Chicago's Jardine Water Plant

Flow Monitoring at the Largest Water Treatment Plant in the World

Nearly 5 million people in the city of Chicago and 118 outlying suburbs rely on the Jardine Water Treatment Plant for high quality potable water. Jardine purifies an average of 660 million gallons per day from Lake Michigan with a design capacity of 960 million gallons per day making it the largest water treatment plant in the world, with the next largest being the Los Angeles Water Treatment Plant at 600 MGD.

Because of the importance of efficiently running such a massive water treatment plant, there has always been a trend toward automation within the plant since it was first established in the early 1960s. What began as a pneumatically controlled plant has since moved into a highly accurate electronically controlled plant. In terms of maintaining high accuracy within the plant, measuring flowrates in the six 15' x 15' box conduits used for chemical treatments was no exception.

In 1997 the city of Chicago made a decision to move away from using very large, cumbersome propeller meters and into a highly accurate, multiple path acoustic flow meter manufactured by Accusonic Technologies.

One obvious problem with the obtrusive propeller meter is that the bearings wear out and have to be replaced. Additionally, as the bearings go from new to old, the accuracy goes from fair to poor.

Another problem with the propeller meter is that it is prone to magnetic pickup resulting in bad signals and questionable flow readings. Finally, the size of these massive propellers makes maintenance a major undertaking.

The Accusonic multiple-path ultrasonic transit-time flowmeter has virtually none of the problems associated with the use of the propeller meters. The Accusonic system uses pairs of transducers at four elevations that mount almost flush against the sides of the rectangular channel at specific elevations (see picture below).

Model 7657 / 7658 intrinsically safe transducer

Velocity at each elevation is determined using the differential travel time method in which an acoustic pulse travels upstream. A pulse of sound traveling diagonally across the flow in a downstream direction, will be accelerated with the velocity component of the

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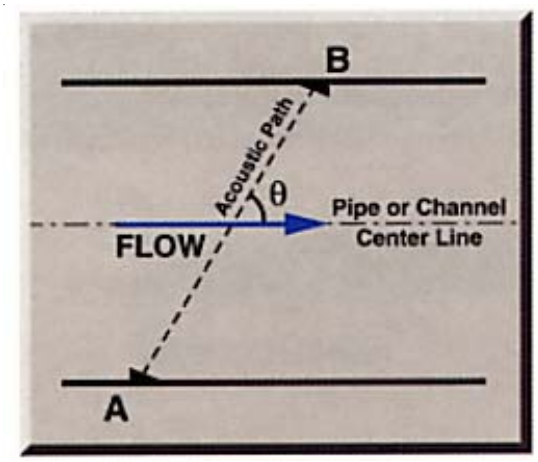
water and, conversely, a pulse traveling diagonally upstream will be decelerated by the water velocity (see figure below).



There are no moving parts on the Accusonic meter. An electric pulse travels through a communication cable from the flowmeter console to the transducer. The transducer generates an acoustic pulse from the electric pulse input, which is sent to its paired transducer on the other side of the flow conduit. A separate acoustic pulse is then returned in the opposite direction. With no moving parts to wear out, maintenance is kept at a minimum. Jardine's rectangular chemical application channels are all below ground making low maintenance a major advantage.

As with many water and wastewater treatment plants, buildup on pipe and channel walls can drastically affect the ability to meter flow. The Jardine plant is prone to a significant buildup of carbon and zebra mussels. The Accusonic meter utilizes what is known as Automatic Gain Control. As acoustic pulses are sent and received, the transducers look for strong acoustic signals.

As buildup increases, signal strength typically decreases; the Accusonic meter automatically amplifies the received acoustic pulse to ensure strong usable signals (see picture below).

(Build-up on functional transducer)

Jardine faced one other major problem. The large chemical application channels where the flowmeters are located are prone to deposition of sediment on the channel floors, thus changing their cross sectional area. The challenge was to accurately account for the continuous change in cross sectional area. To meet this challenge, Accusonic installed an additional acoustic transducer on the ceiling of each channel facing the floor. The down-looking transducer continuously monitors sediment level on the floor of the channel and makes automatic adjustments to utilize the actual channel cross-section area for flowrate determination.

For the personnel in charge of operations at the James W. Jardine Water Treatment Plant, accurately monitoring an almost 700 MGD plant throughput is anything but trivial. Thanks to hard work, dedication, and a willingness to implement higher levels of technology, Jardine will continue to be viewed as a leader in water plant processing and technology.