Keys to Accurate Open Channel Level Monitoring

The need to know the flow rate and level in rivers and streams has existed since man first attempted to harness the energy and benefits of flowing water for irrigation, drinking water, and other practical uses. Efforts to monitor river level had humble beginnings of a simple graduated stick that eventually gave way to the use of floats.

There are many choices for open channel level measurement and ultrasonic level outperforms all others. Care should be taken when selecting the right technology for open channel monitoring. Radar technology is popular for high pressure and high temperature applications. Unfortunately radar technology suffers from several disadvantages when it comes to use as an open channel monitor such as no relays, outputs, alarms, totalizers or local displays. In some countries, using high frequency radar devices outside of a vessel/tank is not yet approved. Current radar transmitters do not offer the high accuracy required by open channel applications as they can only achieve ± 3 to ± 10 mm in 1 m applications.

Contacting pressure transmitters can suffer from calibration drift and biological buildup. Other contacting technologies such as capacitance and TDR (time domain reflectometry) suffer from build-up and would also interfere with the flow stream and disrupt the flow profile therefore affecting ultimate accuracy.

Today the most popular choice for open channel monitoring is a primary measuring device such as a flume or weir and a non-contacting ultrasonic flow monitor. Non-contacting ultrasonic equipment has a low cost of ownership, is legal for open air applications, and does not have temperature drift issues associated with other technologies. Correctly applied, ultrasonic level and flow technology will yield reliable performance of ±1mm with virtually no maintenance required.

Many of today's ultrasonic monitors contain built in flow equations, that are required for use with typical flume and weir primary measuring devices. For applications in non-standard primary measuring devices, linearization curves may be entered into the controller. When monitoring an open pipe, ditch, or spillway selected ultrasonic controllers will take an input from an external velocity sensor.

The key to accurate and reliable measurement starts with the selection of the correct equipment and proper installation. A quality open channel monitor such as the Siemens OCM III, SITRANS LUC500, or HydroRanger 200 is a good start. Add the Echomax XRS-5 ultrasonic transducer and you are ready to measure flow.

Siemens patented "Sonic Intelligence" is in most of the ultrasonic level products manufactured. Sonic Intelligence is the resident firmware that uses special processing, algorithms, and a dynamic TVT (Time Varying Threshold) to reliably and accurately read level in challenging conditions.

For critical applications where the best accuracy is a must the OCM III, Echomax XRS-5, and TS-2 remote temperature sensor offers ±1mm accuracy. The OCM III uses patented high accuracy analog signal processing to provide exceptional accuracy.

Ultrasonic Technology

Ultrasonic technology is based on the time-of-flight principle with regards to sound energy. A transducer acts like a speaker and generates a sound burst that is focused through the face of the transducer. The sound travels to the surface of the material and back to the face of the transducer. When the sound arrives back at the transducer the transducer acts like a microphone and converts the sound back into an electrical pulse for the transceiver to process. The key to a reliable measurement is to have a transducer that is engineered to tight tolerances and maintains echo characteristics through changing environmental conditions and temperatures.

Distance Measurement

The speed of sound is 344 meters per second at 20 °C. The ultrasonic transceiver measures the time it takes from the generation of the sound burst to the reception back to the transducer. Once the time of the pulse is measured, this time and the known velocity of sound is used to calculate distance using the following equation:

Distance = Velocity of Sound x Time

We then divide the result by two. The reason for dividing by two is that the time recorded is for a round trip to the surface and back to the face of the transducer. We are only interested in the one-way trip as it represents the distance from the face of the transducer to the target surface.

Why Measure Temperature?

When the ambient air temperature changes so does the speed of sound. For every one degree celsius change in temperature the speed of sound is affected by 0.17%. To compensate for changes in temperature the ultrasonic controller processor takes the temperature reading and calculates a correction with every return echo (see *Fig. 1*).

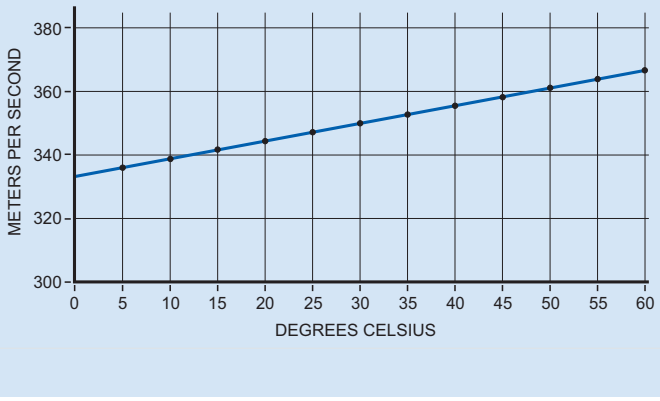

Fig 1. The speed of sound changes based on the temperature of the ambient air.

Because real world applications are not at reference conditions we monitor temperature. Depending upon the model the temperature sensor may be integral to the transducer or remotely mounted. Remote mounted temperature sensors offer a faster response to ambient temperature change than integral temperature sensors and therefore result in better overall accuracy.

Installation Considerations for Ultrasonic Transducers and Remote Temperature Sensors

Careful consideration should be given to the placement of the transducer. When monitoring a primary element, such as a flume or weir, the upstream transducer mounting location is dependant upon the type and size of the channel. Siemens offers stainless steel mounting brackets for various mounting configurations to ensure the right installation is followed. Select an installation location that is free from obstructions and has a clear path to the material surface. It is recommended that installers follow transducer placement recommendations found in the manufacturers operating manual in selecting the preferred location.

Once the mounting location has been determined the height and alignment of the transducer must be considered. The transducer should be mounted so that the highest head level will not enter the blanking zone of the transducer as valuable readings could be lost in the event of higher than expected flow. For best results the calibration plate should be as close to a "real-life" head level as possible.

Alignment of the transducer must be perpendicular to the target for best results. Signal confidence is not an issue as water only absorbs 15% of the acoustic energy and reflects 85% of the acoustic energy back to the transducer.

Avoid over tightening the transducer into the mounting bracket. Hand tightening the sensor is recommended as over tightening may cause degradation of transducer performance due to excess vibration or ringing.

Fig 2. Sun shields ensure that radiant temperature fluctuations do not influence level readings.

A common omission in many open channel monitoring installations is the lack of a sun shield. Solar radiation can artificially heat up the transducer or temperature sensor and create false high ambient temperature conditions. A sun shield should be located over the transducer and remote temperature sensor to avoid these false readings. Adequate ventilation should be provided to avoid trapping heat under the shield. As discussed previously, temperature affects the speed of sound. An accurate representation of temperature is required for the best results in an open channel flow application.

For applications where there are heavy winds a stilling tube may be necessary. Wind could artificially change the temperature surrounding the sensor and cause misleading readings. For applications in sewers a submerged shield may be employed to detect submergence conditions. The submergence shield creates an air pocket in front of the transducer face. The air pocket keeps debris off the transducer face in the event of flooded condition thereby reducing maintenance.

Primary Measuring Devices and Flow

A great deal of thought goes into the selection of the primary measuring device. Today's flow rate requirements and tomorrow's flow rate requirements must be taken into consideration to avoid purchasing inadequate systems. Further considerations include accuracy, maintenance, and the material to be monitored. The accuracy of the ultimate reading will be affected by improper installation or sizing of the primary measuring device.

Weirs result in better accuracy than flumes but require more routine maintenance. Flumes are considered "self cleaning" as the flow helps sweep the channel clean. That being said, any primary measuring element should be routinely examined to make sure that the approach and downstream areas are free from debris or build-up.

Several mounting options are available to install transducers over weirs and flumes. Accurate level readings of these open channels help avoid overflow conditions.

Care must be taken that the site at which the secondary measurement will take place is not affected by a change in the flow profile due to build-up. The flow quality at the location of the ultrasonic transducer should be as flat as possible. Surges or inputs close to the measuring point will affect accuracy. A clogged or impeded outflow will also degrade the quality of the measurement.

Conclusion

When applied correctly ultrasonic flow monitors can offer ± 1mm accuracy. Great care should be taken when selecting, installing, and maintaining the primary measuring device. An under or oversized primary measuring device will yield poor results. Further, an improperly installed flume or weir can dramatically affect the flow profile in the channel and the ultimate reported flow output. Routine maintenance and cleaning of the flume, weir, or channel will ensure an accurate reading in the application.

Utilizing proper installation of ultrasonic open channel flow monitoring equipment coupled with routine maintenance of the primary measuring device will yield accurate trouble-free flow results for years to come.

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New Branding for Specialist Manufacturer of Water Instrumentation

Partech (UK), the specialist designer and manufacturer of water instrumentation and analysing technologies, has unveiled a new brand image. Introduced at the WWEM exhibition in Telford, the new corporate brand image reflects the company's commitment and drive towards meeting industry's ever-changing requirements with innovative technologies and support services. "The new branding attracted considerable attention from delegates and visitors to WWEM," reports sales and marketing director Angus Fosten, "as it is so different from the company's past. Most importantly, the reaction from the many visitors to our stand was very positive." The new branding is being rolled out through a wide range of sales and marketing indicatives and will soon appear on a completely new website. "To mark the launch of the brand, we have produced a new corporate brochure which sets out our complete range of technologies and services," says Angus Fosten. "The branding is also being applied to company's comprehensive range of products, the majority of which are manufactured in-house at Partech's UK plant. One of the major benefits that customers identify with the Partech brand is that the company's design and manufacturing facilities are UK based," continues Angus Fosten. "This enables us to provide in-depth advice, customer-focused service and a rapid response whenever technical assistance is requested."

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A New Force in Pools and Spas

A NEW force has arrived in pool and spa maintenance, as water industry experts **Process Instruments** (UK) has joined pool and spa specialists AQS to produce a range of innovative products. After research showed the poor quality of controllers available for the pool and spa industry, Process Instruments decided to develop instrumentation which uses the same high quality sensors as those used in the water industry. The CRIUS 3600PS and the AQS A3000 are now being used to control disinfection systems ensuring bacteria is kept at a safe level in pools and spas. The instruments feature the same technology used to analyse and process water and waste water. The products also include Process Instruments innovative GSM/GPRS based system, which means the instrument will text the user when it needs maintaining or if there is a problem. AQS has over 15 years working within the pool and spa industry and offers total solutions for all leisure projects. Managing director of AQS, Nick Chatburn said: "We've been involved in the pool industry for many years and we've seen lots of controllers with big claims, so I was sceptical at going into partnership with Process Instruments at first. "Having trialled a few units and looked into the chemistry behind these sensors and tested the functionality of the texting alarms and remote internet access, I am enormously impressed. This is the best controller we've ever seen by a long way. I am so impressed that I've put the AQS name on it and am busy supplying it to our customers." Mike Riding of Process Instruments said: "When we approached AQS we were looking for a knowledgeable and capable partner and we've found exactly that in AQS. The company provides an excellent service to its customers which include some of the biggest names in the leisure industry."

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