App note
A202505

64-fold retrofit with Xylem‘s WTW sludge level sensor IFL 700 IQ

for measuring the sludge level at Germany’s largest municipal wastewater treatment plant

Background – sludge level measurement at Germany’s largest municipal wastewater treatment plant

The Hamburg wastewater treatment plant treats approx. 350,000 m³ of wastewater daily. Around 4,000 m³ of sludge is produced and separated from the treated water in 64 secondary clarifiers. Each basin is equipped with a dedicated sludge level measurement system.

Reliable sludge level measurement is essential for stable, safe, and environmentally compliant plant operation. It enables efficient process control, prevents sludge carryover, and ensures legal monitoring values are met. Reliable and accurate measurement is therefore essential and presents operators with the challenge of selecting suitable measurement technology and adapting it to their process.

Read on to learn more about the switch to Xylem’s WTW brand IFL 700 IQ sludge level sensor at the Hamburg wastewater

Client
Hamburg Wasser

Xylem’s role
Enabling reliable sludge level measurement through installation of sensors, commissioning, optimization in operation, and continuous status monitoring.

Project results
Increased operational safety and environmental protection by reducing sludge carryover.

treatment plant, as well as the background to the retrofit and the optimization process in operation.

The challenge – issues in measurement

The previous sludge level measurement technology was causing increasing problems for the operator: it had to be replaced approximately every two years due to moisture ingress and sealing problems, which made economical operation impossible. In addition, the accuracy of the measured values and network integration were unsatisfactory, and heavy algae growth formed on the measurement technology (see Figure 1), which required increased cleaning.

Fig. 1: Comparison of algae growth on the IFL 700 IQ sensor (left) and previous measurement technology (right) after the same operating time (approx. 4 weeks)

The solution – Xylem's WTW IFL 700 IQ sludge level sensor

To have a basis for deciding on a change in measurement technology, a test campaign was launched in 2022 in which an IFL 700 IQ sludge level sensor was installed in a tank in addition to the existing measurement technology and tested over a period of two years.

The IFL 700 IQ is based on the ultrasonic measurement principle, which is illustrated in Figure 2. Ultrasonic waves ① emitted by the ultrasonic transducer are reflected completely ③ or partially ② by layers where the density of the measurement medium changes (e.g., sludge level, basin floor) and are received again. The distance between the layers and the ultrasonic transducer is determined from the transit time of the echoes, and thus the sludge level depth or height is determined.

Comparative measurements were carried out using a WTW hand-held turbidity meter. The turbidity probe was lowered into the secondary clarifier together with a pressure sensor until the turbidity rose sharply, marking the sludge level. The pressure display can be used to determine the depth of the sludge level via the hydrostatic pressure.

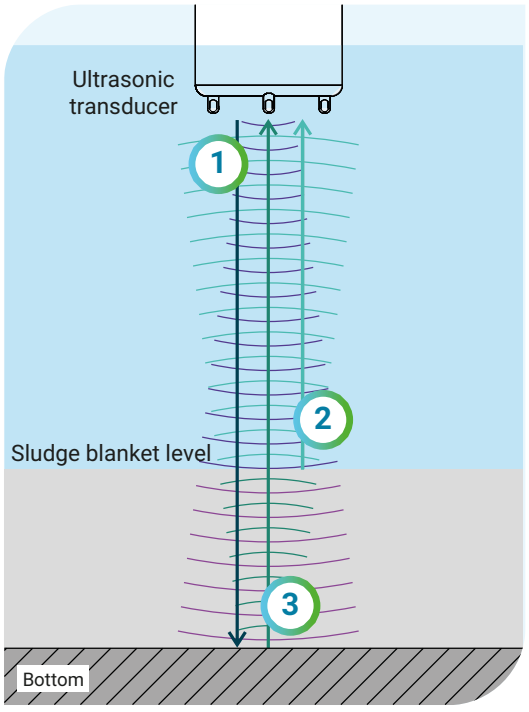

Fig. 2: Illustration of the ultrasonic measuring principle of the IFL 700 IQ sludge level sensor

Retrofit and optimization phase

After satisfactory tests, the 64-fold retrofit and an intensive optimization phase were carried out in early 2025. The optimization phase served to reduce outlier measurements, whereby recorded echo data was first used to gain a deeper understanding of the dynamics in the secondary clarification tanks.

Figures 3.1 to 3.3 compare three echo profiles recorded in Hamburg at different times and subsequently evaluated. All three graphs show the echo intensity plotted against the depth of the basin. The intensity peak at approximately 4 meters is due to the reflection of the basin floor at a water depth of 4 meters.

Echo 1 also shows an intensity peak at approximately 3.2 meters, which corresponds to the correctly recorded sludge level depth.

Echo 2 shows how interference reflections at low depths cause an incorrect measurement of the sludge level depth of 0.6 meters. Interference reflections can be caused, for example, by floating bulky sludge, but can be largely eliminated by optimizing the sensor settings.

Echo 3 shows further intensity peaks at depths of approximately 1.75 and 3.5 meters, which are caused by passing chain scrapers. Appropriate sensor settings prevent these from being incorrectly recognized as sludge levels.

Optimizing sensor settings during operation is therefore crucial to reduce erroneous measurements of sludge depth caused by interfering reflections and thus prevent outlier measurements. Figure 4 shows how optimizing sensor settings in Hamburg led to a significant reduction in outlier measurements. Measurements of the sludge level over a period of several days before (left) and after (right) the optimization phase are compared.

The IFL 700 IQ was integrated into the utility's PLC system via a PROFIBUS interface, whereby the main and secondary measured values, the measured value status, and extended status information

Comparison of three echo profiles

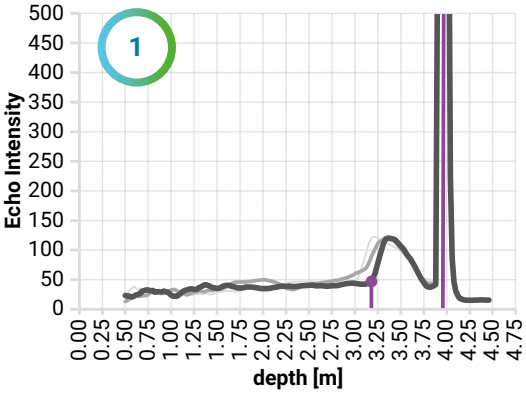

Fig. 3.1: Correct sludge level measurement

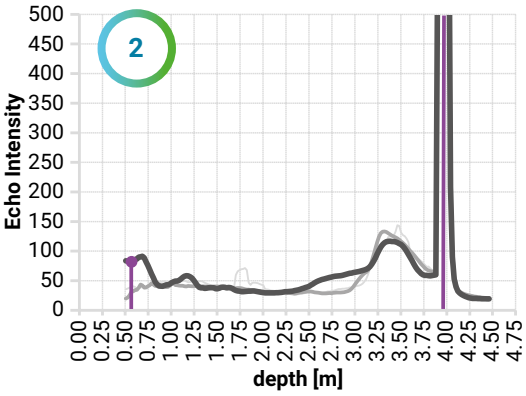

Fig. 3.2: Outlier measurement

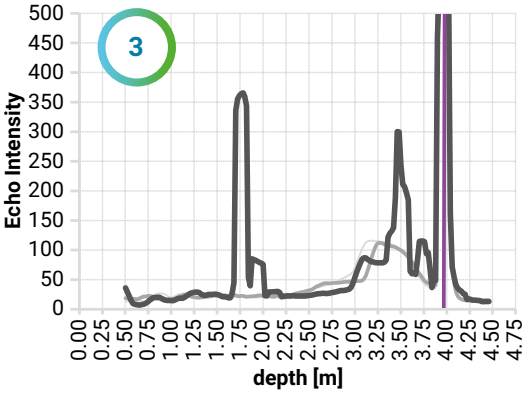

Fig. 3.3: Detection of a scraper

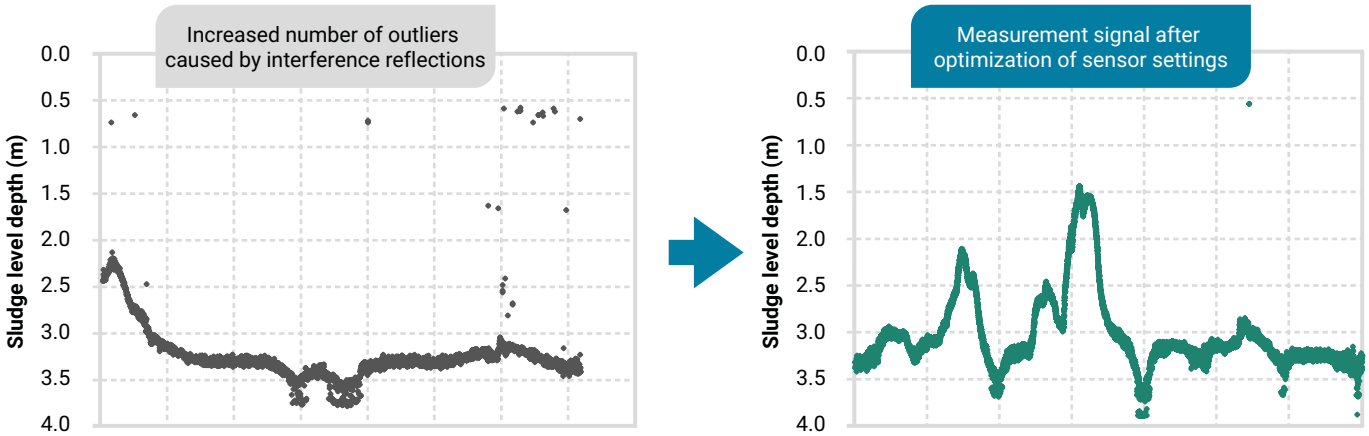

Fig. 4: Comparison of measurements of sludge level depth over a period before (left) and after (right) optimization of sensor settings during operation

from the sensor are transferred. The extended status information is used to distinguish between the following states:

1. Sludge level present
2. No sludge signal, but bottom signal
3. Sludge level is too high or sensor is already stuck in sludge (imminent sludge discharge)
4. No sludge signal, sensor is stuck in air
5. No sludge signal and no bottom signal

This status information is crucial, as the control of the secondary clarifiers must be automated, also due to the size of the plant. If there is a risk of sludge discharge in a tank, the inlet to this tank is closed by a slide valve. The continuous or even increased return pump causes the fill level to drop and the sensor may hang in the air. The volume that has been freed up can be refilled. All these conditions are detected by the sensor and transmitted to the PLC as clearly identifiable status information.

Fig. 5: WTW IQ Sensor Net Controller in the control room

Summary

By switching to Xylem's WTW IFL 700 IQ sludge level sensor in all 64 secondary clarifiers, the Hamburg wastewater treatment plant, Germany's largest municipal wastewater treatment plant, is responding to problems with previous sludge level measurement technology. The new measurement technology prevailed in a competitive bidding process. The subsequent optimization phase further improved the quality and accuracy of the measurement results and automated sludge management.

We would like to take this opportunity to thank HAMBURG WASSER, and in particular Mr. Treichel, Ms. Schuller, and Mr. Fischer, for their excellent cooperation.

Read more about the advanced status information provided by the IFL 700 IQ sludge level sensor in **Tech Note T202601**.

Key Takeaways

- Convinced by Xylem's quality and service, the Hamburg wastewater treatment plant has retrofitted all 64 secondary clarifiers with the IFL 700 IQ sludge level sensor.
- High measurement quality thanks to optimized sensor settings.
- Sensor status enables detection of sludge drift and automatic sludge management.

Products used:

- IFL 700 IQ sludge level sensor
- IQ SENSOR NET system 2020 3G

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