High Accuracy Pump Station Flow Monitoring

Middelfart, Denmark

TELEDYNE ISCO
A Teledyne Technologies Company

Expertise in Flow

Case Study

The ADFM Hot Tap Pulsed Doppler flow meter from Teledyne Isco, Inc. provides a high accuracy and cost saving flow monitoring solution at a pump station with limited straight run in Middelfart, Denmark.

Benefits of ADFM Hot Tap:

- 2% flow rate measurement accuracy
- Accurate measurement in difficult hydraulic conditions
  - Turbulence
  - Entrained air
  - Near zero/ zero velocity
  - Peak velocity shifting from side to side in channel
  - High velocity (±9m/s)
- Large flow measuring span (0.45 - 2.7m pipe diameter)
- Up to 20 BAR pressure
- 4 Pulsed Doppler velocity sensors in multiple points (bins) and pointing in different directions of the flow
- No bypass required
- Minimal straight runs needed
- No pipe shutdown needed for installation & maintenance
- Generates a true flow profile
- Calibration-free technology

ADFM Hot Tap sensor

"The Future of Flow!"™

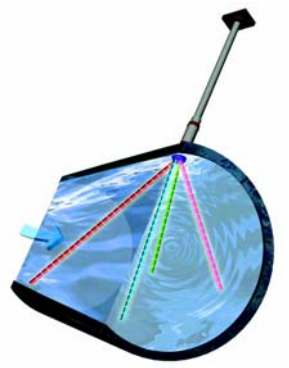
Figure 1: Middelfart pump station
ADFM Hot Tap installation with 2 pipe diameter straight run

Project background

Middelfart Spildevand as is responsible for operation, service and maintenance of wastewater treatment plants (WWTP's) and urban collection systems in the municipality of Middelfart in Denmark. This includes 7 WWTP's, 750 km of pipeline and 231 pump stations, treating 1.8 million m^3 of wastewater yearly. Due to capacity issues in the existing network and to secure the network for future climate induced increases in urban drainage, investments are being made for conversion of the combined sewer system to a separated system. The municipality also wants to build the new system so that wastewater is routed around the city, rather than through it. This represents 2 km of additional new pipeline. Accurate hydraulic modeling is crucial to select correct pipe dimensions for the new system. To calibrate the models, flow data from dry weather conditions is needed from key points in the existing network.

Pump station challenge

Traditionally, pump station construction does not take flow monitoring needs into account. The location where Middelfart Spildevand needed dry weather flow data is one such case. The only possible location for a flow meter was 2 pipe diameters downstream of a tee-section leading out from a pump. Difficult hydraulic conditions due to limited straight runs of piping causing turbulence and entrained air, limiting the capabilities of traditional measurement technology such as electromagnetic flow meters and clamp-on transit time flow meters. The cost to reconstruct the pump station in order to accommodate flow monitoring needs is very high.



ADFM Hot Tap sensor operation

System Options:

- Stationary or portable
- Communication:
  - Data logging (32MB)
  - Analog (4-20mA)
  - Digital (MODBUS/ Ethernet)
  - Relay Alarms
  - GSM/GPRS
- Flowlink 5.1 software:
  - Data Analysis
  - Diagnostics
  - Graphs/Tables
  - Editing

accQcomm Interface Module

- Three serial inputs, RS232 or RS422
- Selectable output providing the sum or average of data from three different instruments
- Eight optically isolated relay outputs

ADFM Hot Tap solution

Teledyne Isco's dealer in Denmark, Hans Buch A/S, was approached by consultant company Grontmij | Carl Bro A/S; they suggested the ADFM Hot Tap as a solution for this challenging site condition. The ADFM Hot Tap Pulsed Doppler technology allows accurate measurement of flow rate in large pipes up to 2.7 meters in diameter. The Hot Tap can be inserted into pressurized lines up to 20 BAR, without disrupting flow, through a standard 2" corporation stop or tap. It installs near bends, pumps, and tees, and still yields reliable data.

Figure 2: ADFM Hot Tap sensor installation

The four (4) velocity sensors at the end of the ADFM Hot Tap shaft emit short pulses (pings) along narrow acoustic beams pointing both upstream and downstream in the flow. Each sensor precisely measures velocity at multiple level points (bins). One measurement can consist of hundreds of pings, yielding thousands of velocity data points throughout the water column. The measurements are then used to determine the flow pattern over the entire flow cross-section, creating a true velocity profile. Since the flow pattern and measured velocity distribution are independent of each other, the ADFM Pro20's advanced flow algorithms automatically adapt to changing hydraulic conditions. It removes the need for in-situ calibration and ensures accurate flow rate measurement even in difficult flow conditions including turbulence, entrained air, non-uniform flow, backwater, high velocity, near zero or zero velocity and reverse flow.

Measuring results and feedback

The ADFM Hot Tap showed consistent and accurate measurement results, even in the challenging conditions. The Hot Tap's data was supported by existing hydraulic data. The most important finding was that defective contra valves were causing high return flow after each pump cycle. Up to 20% of the total pumped flow was returned water.

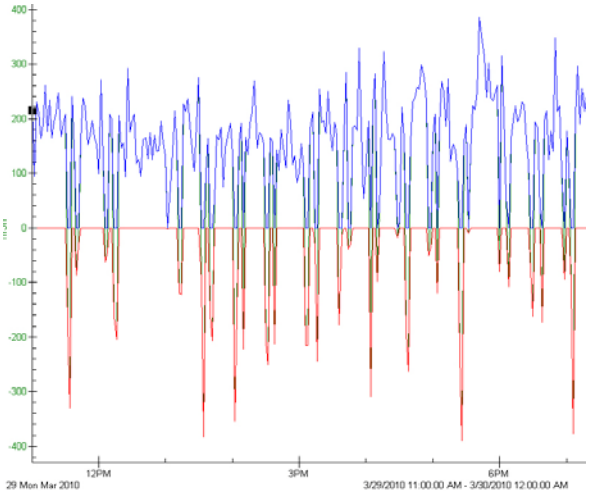


Figure 3: Flowlink 5.1 flow data
Positive values indicated in blue & negative in red

Siv. Eng. Frank Jordt Kappel from Grontmij | Carl Bro A/S was impressed by the performance of the ADFM Hot Tap flow meter.

"The biggest eye opener was the defect contra valves. This was incredibly important information, and has changed our perspective on the dry period flow completely. The data allowed us to reduce the dimensions of the new pipelines and to run the pumps more energy optimal. Through the ADFM Hot Tap, Middelfart Spildevand obtained a great material cost saving from the reduced pipe dimensions, and also obtained an energy saving that will have a positive effect on their running cost in years to come."

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