UIM Webinar

WATER UTILITY INFRASTRUCTURE MANAGEMENT

ACCUSONIC

Performance Integrity - A Flowmeter Selection Process

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Questions & Answers

- What are the recommended up and downstream piping requirements for most flowmeters?
    - Recommended up and downstream piping requirements vary depending on the specific flowmeter type. Different flowmeter technologies have different inherent abilities to handle the negative impact due to distorted flow profiles leading to different recommendations. There is an old rule of thumb of 10 diameters upstream from the flowmeter location and 5 diameters downstream. While this is not a bad recommendation, it may in fact be insufficient depending on what in the process piping created the distortion. Different elements within the process piping have significantly different effects on the flow profile and how long the impact to the flow profile may last. Simple elements as flanges, thermowells and ports or taps will have a fairly insignificant impact on the flow profile, please recognize though that there is an impact, and the distortion will not last for very long. Other elements such as pumps, valves, double elbows out of plane to name just a few, will have a significant impact on the flow profile and the impact can last for an extended distance down the pipe. Existing standards recommend straight upstream lengths of pipe from a flowmeter for as much as 20 to 30 diameters. I recommend that you familiarize yourself with the various standards' recommendations and make a comparison to the recommendations from manufacturers of the different types of flowmeters.

- Can you elaborate more on the speed of response issue?
    - Speed of response can be a critical issue depending on the specific application and process. For example, if the purpose of the flowmeter is to measure the total amount of flow that a chemical feed pump delivers and the pump operates at a speed of 30Hz, then a flowmeter with a speed of response of only 10Hz will be too slow to accurately measure the amount of chemical the pump delivers. In

this application, the flowmeter requires a speed of response at least as fast as the pump to provide the required accuracy. Conversely, this same flowmeter used as the primary element in a PID feedback control loop to control the chemical pump's output to a defined flowrate (set point) then, due to the averaging/dampening needed to properly control the pump, the flowmeter's speed of response of 10Hz may be adequate. Determining the exact need of the flowmeter in this example, either total chemical discharged versus control of the chemical feed pump, would assist in determining the required speed of response.

- What difficulties can solids in the flow stream present to the flowmeter?
    - Once again, this is flowmeter type dependent. Certain technologies, such as Doppler, require solids, or at least a reflector, like gas bubbles (sonic discontinuity), in order to measure flow. Other technologies may suffer accelerated wear or operational issues with the presence of solids. There are numerous issues to consider relative to solids:
        - Type of solid, organic or inorganic.
        - Percent solids in the flow stream.
        - Size of solids.
        - Entrained air or gas within the solids.
        - Varying characteristics of the solid, such electrical or sonic conductivity.

      Each of the above points needs to be considered in the flowmeter selection process to help select the appropriate flowmeter technology. Please refer to the applicable standards and review this issue with various flowmeter manufacturers for further details and recommendations.

- What flowmeter technology can be used on the widest range of applications?
    - There are a number of flow measurement technologies that offer a diverse range of applications. Conversely, there are certain flowmeter technologies that are restricted to very few applications. When evaluating the best flowmeter technology for a given application, the versatility of the technology is not critical as the immediate concern is only with that given application and what technology is best for that specific requirement. A secondary consideration though can be the application versatility offered by a technology as there are benefits for standardizing on such a technology including reduced inventory of spare flowmeters or parts and operator familiarization and training time reduction. The question in the selection process is to determine if the secondary issue here, standardization, outweighs the primary criteria of the best technical performance. This evaluation needs to be considered on a case by case basis.

      With that said, the most versatile flowmeter technology I'm aware of is transit-time ultrasonic (acoustic). This technology measures both liquids and gases, both open channel (partial full pipe) and full pipe, and from the smallest diameter applications such as arterial blood flow to the largest pipes or channels in the world. Please also recognize my possible bias on this issue as Accusonic commonly uses transit-time flowmeters on our projects.

- I've dealt with flowmeter vendors that do not require the amount of information you define is required to perform a proper evaluation. Is all this information truly required?
    - The information and details I recommend to be used in the selection of a flowmeter is for the sake of making the most informed and intelligent decision possible. All of the information defined in the presentation, and details that were not specifically addressed, are critical to lead to the proper selection. This effort is in the best interest of the flowmeter user and, while it is an effort, it is one that will help prevent unnecessary mistakes.

      Another way to look at this question is to turn the question around and to address it to the vendors that do not request this amount of information when they are evaluating the flowmeter selection. It may be best to ask them why they do not require this amount of information as a thorough evaluation cannot take place without it. How are these vendors providing a flowmeter recommendation without performing a proper evaluation?

- What is the life of a flowmeter if installed at a raw sewage pumping station?
    - This may sound somewhat like the non-answers I gave to some of the above questions but, it really depends on a couple of issues. First of all, an assumption must be made that the pumping station is performing properly including the pumps. There are a few issues related to the pumping station that can have an adverse affect on the life expectancy of the flowmeter.

        - If the lift station pumps experience cavitation, this can negatively impact the performance of the flowmeter as well as the life expectancy.

        - The operating levels of the wet well should be controlled in a manner that air is not sucked from the wet well through the pumps into the downstream piping. This issue, as well as cavitation, can negatively impact the pumps, the piping, and the flowmeter.

    - The type of flow measurement technology used for the pumping station will also help define the life expectancy. The most common flowmeter used for raw sewage pump stations are magnetic flowmeters. The typical life expectancy for a magnetic flowmeter can be 7 to 10 to 15 years, and possibly longer, depending on the specifics of the particular installation. However, should there be a grease issue in that area of the collection system, or other possible issues, the magnetic flowmeter may not be the ideal choice. Clamp-on flowmeters, either transit-time or Doppler, are also commonly used for the application and have less concern with some of the issues identified above as they do not come in contact with the raw sewage. Between transit-time or Doppler, I prefer transit-time for the application. In either case, life expectancy can be 12 to 20 years typically. Depending on the line size and required performance, multiple parallel chordal path transit-time flowmeters can also be considered but, as the transducers are wetted, some of the concerns stated above regarding the magnetic flowmeter need to be considered here as well. Life expectancy for raw sewage applications for this type of flowmeter can be 12 to 15 years and possibly more.

- What is the accuracy of the Accusonic flowmeters?

    - The accuracy of Accusonic flowmeters vary depending on the number of transducer paths, if it is full pipe or open channel (or partial full pipe), line size, flow profile conditions at the point of measurement and the customer's budget. We typically design our flowmeter systems to meet the installed performance requirement of the client. This may lead to just a 2 path flowmeter or to as many as an 18 path flowmeter for full pipes to as many as 108 paths for a low head hydroelectric facility. The typical installed accuracy or uncertainty statement for an Accusonic flowmeter will range from +/-0.5% to +/-2.0% for full pipe applications to +/-2.0% to +/-5.0% for open channel applications. Again, please note that these are installed accuracies and not the accuracy the flowmeter can achieve only under ideal conditions.

- Isn't it true if the meter is accurate that it would also be repeatable?
    - In most cases, a flowmeter that is accurate will be repeatable. There are instances that can occur where a flowmeter will meet a specified accuracy (uncertainty), but not meet a specified repeatability (as a specified repeatability is typically much less than a specified accuracy). This would be due to high standard deviations from a data set that falls within the specified accuracy, but outside of the specified repeatability.

- Could you please elaborate on calibration methods needing to be 4X better than certain standards?
    - The 4X rule of thumb dates back many years in metrology and I believe the origin of it came out of military standards for testing. In discussing this issue among some people familiar with metrology and various flow calibration facilities, it appears as if some labs apply this general rule where others do not. An important point on this topic is if the flow laboratory provides a flowmeter calibration certificate as part of the calibration report or not. If a certificate is included, then it is likely that some ratio is applied between the uncertainty of the lab and the uncertainty the flowmeter is certified to. If the particular lab just provides a report stating the testing performance of the flowmeter without providing a calibration certificate then it is a non-issue.

- Can you provide the different standards numbers to evaluate the uncertainty?
    - I am not absolutely clear as to what information you are requesting. If you are interested in what various standards apply to what particular flow measurement technologies, I encourage you to visit the various association websites for this information. Please refer to the following for standards applicable to transit-time flowmeters from various associations.

        - AWWA C750-03
        - ASME MFC SC5
        - ASME PTC18
        - IEC 60041
        - ISO 6416

    - If what you are interested in is the defined uncertainty pertaining to different standards, I once again, recommend you visit the various association websites to investigate this information for the various flow measurement technologies. The above standards applicable to transit-time flowmeters do address expected accuracy performance with both ASME PTC18 and IEC60041 including the criteria for a detailed uncertainty analysis.

- Can you provide a PDF version of the presentation for future reference?
    - A PDF version of the presentation is available. Please send me an e-mail at jtrofatter@idexcorp.com if you would like a copy.

- Are you familiar with OIML R 94 Recommendation? Your opinion on this Recommendation?
    - Unfortunately I am not familiar with this particular recommendation and have not been able to locate it at this time. I am aware that OIML has 125 recommendations listed on their website but R94 was not among them. My prior experience with OIML was solely for hydrocarbon liquid applications and I have always highly respected the work, standards and recommendations from OIML.