“MEASUREMENT OPTIMIZATION IN WATER AND AGRICULTURE BY MEANS OF THE USE OF PIEZOELECTRIC CERAMIC SENSORS AND ISP TECHNOLOGIES”

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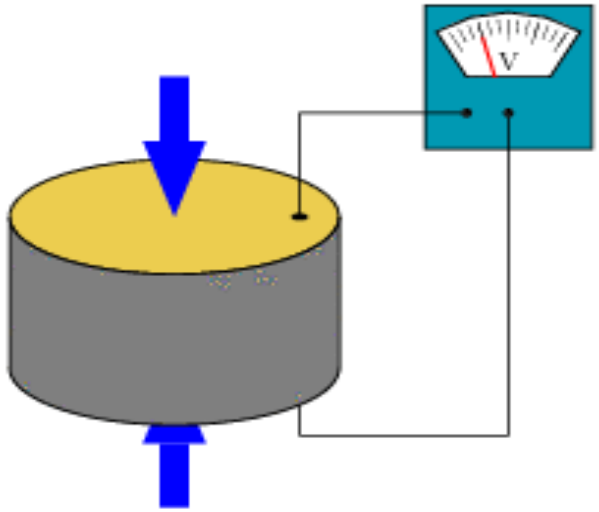
WHY WE SHOULD USE PIEZOELECTRIC SENSORS?

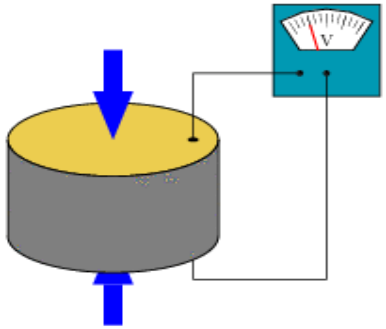
Piezoelectric sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used, and has become a mature technology with excellent inherent reliability.They have been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a tilt sensor in consumer electronics or a pressure sensor in the touch pads of mobile phones



Interface electronic circuit

A typical piezoelectric PiezoStar pressure sensor

A piezoelectric substance which is a crystalline mineral that responds to a mechanical force by generating an electric charge.



Piezoelectric sensor component includes a microchip which sends information that can be collected by using voltmeter.

In PiezoStar sensors a signal-conditioning circuit must have low input impedance but piezoelectric transducer have high input impedance which is bad thing for piezoelectric sensor. A typical input impedance for piezoelectric transducer is 3500 kΩ.

The system has some output noise which is approximately some hundreds of nV/sqrt Hz (nanovolts per root Hertz). Noises are coming from voltage and current.

Piezoelectric sensors are usually very stable so they don't need calibration

The pressure sensor input variants about the pressure, temperature and material.

The input bias currents of this type of amplifier is usually below 100 pA, it should be fine as long as the feedback resistor value is below 1 GΩ. Specified voltage for all standard ICP sensors and amplifiers is generally within the range of 18 to 30 volts.

The signal is converted to digital signal with an A/D converter.

Typical characteristics of piezoelectric transducers

- Transfer function

$$\frac{V_r}{F_L} = \frac{2Z_r}{(A_g Z_L + B_g) + Z_r(C_g Z_L + D_g)}$$

- Sensitivity: the change in output resulting from a change in input

-33pC/bar

- Operating temperature range:

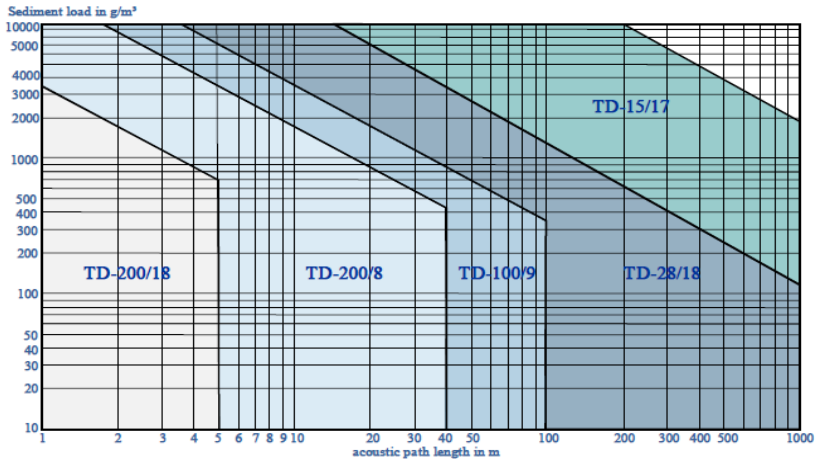
-20 to 350 degrees

- Measuring range:

0 to 300 bar (non-SI unit, like Pa)

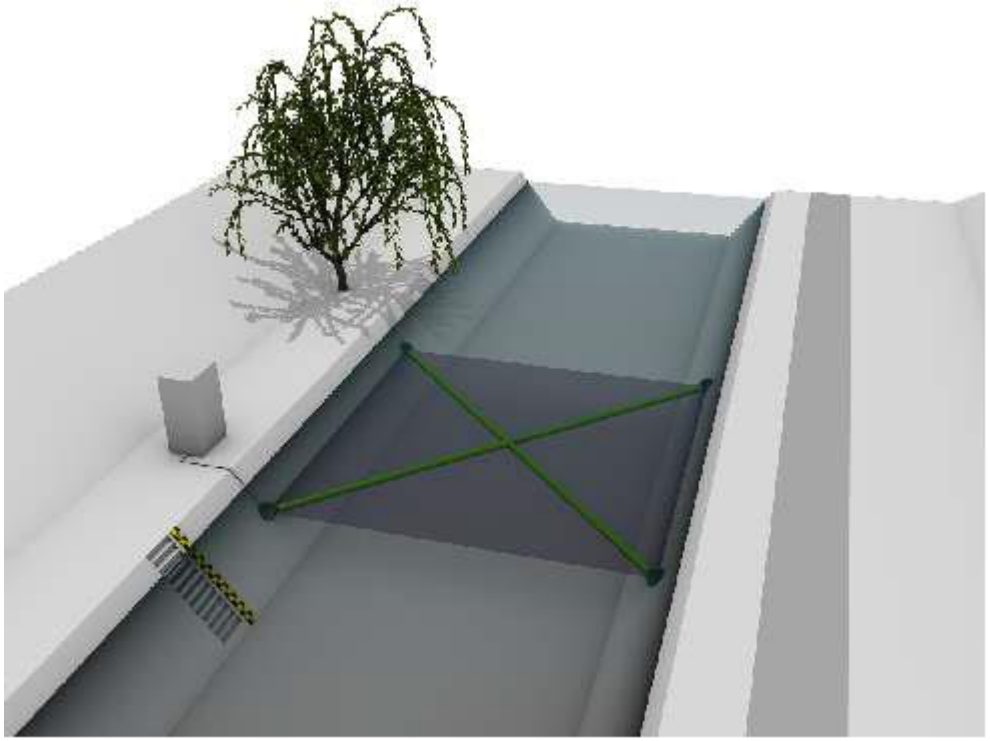
PIEZOCERAMICS SENSORS

In a flow meter, the transducer converts a high voltage electrical pulse at a given frequency into mechanical vibration. This creates a sound wave that is transmitted through the water in the desired direction according to the characteristic radiation pattern of the transducer. All piezo -ceramics have at least one series resonant frequency at which they vibrate most easily. This is dependent on the ceramic material, shape and dimensions. Attenuation of sound in water increases with frequency. Because there is less attenuation of lower frequency signals, lower frequencies must be used to achieve longer path lengths



Pic-1 Piezoceramic sensor and his analyze graphic in computer

PIEZOCERAMICS SENSORS

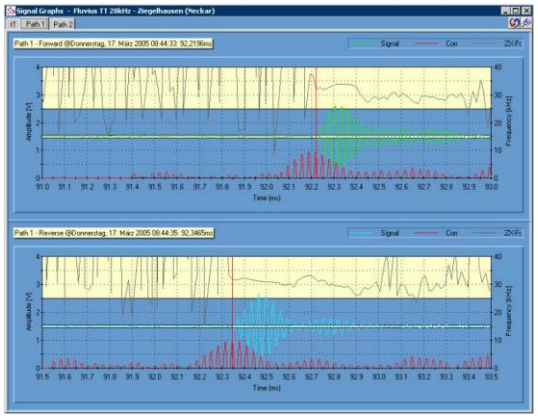


FEATURES

The flow meter is a compact instrument incorporating the latest electronics and digital signal processing technologies, realizing high performance and easy operation. With the use of high-speed micro-processor, the response time is as fast as 1s or less, housed in a IP-65 enclosure (NEMA-4x), the system is well suited to most environments. Programming of the flow meter is simple and can be accomplished with FlowVision, a Microsoft Windows compatible configuration and signal analysis program. It provides access to a extensive range of diagnostic information.

ISP –TECHNOLOGY IN PIEZOCERAMICS SENSORS

The flow meter combines digital signal processing (DSP) with correlation detection methods. It uses controlled signals, whose characteristics are imposed during the transmission phase (duration, frequency, level...). The reception is therefore based on the suitable filtering of these characteristics, possibly accounting for the perturbations brought by the environment. The frequency modulated signals are processed on reception by correlating the received signal with a copy of the expected signal. The use of this Intelligent-Signal-Processing is justified for very accurate measurements of transit time with an excellent time resolution and a high processing gain.



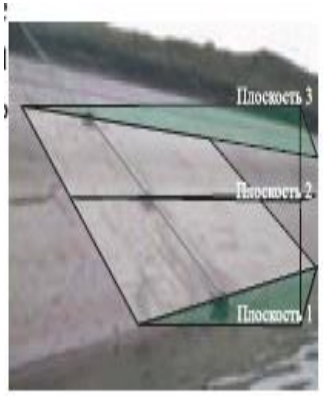
Pic-2 ISP technology monitoring technology and display

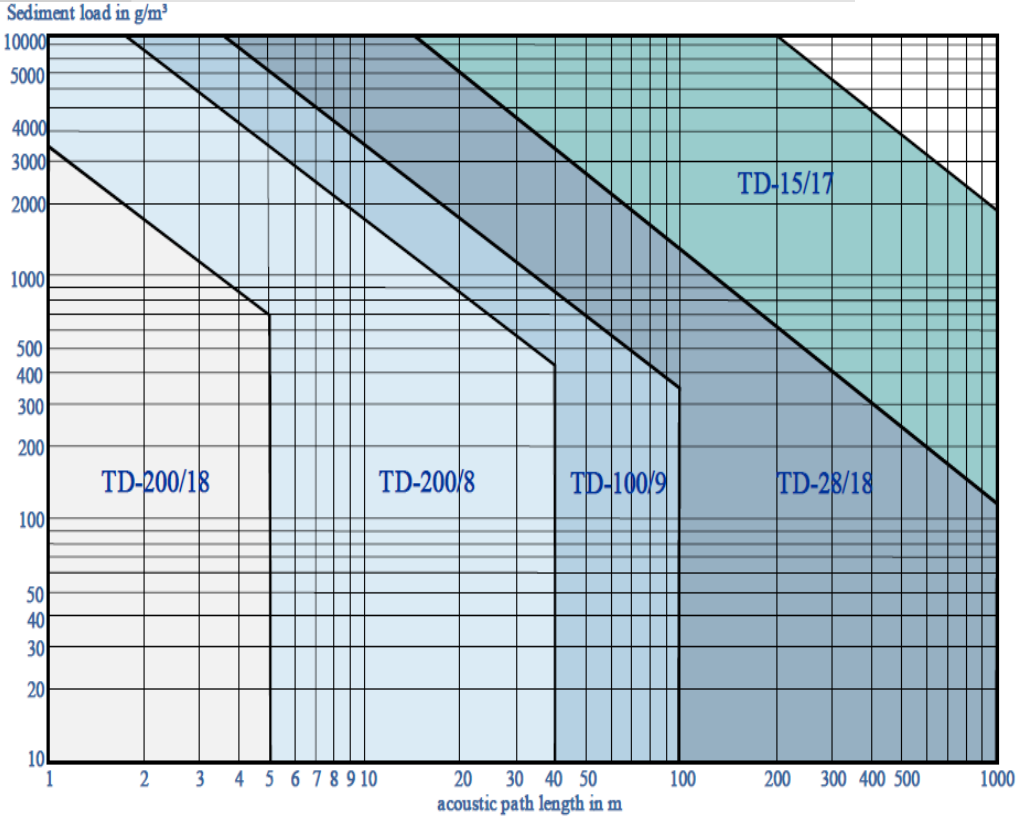
PRINCIPLE OF MEASUREMENT

The acoustic method of discharge measurement is based on the fact that the propagation velocity of an acoustic wave and the flow velocity are summed vectorially It follows that an acoustic pulse sent upstream travels at a lower absolute speed than an acoustic pulse sent downstream. By measuring the times of the traverse of pulses sent in the two directions, the average axial velocity of the fluid crossing the path of the pulses is determined The acoustic method of discharge measurement is based on the fact that the propagation velocity of an acoustic wave and the flow velocity are summed vectorially. It follows that an acoustic pulse sent upstream travels at a lower absolute speed than an acoustic pulse sent downstream. By measuring the times of the traverse of pulses sent in the two directions, the average axial velocity of the fluid crossing the path of the pulses is determined.

TRANSDUCER

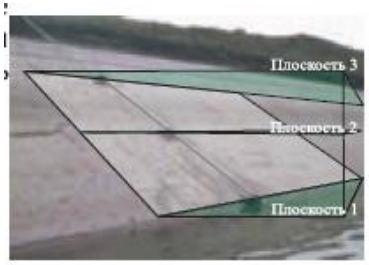
	Channels		Rivers		
Type	TD-200/18	TD-200/8	TD-100/9	TD-28/18	TD-15/17
Frequency	200 kHz	200 kHz	100 kHz	28 kHz	15 kHz
Beam with at -3dB	18°	8°	9°	18°	17°
Dimension	Ø 31.8 mm (1,25 in.) Height 50mm (1.97 in.)	Ø 70.0 mm (2.76 in.) Height 40mm (1.57 in.)	Ø 183 mm (7.2 in.) Height 142mm (2.68 in.)	Ø 183 mm (7.2 in.) Height 142mm (5.59 in.)	Ø 368 mm (14.49 in.) Height 121mm (4.76 in.)

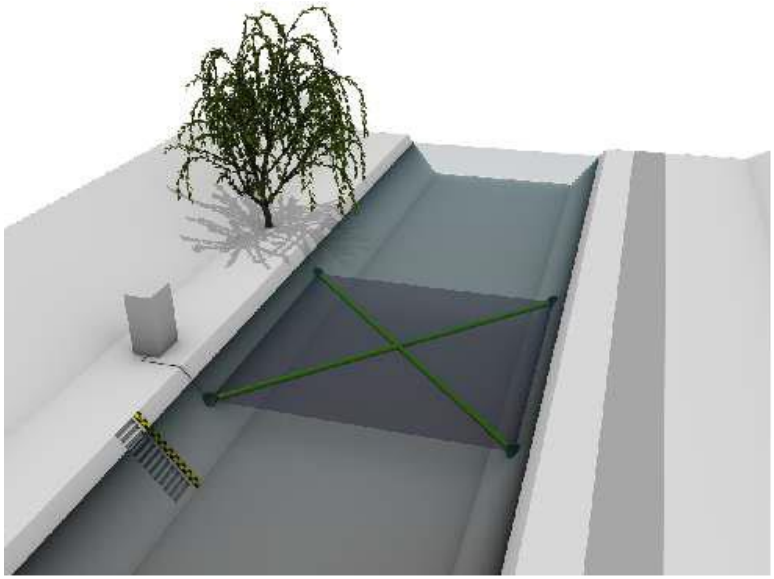




Where we can use this technology in Uzbekistan

We can use this technology in pump station and other industrial factories





we know that in 2009 Sayano–Shushenskaya hydroelectric power station accident occurred at 00:13 GMT on 17 August 2009, (08:13 AM local time) when turbine 2 of the Sayano–Shushenskaya hydroelectric power station near Sayanogorsk in Khakassia, Russia, broke apart violently. The turbine hall and engine room were flooded, the ceiling of the turbine hall collapsed, 9 of 10 turbines were damaged or destroyed, and 75 people were killed

Thank you !