density and concentration of waste activated sludge
- With titanium measuring tube for stable and accurate measurements
- Single straight-tube design: self-draining and maintenance-free
- Maintains operation even with entrained gas of up to 100% (EGM™)



OPTIFLUX 1050 C

- Electromagnetic flowmeter for simple applications
- Low-cost measurement of conductive liquids

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION NOTE

Water & Wastewater

Flow measurement of fat for CO fermentation

- Increasing biogas yield during anaerobic sludge stabilisation in a digestion tower
- Flow measurement of highly adhesive fat mixture for billing and dosing purposes
- Replacement of conventional electromagnetic flowmeters (EMF)

1. Background

A municipal water management company in Saxony-Anhalt, Germany, operates a sewage treatment plant for wastewater from approximately 90,000 inhabitants. In order to provide its own energy and heat, the utilities company also operates a combined heat and power (CHP) unit fed with biogas. Sewage sludge from the sewage treatment plant is used in biogas production.

To optimise biogas yield from the sewage sludge, the digestion tower is enriched with external carbon sources for the digestion process (CO fermentation). This includes grease/water mixtures from grease separators, commercial kitchens, fish and meat plants as well as oil mills and chocolate factories, all delivered in vacuum tankers with a capacity of 12 m³ / 3,170 gal (US).

2. Measurement requirements

The customer has been using conventional electromagnetic flowmeters (EMF) for billing the grease quantities delivered and subsequent loading of the digestion tower. However, the grease/water mixture is only very low conductive and leaves large fat deposits, especially on the inside of the pipe walls. As a result, the electrodes on the measuring devices became clogged. This meant that the EMFs sometimes displayed a flow rate even during downtime.

Pipeline from CO fermentation with large fat deposits

Unlike for the measurement of wastewater loads in sludge acceptance, these types of EMF are not suitable for CO fermentation. Transparent billing and other optimisation of CO fermentation is not possible with these devices. For this reason, the sewage treatment plant operator was looking for a measuring device that came in at the same price point as conventional EMFs but that could measure extremely greasy and adhesive products.

KROHNE

3. KROHNE solution

The operator of the sewage treatment plant replaced the existing EMFs with two OPTIFLUX 7300 C (DN80 / 3") flowmeters. These electromagnetic flowmeters feature large-area, non wetted electrodes installed behind the liner that enable capacitive signal pick-up. The signal pick-up between the product and the electrode is thus not affected by the fat deposits.

For billing purposes an OPTIFLUX 7300 was installed directly at the collection point and in front of the storage containers in which the fat is mixed into a uniform suspension. Behind the containers, a second OPTIFLUX 7300 measures the flow to the digestion tower. In keeping with these measured values, the PLC controls a pump to evenly load the digestion tower with fat.

Installation of OPTIFLUX 7300 C for billing purposes

4. Customer benefits

Unlike conventional EMFs, the OPTIFLUX 7300 C ensures long-term stable measurement of the fat mixture. The design of the KROHNE device eliminates measuring errors such as those that occurred with the old devices. This now allows the customer to transparently bill fat quantities and to run the dosing process efficiently and with the best possible gas yield in mind.

On top of that, CO fermentation can now be optimised further. In the future, even higher-quality fats from oil mills and chocolate factories can be strategically collected in a tank and precisely added as needed. This also makes it possible to achieve consistent fat quality, even if the fat delivered over a prolonged period of time has a low energy value. Thanks to the use of the OPTIFLUX 7300 C, the operator is one step closer to the goal of self-sufficient energy supply to the sewage treatment plant.

Flow measurement of fat for pump control

5. Product used

OPTIFLUX 7300 C

- Electromagnetic flowmeter with non wetted electrodes and ceramic liner for the measurement of fat quantities for CO fermentation
- No insulation, corrosion or wear on the electrodes due to fat deposits
- Suitable for low conductivities up to 0.05 µS/cm / µmho/cm
- Excellent accuracy and long-term stability
- ATEX (zone 1)
- HART®, FOUNDATION™ fieldbus, Modbus, Profibus®-PA/DP, PROFINET

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

APPLICATION REPORT

Water & Wastewater

Checking the energy production of a sewage treatment plant

- Measurement of energy transport from digestion tower to biogas plant
- Vortex flow measurement of methane at 7 to 8 mbar / 0.10 to 0.11 psi of pressure
- Superior measurement stability despite descending pipeline and fluctuating parameters

Kanalwerk BURGHAUSEN

1. Background

The Burghausen public utility company operates a sewage plant including sewage treatment plant and connected combined heat and power plant fuelled by digester gas (methane). To this end, the sewage sludge is transported from the sewage treatment plant to the digestion tower where the residual solids are partially decomposed by microorganisms. The methane released in the process is then supplied to the biogas plant as an energy source.

Gas inlet with first water separator

2. Measurement requirements

To obtain accurate information about the energy production of the sewage treatment plant the operator requires continuous measurements of the volume and energy flow of the methane being transported from the digestion tower to the combined heat and power plant. Despite two water separators installed in the pipeline, the exhaust gas is still very wet. The pressure of the gas was initially very low at 65 mbar / 0.94 psi and decreased over time to 20 mbar / 0.29 psi and then to an average of just 7-8 mbar / 0.10-0.11 psi with the installation of a low pressure system. Despite the insulation in the digestion tower, the gas is exposed to external influences such as seasonal temperature fluctuations, which then affect the gas density (0.717 kg/m³i.N. / 1.565 lbs/scf). The operator of the sewage treatment plant had already tried using a differential pressure device but stopped using it due to faulty measurements. Based on this experience he was very skeptical about finding a measuring principle that would work with the existing parameters.

Flow measurement of methane gas at 7 mbar / 0.10 psi

KROHNE

3. KROHNE solution

KROHNE provided the OPTISWIRL 4070 C vortex flowmeter – initially as a test device – in the recommended size of DN25 / 1". To accommodate, the pipeline had to be reduced to DN25 / 1" from the original DN50 / 2". The device was installed as per customer request with a flange connection in a descending pipeline. The necessary inlet and outlet runs were provided.

The vortex device measures the operating pressure, temperature and volume flow and then automatically calculates the mass and energy flow of the methane gas based on those measurements. As the instrument also features a shut-off valve, its pressure sensor can be replaced if necessary, even during operation and without process intervention.

OPTISWIRL 4070 C in descending pipeline

4. Customer benefits

With the OPTISWIRL, the operator of the Burghausen sewage plant can accurately test and demonstrate the performance and energy production of his sewage treatment plant. In so doing he benefits from the OPTISWIRL's large span. Even though the system pressure following the conversion decreases to 7 mbar / 0.10 psi or even lower and the gas is extremely wet, the device still measures continuously and provides accurate measuring results.

Given the measuring parameters, the customer was surprised by the measuring performance of the OPTISWIRL and made the decision to purchase the instrument. The OPTISWIRL has now been running without interruption for over three years and without any maintenance requirements. The vortex device in the sewage plant has measured over 620,000 m³ / 21,891,171 f³ of digester gas to date.

5. Product used

OPTISWIRL 4070 Vortex flowmeter

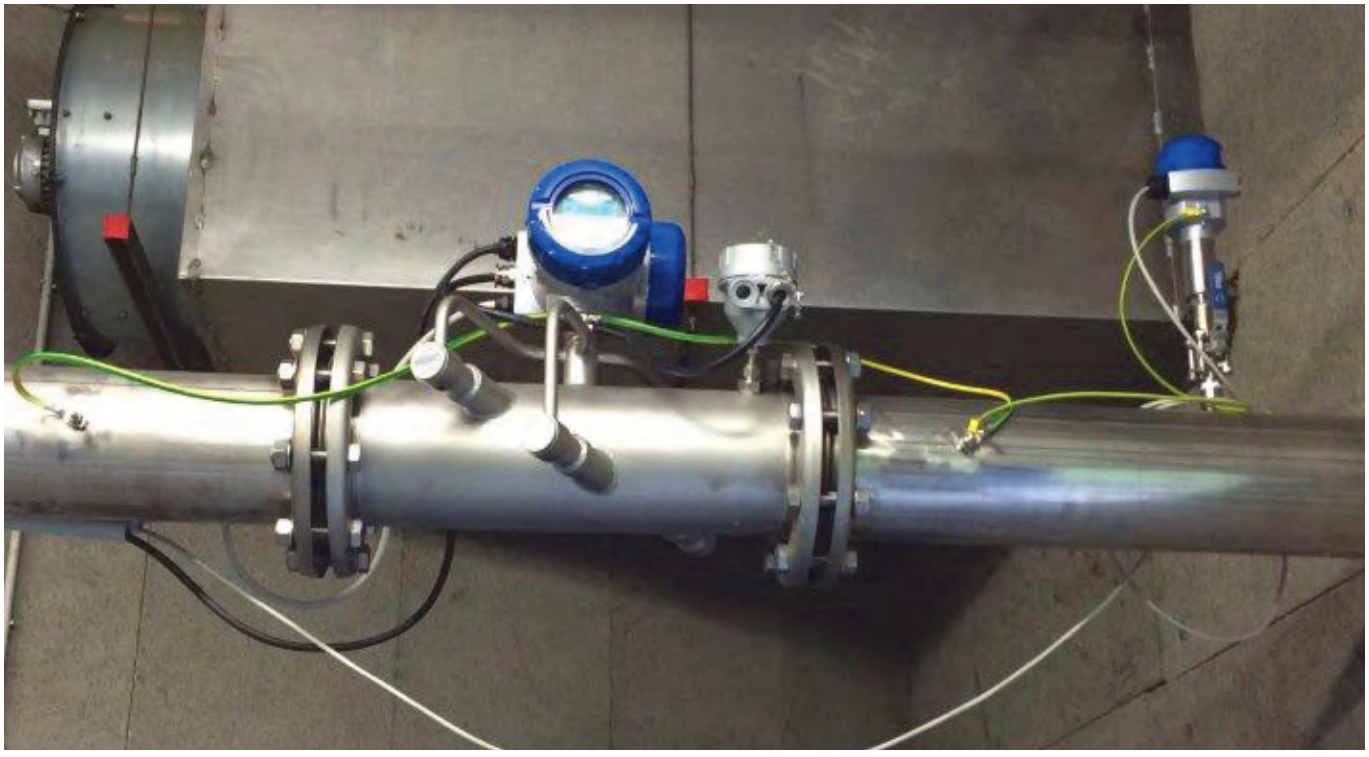
- 2-wire device with integrated pressure and temperature compensati and conversion into energy
- Non-wearing, fully-welded stainless steel construction
- Suitable for wet gases
- High resistance to corrosion, pressure and temperature
- High measuring accuracy and long-term stability
- Immediately ready to use thanks to plug & play

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com



APPLICATION REPORT

Water & Wastewater

Flow measurement of raw biogas

- Supplying a boiler with power for sewage sludge incineration
- Ultrasonic flow measurement of wet gas with corrosive H_2S content
- Integrated calculation of methane content to determine biogas quality

1. Background

The Saur Group supports municipal and industrial customers with development projects in the fields of building, energy and water. In the field of wastewater treatment, the service provider is helping the municipal association of Saint-Etienne Métropole in southwest France implement a modernisation plan to improve treatment processes. Out of consideration for the region's ecosystem, the wastewater treatment plant operated there may only divert purified wastewater loads into the Loire river. The sludge accumulated during cleaning is reused as part of a sustainable economic strategy and sent to a digestion tower for fermentation. The plant operator uses the biogas produced in the process as an energy source to burn the dried sludge.

2. Measurement requirements

To ensure that the biogas can be used as the primary energy for the boiler, the operator needs to know the quantity and quality of the biogas produced. Only when the methane content of the biogas is above 60% vol. can the medium be used as an energy source for the boiler. This requires a technical solution capable of measuring the volume flow (40 Nm^3/h / 24.9 SCFM) and calculating the methane content in the raw biogas. The product is difficult to manage. Parameters including low pressure (50 mbar / 0.72 psi), fluctuating temperatures, a high CO_2 content and parts of water and hydrogen sulphide (H_2S) influence the measurement.

3. KROHNE solution

KROHNE recommended the OPTISONIC 7300 Biogas ultrasonic flowmeter (in DN150 as Ex version). The flowmeter is specially designed to measure biogas with a high CO_2 content and small amounts of other gases like H_2S and condensation water. The device features integrated temperature measurement and can calculate methane content. KROHNE Service tested the use of the device on-site once again and a suitable measuring point was selected.

Inspecting the measuring point

The device was then installed directly behind the biogas filter in a stainless steel DN150 pipeline. KROHNE integrated the measuring point into the customer's process and installed and started-up the measuring device according to customer specifications. The OPTISONIC 7300 was also connected to the OPTIBAR PC 5060 pressure transmitter for the integrated calculation of the standard volume.

The OPTISONIC 7300 Biogas installed behind the filter

4. Customer benefits

The OPTISONIC 7300 Biogas now allows the wastewater treatment plant to feed the boiler with biogas at the best possible rate. The customer uses the ultrasonic flowmeter to find out how much biogas he is producing or still has saved in the gasometer. Now the operator can also determine the quality of the biogas and decide whether the methane content is high enough to burn the biogas or whether it still needs to be treated.

KROHNE Service implemented the complete measuring point without the customer having to deal with a prolonged, unplanned process interruption.

5. Products used

OPTISONIC 7300 Biogas

- Ultrasonic flowmeter for biogas, landfill and sewage gas applications
- With integrated temperature sensor and optional integrated pressure sensor
- Integrated standard volume correction and methane content measurement
- Also for use in hazardous areas (Zone 1)
- Lap joint flange: DN50...200 / 2...8", max. PN10 / ASME Cl 150
- 4...20 mA, HART®, Modbus (optional)

OPTIBAR PC 5060 C

- Pressure transmitter for advanced process pressure and level applications
- Robust design with corrosion and abrasion resistant ceramic diaphragm
- Maximum overload and vacuum resistance
- Extremely short response times
- Modular design: converter platform for all applications

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

www.krohne.com

NOTES

NOTES

KROHNE – Process instrumentation and Measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process analytics
- Services

Head office
KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg
Germany
Tel.: +49 203 301 0
Fax: +49 203 301 103 89
application@krohne.com

Global companies and representatives
The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

KROHNE