HIGH-PERFORMANCE MEASUREMENT TECHNOLOGY IN THE WATER INDUSTRY

Surface Water

Ensuring good water quality, monitoring and regulating water levels, checking pressure conditions in water pipelines, and measuring the fill levels in tanks – measurement technology plays a major role in the water industry. With its extensive expertise and many years of experience, KELLER AG für Druckmesstechnik is able to offer a wide range of pressure sensors for water-industry applications.

Nothing runs without water! After all, water isn't just one of the great elements; it's also vital for our survival. Water is both a foodstuff and a necessary part of the process for growing food and maintaining livestock. Water also keeps industry moving as a coolant, a means of transport and a component of power generation processes. In other words, without water, our economy would come to a virtual standstill.

Water should therefore be viewed as essential and irreplaceable. Water is not available in unlimited supply, which is why we are all obligated to use it efficiently and carefully – and not just because of economic interests. Reliable and accurate measurement technology is extremely important here, and KELLER AG für Druckmesstechnik has been doing its part by ensuring reliable pressure measurement in the water industry for more than 45 years now. This is accomplished by the use of level sensors, data loggers, remote transmitters and display units that monitor water supply systems, sewage systems, groundwater levels and surface water. This brochure offers an in-depth look at cost-effective solutions for water applications that are based on the extensive H2O expertise at KELLER and the knowledge accumulated by customers over many years.

Challenges in the water industry

Water is the most common chemical compound on Earth, covering more than two-thirds of its surface. This is also why Earth is referred to as the blue planet. At the same time, most of this water cannot simply be used as desired, which is why the creation of a solid and reliable water supply also always requires efficient processing of wastewater, groundwater and surface water.

Despite its abundance, water is a finite resource and we need to be able to work with what we have of it, regardless of how many people there are on the planet. Approximately 2.1 billion people around the world still do not have access to safe drinking water, and more than 800 million don't even have a basic water supply system.[1] In addition, polluted and contaminated water continues to cause repeated outbreaks of epidemics, and the global ecosystem is increasingly coming under attack from water pollution. This means that it is of crucial importance to all of us to not only safeguard water supplies but also ensure the sustainable utilisation of this most valuable resource, regardless of the application in question.

Ensuring a reliable supply of drinking water and implementing effective environmental protection measures are not the only challenges associated with water management, as the illustration above shows. Indeed, if we don't come up with solutions to everyday problems, we'll hardly be able to address the major issues. Yet we must address all challenges large and small if we are to continue to benefit from water in every conceivable way. Efficient and effective water supply and monitoring solutions are needed everywhere around the world – and these solutions must be based on accurate and reliable measurement technology.

Surface Water – Reliable Flash Flood Alert

Flash floods are sudden and unpredictable. Within minutes, floods can rise over the banks of streams and onto roads, where they then sweep away cars, devastate houses and endanger people.

Although weather services usually issue warnings before severe weather occurs, the towns affected are generally poorly prepared

(1) UNICEF/WHO: «Joint Monitoring Programme Report: Progress on Drinking Water, Sanitation and Hygiene 2017 Update and Sustainable Development Goal Baselines»

11 June 2013: Elbe river flood in Germany: science photo/Shutterstock.com

3 June 2016: Flooding in the streets of Gera in Germany: science photo/ Shutterstock.com

for flash flooding. This is hard to believe, since most regions in Germany have detailed special maps that deliberately highlight the danger zones so that places at risk can prepare accordingly. However, these maps are rarely to be found in town halls, fire stations or at emergency services centres, which is why people usually fail to take proactive measures. What's more, the special maps are relatively roughly drawn; obstructive buildings and roads acting as channels are not always shown. In addition, because of climate change, extreme weather events are occurring more and more frequently and are also becoming harder to predict. As a result of such developments, the maps are not able to solve every problem,

which is why an IoT solution is required that can identify dangers early on in the farthest-flung corners and reliably raise the alarm for any imminent floods around the clock. This makes it possible to notify the necessary agencies (e.g. emergency services) automatically in a matter of seconds, thereby enabling appropriate measures to be taken promptly. KELLER's GSM-2 remote transmitter forms part of such a warning system. The GSM-2 combines an autonomous data logger and a remote transmitter in one device. When used with a pressure transmitter or a level sensor, it reliably transmits water levels and pressure data via the GSM mobile phone network by SMS, e-mail or FTP to those responsible in order to issue flood warnings in good time.

The US National Weather Service (NWS), for example, uses a GSM-2 solution with accurate level sensors, a remote transmitter and a special type of software adapted to its needs. KELLER also provides technical support for setting up, installing and programming the system, which sends the responsible municipal workers an SMS notification when water levels rise. After the system has been implemented, the infrastructure can be converted from manually positioned mobile barriers to permanently installed swing gates that close when flash flooding occurs.

Surface Water – Dam Water Level Monitoring

Dam in Niedzica, Poland: Shutterstock.com

Dam near the Lomnica river in Karpacz, Poland: Shutterstock.com

Water level monitoring at dams is a basic measurement. The main requirements for such a measurement are reliability and very high accuracy. Series 36 X W level sensors from KELLER can fulfil these requirements while also providing an added benefit in the form of communication via a bus system.

Hundreds of PAA-36 X W level sensors have been installed at numerous dams in Poland, which experiences major flooding on a regular basis. Here, capillary solutions with relative pressure sensors are often not acceptable due to humidity problems. Thanks to RS485 MODBUS communications, all the absolute pressure sensors in the PAA-36 X W series can easily communicate with barometric sensors that also use MODBUS.Their very strong additional lightning protection also makes the level sensors virtually indestructible. None of the sensors has failed since 2009, whereas prior to that time the electronic systems were often damaged by lightning. Apart from the elimination of humidity problems, the use of the absolute pressure sensors provides for extraordinary long term stability and a total accuracy of 0.05% to 0.1% in real conditions.

M.O.S.E helping keep Venice afloat

The Grand Canal and the Rialto Bridge: Shutterstock.com

Concrete element with maintenance walkways and supply conduits: KELLER AG für Druckmesstechnik

city to the Adriatic Sea was widened. The huge amount of water thus introduced carries sediment away and out of the lagoon, and this phenomenon is being reinforced by the effects of global warming.

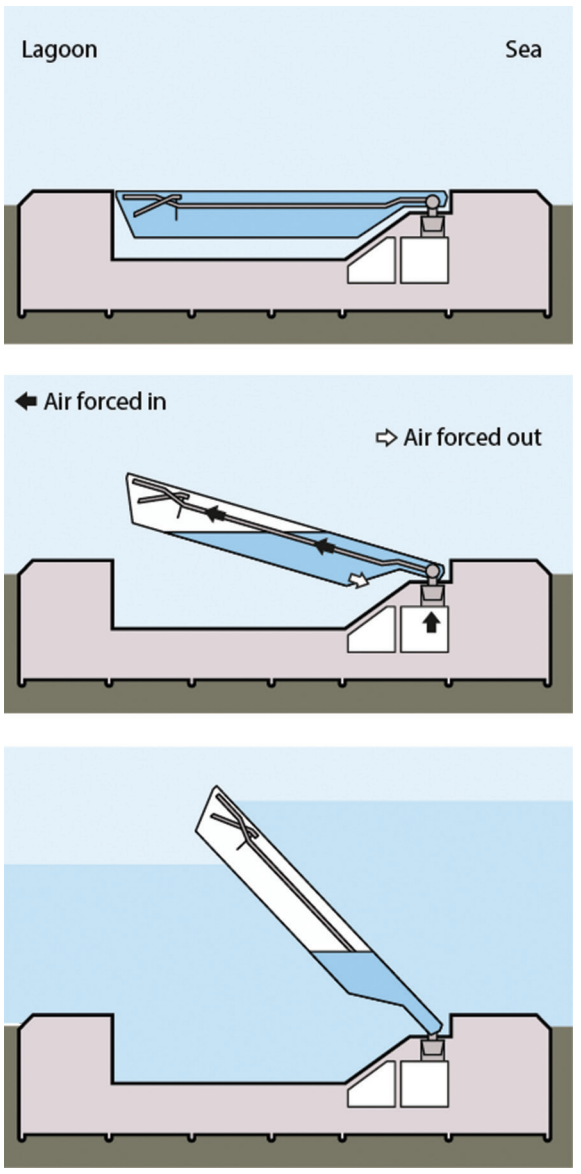
Over the years, various proposals were presented to deal with the problem, but there were also corruption scandals and protests by the local population. Finally, the parties involved agreed to launch a project known as M.O.S.E. (Modulo Sperimentale Elettromeccanico – "Electromechanical Experimental Module").

This flood prevention project uses moveable flood gates installed at the four entrances to the Venetian Lagoon. The idea is to protect the historical centre of Venice from floods that are becoming ever more frequent. The concept is not completely new, as similar flood barriers have also been built in London (Thames Barrier) and Rotterdam (Maeslant Barrier).

When a flood alert is issued, the four entrances to the lagoon are closed off using floating barriers. The flood protection system consists of a total of 78 movable elements. The technology used here is tried and tested, as it's been employed for quite some time at the gates of large ship docks. MO.S.E. is a lot bigger, however, and its gates are also networked with one another and equipped with intelligent control and monitoring systems. Data from throughout the system is sent to a control centre. Information on weather conditions and sea currents is also analysed and used as a basis for decisions on when to close the flood gates.

KELLER transmitters in the foundation

Caissons made of reinforced concrete form the foundation of the flood protection system: KELLER AG für Druckmesstechnik



M.O.S.E gate system: KELLER AG für Druckmesstechnik

Secured by giant hinges set in concrete, the steel gates are 20 metres wide, five metres thick and up to 30 metres high. When there is a danger of flooding, air is pumped into the gates, which causes them to rise up to form a protective barrier against the Adriatic Sea and block off the lagoon like a floodwall. When the water is at a normal level, the gates lie retracted beneath it (see illustration).

Extremely precise data is needed to control and monitor the gates. In order to monitor the structure of the caissons, geotechnical specialists at Agisco s.r.l. therefore installed digital (bus) profilometers in the concrete elements. The profilometers work with highly accurate KELLER X series transmitters with IP-68

protection. This solution guarantees impressively high precision – down to one-tenth of a millimetre over a length of several kilometres.

High-precision pressure transmitters The X series

The pressure transmitter's extremely high accuracy of 0.01%FS is available as an option; the standard precision of the X series (33X, 35X and 36X) is 0.05%FS. This high degree of measurement precision is achieved by combining a stable, floating, built-in piezoresistive transducer with an XEMICS microprocessor with an integrated 16-bit A/D converter. The latter uses mathematical compensation to eliminate the temperature dependencies and non-linearity of the sensor. The transducer registers even the tiniest pressure fluctuations. In order to ensure that this high sensitivity is effectively exploited, the measuring element must be well shielded from disruptive external influences. For example, the floating installation setup completely decouples the transducer from mechanical tension in the outer housing.

Surface Water – Hydrological Water Level Monitoring

The Russian Federal Service for Hydrometeorology and Environmental Monitoring ("Roshydromet") is increasingly making use of systems for monitoring water levels and temperature in rivers and lakes. Some time ago, six divisions at the Federal Service began to switch over to a fully automated hydrological system manufactured by KELLER AG für Druckmesstechnik. The monitoring system must provide measurements that are highly accurate and transparent, as Russian state-owned institutions need to be able to control the security and confidentiality of their own data.

Monitoring icy surface water

Siberian division equipment protected against theft and vandalism : KELLER AG für Druckmesstechnik

The water level monitoring system consists of a 36 XW level sensor, which measures pressure and temperature, and a GSM-2 autonomous remote transmitter, which is used for automatic data collection and transmission. The GSM-2 modules are also equipped with a barometer.

The GSM box needs to transmit correct readings and work

A measurement station operated by Roshydromet's Northern division: KELLER AG für Druckmesstechnik

consistently and independently over several years and in extreme weather, as Roshydromet's northern divisions also use KELLER systems in remote areas in the Gulf of Finland and the Barents Sea. The former is an elongated bay in the Baltic Sea, south of Finland, while the latter is situated north of Finland and flows into the Arctic Ocean, where temperatures can fall to -30 °C.

The data logger is used to help monitor the condition of the ice. All GSM-2-based monitoring systems are equipped with autonomous still and video cameras for security purposes to protect against theft and vandalism. The GSM boxes are installed in walk-in containers in close proximity to the measuring points.

Regular long-term measurements

The hydrostatic systems have been gathering precise measurements every hour for several years now. This data is transmitted to Roshydromet every 12 hours via GSM/GPRS. Measurements are only deleted every five to seven years, as this is when the lithium batteries also need to be replaced. No other maintenance work is required throughout this entire period. The battery charge status is also transmitted along with other data, which makes it easy to plan battery replacements in good time.

Comprehensive installations

Roshydromet's Northern division installed 22 hydrostatic systems fitted with security recorders in the Arkhangelsk region in 2016.

In October 2017, the Siberian division began operating 12 GSM-2 modules with level transmitters. The Siberian part of Russia is also a place where icy temperatures pose the greatest challenge, as the air temperature there can drop to as low as -38 °C. In addition to the security cameras, the containers are surrounded by metal fencing to prevent any kind of vandalism. The video recorder is linked up to the GSM-2 module, to which it sends a signal if anyone gets inside the metal fencing. The module then sends a notification of this to Roshydromet's Siberian division.

In November 2017, four hydrostatic systems were installed in the Chernozem Region in central Russia, where the air temperature generally drops to "only" a maximum of -25 °C. High masts made from steel tubing are used to build these hydrological measuring stations. This type of installation requires the use of GSM modules with dimensions that allow them to be installed inside the masts. More specifically, a diameter of 57 mm (two inches) is standard in the industry here. When set up this way, the measuring station remains hidden and protected from flooding. It monitors the ice levels on rivers and is also fitted with an autonomous camera for security purposes.

There are two systems at Roshydromet's testing site in the Novgorod region, where the measuring stations are also connected to a rain catcher.

Roshydromet operations in the Chernozem (Black Earth) Region: KELLER AG für Druckmesstechnik

GSM-2 box (below) with rain catcher at a testing site in the Novgorod Oblast: KELLER AG für Druckmesstechnik

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