Application Note

Water and Wastewater W-AN15

TELEDYNE ISCO
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Non-contact LaserFlow performance at Hamburg WWTP influent and effluent

LaserFlow at inlet of Hamburg Kohlbrandhoft WWTP.

LaserFlow at outlet of Hamburg Dradenau WWTP.

Teledyne ISCO's LaserFlow® sensor was installed for a test measurement purposes at the inlet of Köhlbrandhöft WWTP and outlet of Dradenau WWTP, both located in Hamburg city. The two weeks tests for each site allowed to check sensor at various flow conditions and prove its accuracy and reliability.

Site Description and Challenges

Köhlbrandhöft and Dradenau WWTPs combined have a total capacity of 1 mln m^3/day, a population equivalent (PE) of 2.2 million. Both plants are managed by Hamburg Wasser Company, Northern Germany's largest public water-supply and wastewater utility. Measurement points are located on the 3-meter wide rectangular channels at the inlet of Köhlbrandhöft and the outlet of Dradenau. Tests performed in September and November 2020 were designed to compare against existing Doppler Area Velocity sensors attached to floats (Köhlbrandhöft), and on the channel bottom (Dradenau). Higher-than-expected failure rates caused the user to consider the possibility that non-contact laser technology would be less affected by wastewater composition and fluctuations in flow.

Existing contact sensors attached to floats at inlet channel of Köhlbrandhöft WWTP.

Flow Rate Fluctuations

Flow measurement conditions on the two large channels are stable at average flow rates, but are significantly more challenging at near zero velocities (< 0.1m/s), and after high flow and stormwater events causing sudden surges. The ability to measure across the entire range was an important requirement, especially the accuracy of the data during high flow/stormwater events that is to be used for managing technological processes within the plant. The customer also wished to reduce the cost of maintaining the flow measurement system. Teledyne ISCO's non-contact laser technology was thought to be an effective way to meet all of these criteria.

LaserFlow and Signature Solution

The LaserFlow sensor was installed approximately 1 to 2 meters above the water surface in the channels at Köhlbrandhöft and Dradenau WWTPs. To ensure quick and easy installation, sensors were attached to existing structures. The non-contact laser technology allows installation and setup without interfering with the flow stream and with no need to rebuild existing channels.

The flow data was collected locally in the Signature® logger and pushed remotely via GSM communication to Teledyne ISCO's Web User Interface Flowlink® Global.

Signature logger installed at Köhlbrandhöft WWTP.

Remote communication enabled the customer to keep track of readings in real time. In addition, the settings of the Signature logger can be changed via remote IP connection, resulting in lower operational costs for each site. Non-contact installation is expected to save costs in the future that would have been required for maintenance if a conventional contact measurement device were installed instead.

Measurement Results

The Signature logger with TIENet® 360 LaserFlow sensor showed consistent measurement results despite challenging conditions at low velocities and high flow rate fluctuations.

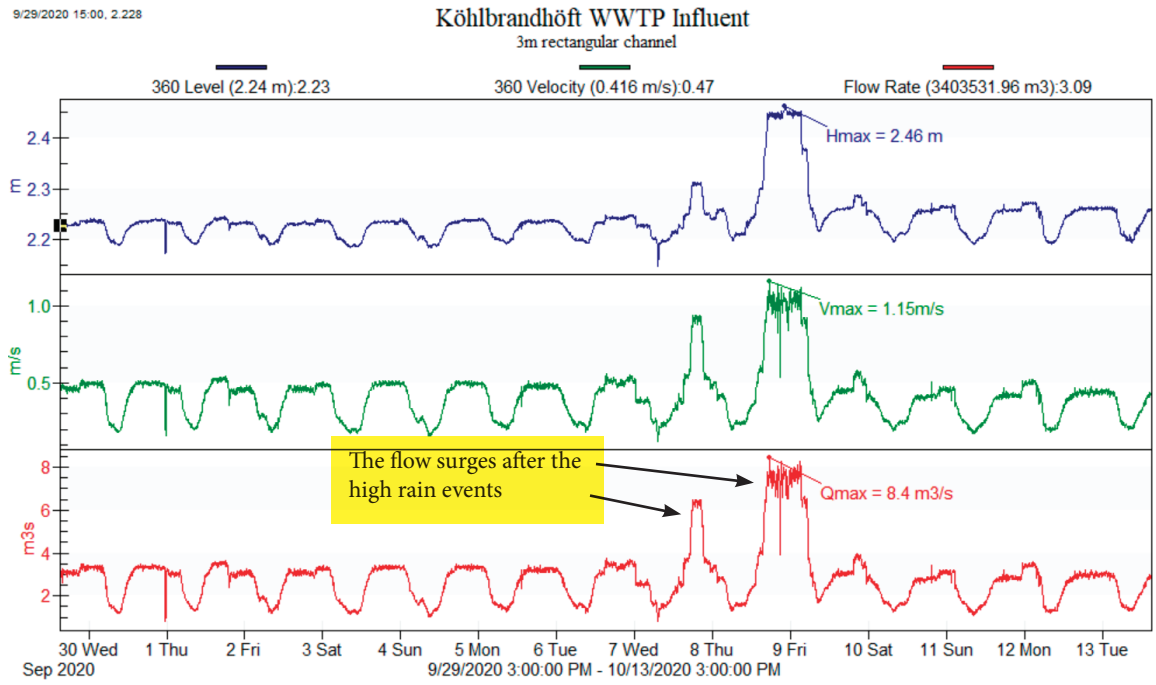
Graph 1 on the next page presents the data from the Köhlbrandhöft WWTP (influent). Significant flow surges occurred twice during the measurement period, after the intensive rain events. The maximum flow peak recorded at 8.4 m^3/s was more than 2.5 times higher than the average flow of 3.09 m^3/s for the two-week time span. In the same period the velocity increased from around 0.6 m/s to over 1.1 m/s.

The minimum velocity in the channel could drop below 0.2 m/s at the flow rate of 1.1 to 1.5 m^3/s during morning hours. This indicated possible flow condition changes between dry and wet periods, and depending on the time of day.

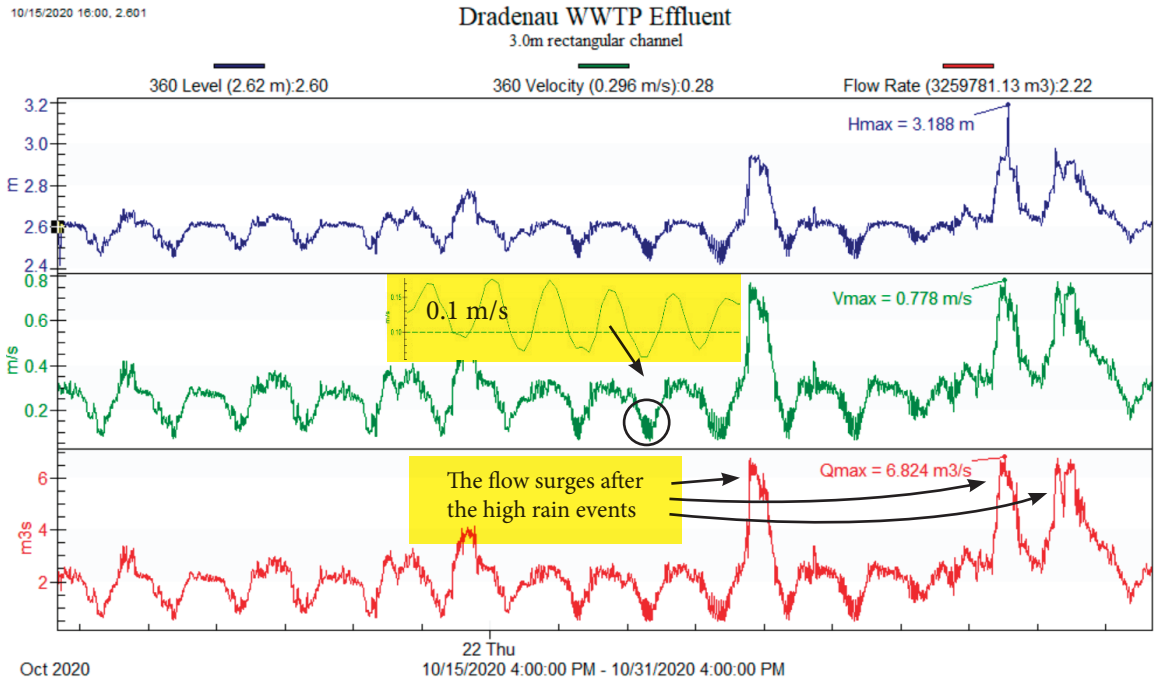
Graph 2 presents the data from the Dradenau WWTP effluent channel. The flow peaks caused by the rain events were recorded three times during the measurement period, reaching max Q equals 6.82 m^3/s, being more than 3 times the average flow 2.22 m^3/s for the whole measurement period. The velocity for all events increased from around 0.4 m/s to nearly 0.8 m/s. The velocity in this channel also tends to drop well below 0.1 m/s at flow rates between 0.5 to 1.0 m^3/s.

Due to the large channel capacity, even small changes in water level can cause large increases in flow. The level changes recorded did not exceed 0.8m at Dradenau and 0.3 m at Köhlbrandhöft.

The data recorded reflected conditions characteristic for such large channels on WWTPs, where flow changes might be significant in a longer period of time. The data shows the flow rate at minimum velocities can be around one third to one-half of the average flow and therefore it is critical to continuously obtain accurate readings for the near zero velocities as well.



Graph 1. LaserFlow measurements at the inlet of Köhlbrandhöft WWTP.



Graph 2. LaserFlow measurements at the outlet of Dradenau WWTP

Customer's Feedback

The tests performed on the two channels on Hamburg WWTPs at various flow conditions and at different wastewater quality conditions (untreated and treated wastewater) proved high reliability, accuracy, and versatility of the LaserFlow system. As per customer opinion: "It is impressive how accurately one single non-contact sensor is able to measure the flow in a channel of such large dimension".

TIENet® 360 LaserFlow Sensor

The TIENet 360 LaserFlow sensor is an area-velocity flow and water-level measurement device that remotely senses flows in open channels using non-contact Laser Doppler Velocity Sensing and non-contact Ultrasonic Level Sensing technologies. The sensor uses advanced technology to measure velocity with a laser beam directed at single or multiple points below the surface of the wastewater stream. Therefore, unlike radar technology, it does not require the creation of ripples on the surface of the stream.

- Zero deadband from measurement point in non-contact level and velocity measurements Continuous measurements in submerged conditions
- Advanced velocity diagnostics for data quality evaluation and analysis
- Bidirectional velocity measurement
- Low level velocity measurement

Signature® Flowmeter

The Signature flowmeter from Teledyne ISCO, designed for open channel flow monitoring, supports flow measurement methods including bubbler, non-contact laser area velocity, ultrasonic, and submerged Doppler ultrasonic area velocity.

With the ability to connect up to 9 sensors, the Signature flowmeter provides a broad range of I/O and communications options:

- pH and temperature
- SDI-12
- RS485
- 4-20 mA output
- Ethernet
- GSM/GPRS modem

The Signature flowmeter is rugged (IP 66) even if the cover of the lid is open. It performs data logging with variable rate data storage and data integrity verification, and has the ability to connect a USB drive for data/report retrieval and programming.

Flowlink® CIPHER

Flowlink Cipher represents the latest advancement in Teledyne ISCO's Flowlink series of data management solutions. Now an advanced cloud-based solution, Flowlink Cipher allows site managers to view and manage all data at multiple sites through an easy-to-use and powerful browser-based user interface. Centralized, secure, cloud-based access to device status, site status, and flow data occurs through desktops, laptops and tablet mobiles devices with no need for client software or mobile apps. With AWS hosting security, there is no better protection from service interruptions or data loss. Advanced user administration provides five levels of access with user profiles including View Only, Editor, Analyst, Site Manager, and Administrator.

About Teledyne ISCO

Teledyne ISCO is a leading manufacturer of a wide range of innovative products designed to increase productivity while improving the quality of life on our planet. Our standard and customized products are used across multiple sectors including water and wastewater, pharmaceutical, academia, oil exploration, and reactant feed. Teledyne ISCO is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

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TELEDYNE ISCO
Everywhereyoulook™

P.O. Box 82531
Lincoln, Nebraska, 68501 USA

Phone: +1 402.464.0231
www.teledyneisco.com