

Flow Metering – Where Non-Contact Really is Proving to be ‘No-Maintenance’

Although open channel flow meters have existed for 100's of years none were able to offer the promise of zero maintenance and long term reliability, combined with ease of installation and use. Since its introduction in 1999 the Flo-Dar instrument from Flowline has remained the only non-contact area velocity flowmeter available and has now evolved into several different systems that cover a wide range of applications and industries. Initially developed and manufactured in the USA and launched after more than five years of research and testing by manufacturers Marsh McBirney, the system was their response to the problems associated with "conventional" wetted type flow sensors, which until that time, were the principal method used in area / velocity metering.



Wetted sensors of all technologies; ultrasonic, electromagnetic etc. all require on-going maintenance. It's simply a fact of life when dealing with sewage and effluent flows, channels will silt up, ragging and fat will accumulate on anything in contact with the flow medium. The issue, especially now, is that maintenance has become a lower priority, however, removing the sensor from the flow eliminates the problem. It should be noted that conventional non-contact open channel flow meters are available, however they only measure level and rely on a primary device such as a flume or simply calculate flow based on level measurements and inferred velocity.

Marsh McBirnie's solution was to develop a radar/ultrasonic based system, measuring both the speed (radar) and the level (ultrasonic) of the flow which enables it to be installed in existing channels and pipes, without the need for a primary device. This greatly simplifies installation and usually eliminates civil costs, thereby significantly reducing capital outlay.



Looking at the measurement principle in more detail

The system consists of a single field mounted sensor, the sensor is common to all the Flo-Dar models both fixed and portable, with the sensing head mounted above the flow. Ideally it is mounted in a location where possible surcharged or peak flows would not reach it, although surcharged flows can also be measured.

Flow velocity is measured using a Doppler radar and the radar itself uses very low power and requires no user licence. Level is measured using an ultrasonic sensor and the data from the sensor is transmitted in digital format to the control unit.

The remote mounted control unit "combines" the sensor data with the pre-programmed site data (channel width, shape) and calculates a volumetric flow reading, this is displayed, logged and/or transmitted.

Proven over time in challenging applications

With a ten year history and over 4000 installed systems, it's natural that Flo-Dar has evolved over time. The first models were only available as fixed AC powered units with a small local display and no data logging capability. However, a portable battery powered version was launched in 2001 with the first systems being sold to Scottish Water for survey use on small remote treatment works.

By virtue of its "no civils" installation requirement, most Flo-Dar systems have been installed in existing chambers and channels often as part of a plant upgrade, but also to allow users to conform to stricter environmental regulations. This retrofitting ability has often seen the system used in very challenging applications, some of which are described below:

Specific Applications

- Dewatering discharge from a quarry, installed into a 900mm dia pipe placed into a small river channel, flow has a PH of 1.
- Hot brine discharge from salt processing plant, atmosphere attacks all metals including stainless steel
- Effluent discharge from Chemical plant, as well as being classified as ATEX Zone 1 the atmosphere in the chambers is toxic with entry into the area prohibited.

The user base for the system is split roughly 50:50 between water companies and industrial dischargers with water companies mainly using the meter for control purposes, whereas consent monitoring is the typical application for industrial users. However, it is in the area of sewer flow measurement and control that the benefit of maintenance free flow meters can really be appreciated. It could be said that the main spur to develop the Flo-Dar was to measure raw sewage flows and it is for this application that the system has been most widely used and appreciated.

Sewer Flow Monitoring and Surveying

Until the arrival of radar based technology the only area velocity meters available for sewer flow monitoring and surveying used a wetted "mouse", usually placed in the invert of the pipe. The sensors used



ultrasonic velocity measurement, either Doppler or correlation type, with both types using ultrasonic beam/s which reflected from particles suspended in the flow. When first launched over 20 years ago these systems were of huge benefit to survey and water companies, sewer design consultants and regulatory bodies. Although still using wetted sensors, the biggest advances seen with these systems has been with the electronics, most notably signal processing which has expanded their usefulness and allowed them to be used in applications where they would not previously have been suitable. Some systems use multiple sensors which can help to compensate for the effects of ragging, silting and fat build up and they can also be used where sewers surcharge. There are hundreds of these types of meters in used in the survey industry, principally due to their low cost.

The downside of using wetted sensors for survey work has been mentioned previously and can be summed up in one word, maintenance. Typically a survey team will have to visit a site every two weeks to download data and check the sensor has not become "ragged up", this can involve hours of driving followed by an entry into a confined space by a qualified team. If a sensor has become fouled then velocity data will be lost, the flow data will then have to be "reconstructed" from just the level readings combined with periods where the velocity data was available. Reconstructing data takes time and skill and delays getting survey results to customers.

In contrast non contact sensors never rag up which means the flow data does not require any processing prior to releasing to a customer, this also means that customers can directly access their own data which brings us neatly to the next benefit of maintenance free meters, remote monitoring.



The Convenience of Remote Monitoring

Data transfer to the internet via the GSM/GPRS network has existed for many years and is now very much an off-the-shelf solution, however, because of the need to "clean up" data this technology was not easily applied to sewer monitors. With Flo-Dar this has now become a reality. The new ATEX certified internet enabled systems log data and transfer it at periods to suit a customer's requirements.

This data is displayed on a web page and can be downloaded in spreadsheet format. The web site itself is user configurable and can show data from over 30 different flow meters on a single page making it ideal for network monitoring.

This ability to measure real time data is of massive benefit to users who need to control sewer flows automatically and many systems have

been installed and work in a closed loop control function to automatically regulate flows in sewers and CSO's. With new housing schemes putting additional pressure on existing networks, automatic control of flows will become more of a necessity as will automatic measurement and billing of discharges into sewer networks.

Technology in Action

The primary benefit of non-contact technology is long term reliability and this is best illustrated by two examples where Flo-Dar systems have been installed. Firstly, at a sewage treatment works in Fazackerly, near Liverpool, where the meter has required no maintenance, no servicing and no problems during 10 years of constant service. The second is the feedback from one user who's Flo-Dar was installed over four years ago, they commented "we just collect the flow readings every week and that's it, we almost forgot had a meter!"

The Flo-Dar system is a rugged, general purpose flow meter for use in most open channels such as; sanitary sewers, storm water sewers and other man-made channels including aqueducts and also 'natural' small streams. It measures open channel velocity and depth by non-contact means, virtually eliminating the need to periodically clean the sensors – as required by all submerged type sensors.

Data recovery from Flo-Dar deployments ranges between 98 to 100% even under site conditions that render most submerged systems inoperable. The accuracy of the system, both under open channel conditions as well as surcharge (submerged) conditions is more than adequate for the most demanding of metering applications, including open channel billing applications.



Conclusions

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