Velocity Profiling in Varying Flow Conditions

Application Note

TELEDYNE ISCO
A Teledyne Technologies Company

Expertise in Flow

ADFM Hot Tap Sensor

Benefits:

- 2% Flow accuracy
- Quad-redundant sensors in a single housing
- Operation in minimal straight-runs
- No bypass requirement
- No pipe shutdown/ dewatering needed for installation and maintenance
- No calibration required

System Options:

- Stationary or portable
- Communication:
  - Data logging
  - Analog (4-20mA)
  - Digital (MODBUS/ Ethernet)
  - Relay Alarms
  - GSM/GPRS
  - CDMA/1xRTT

"The Future of Flow!"™

The ADFM Hot Tap Insertion Pulse Doppler flow logging system from Teledyne Isco, Inc. provides accurate and reliable data under varying and difficult hydraulic conditions.

Example of Varying Flow Conditions

Coastal municipalities that use gravity line as a primary method for discharging treated wastewater into the ocean will likely be influenced regularly by rising tide levels. The high tide level can create a back pressure, reducing flow rate or even reversing gravity flow in the line. To manage the flow during high tide conditions, some treatment facilities close the gravity line and divert the flow by pumping it at pressures higher than the tidal backpressure, through a bypass and back into the effluent line. Once the high tide recedes, the pumps shut off and the valves reopen, returning the flow to normal gravity lines.

During normal flow conditions, the effluent is relatively uniform; however, when the rising tide triggers the pumps, the flow becomes turbulent, causing the amount of entrained air to increase. Therefore, many treatment plants are faced with the challenge of finding one flow measurement technology able to give accurate readings during normal and high tide conditions.

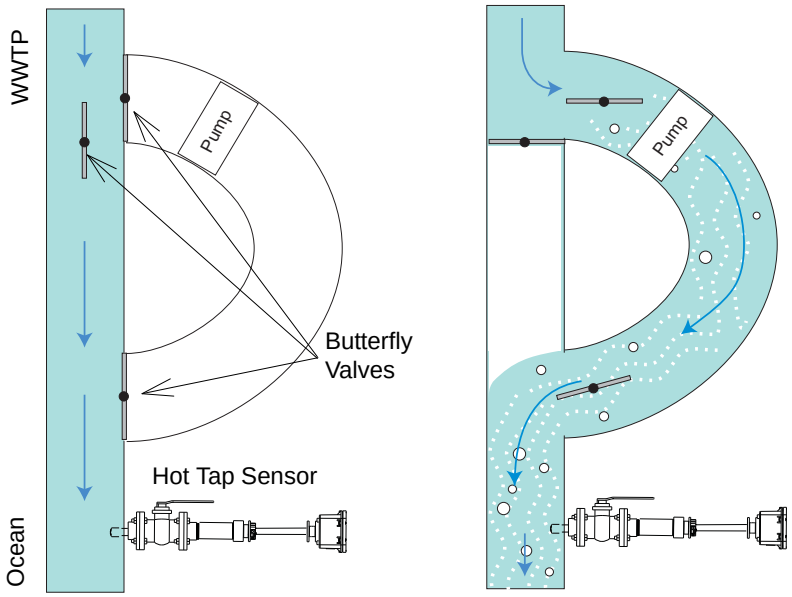


Figure 1: Effluent pipe, valve, & bypass during gravity flow (left) and high tide (right)

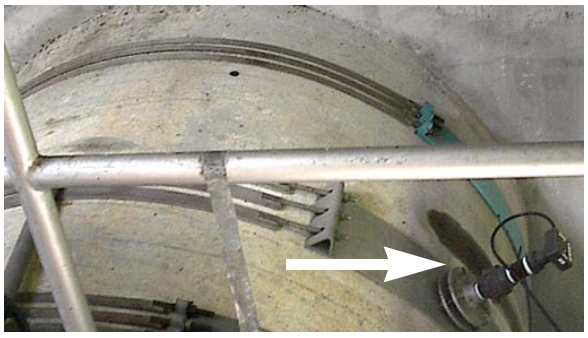


Figure 2: Hot Tap sensor installed in pipe

Accessing Your Data:

Flowlink Software

- Data analysis
- Diagnostics
- Graphs/tables
- Editing

2105 Interface Module

- System integration: rain gauge input - SDI-12 input - sampler enabling
- Cellular communication (CDMA - 1xRTT - GSM - GPRS)

accQcomm® Interface

- Three serial inputs, RS232 or RS422
- Selectable output providing the sum or average of data from three different instruments
- Modbus or Ethernet interface for digital data access
- Up to four isolated 4-20mA outputs
- Eight optically isolated relay outputs

Challenges of Varying Flow Conditions:

Transit time technology can lose the signal due to turbulence and entrained air when the pumps kick in. Continuous wave Doppler sensors can fall short of the full range of a large pipe, resulting in erratic and inaccurate flow readings. Most full-pipe flow meters are susceptible to the varying flow conditions described above. Most installation sites do not have the amount of straight-run piping required by electromagnetic and other flow measurement technologies.

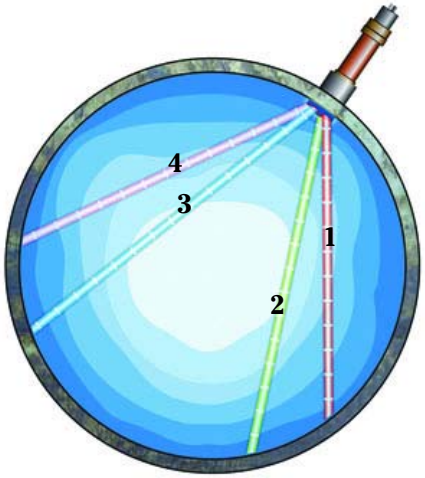
Solution: Pulsed Doppler Technology

An Isco Acoustic Doppler Flow Meter (ADFM), which uses Pulsed Doppler Technology, with Hot Tap Insertion (HTI) sensor, eliminates the need for multiple methods of measurement at a site. The Hot Tap can be installed near bends, pumps, and T-joints and still yield dependable data.

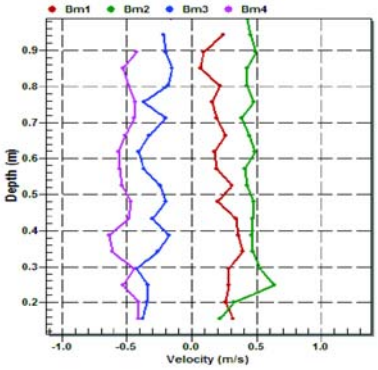
The Hot Tap sensor is inserted into a standard 2-inch tap in the pipe wall of any material, and can be installed or removed without draining the line. Since the sensor is minimally invasive, flow is not disrupted, and there is no need for an expensive, time-consuming bypass.

The Hot Tap's sensor tip emits multiple velocity measuring beams (see the numbered beams in Figure 3). By range-gating the returned signals, velocity is measured simultaneously in multiple, distinct cells. The Hot Tap provides detailed velocity data in relation to its location at numerous points in four different directions within the full pipe, which is then used to calculate a highly accurate flow profile. The resulting comprehensive flow calculation is:

- Based on the true flow profile, and
- Never dependent upon just one signal or assumption of any specific flow condition (such as laminar flow) for data.



Each data point represents a discrete velocity measurement from an individual "bin" along the Pulse Doppler beam.



Velocity beams are range-gated, creating individual "bins" to collect data at numerous points throughout the metering section. This ensures that varying velocities within the flow are accurately measured. The chart shows the individual data collected from each beam.

Figure 3: Hot Tap velocity beams and resultant data

Isco offers a wide selection of display and communication options that enable Plant Operations to view real-time flow data on their monitoring/control system to ensure that flow in the effluent line is working as expected, and that the rate and volume of flow are accurately measured. This enables the plant to daily monitor its compliance with regulatory requirements, and to properly manage the amount of treated wastewater discharged into the ocean.

Teledyne Isco, Inc.
P.O. Box 82531, Lincoln, Nebraska, 68501 USA
USA & Canada: (800) 228-4373 ˘ Phone: (402) 464-0231 ˘ Fax: (402) 465-3091
Web site: www.isco.com ˘ E-mail: IscoInfo@teledyne.com

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