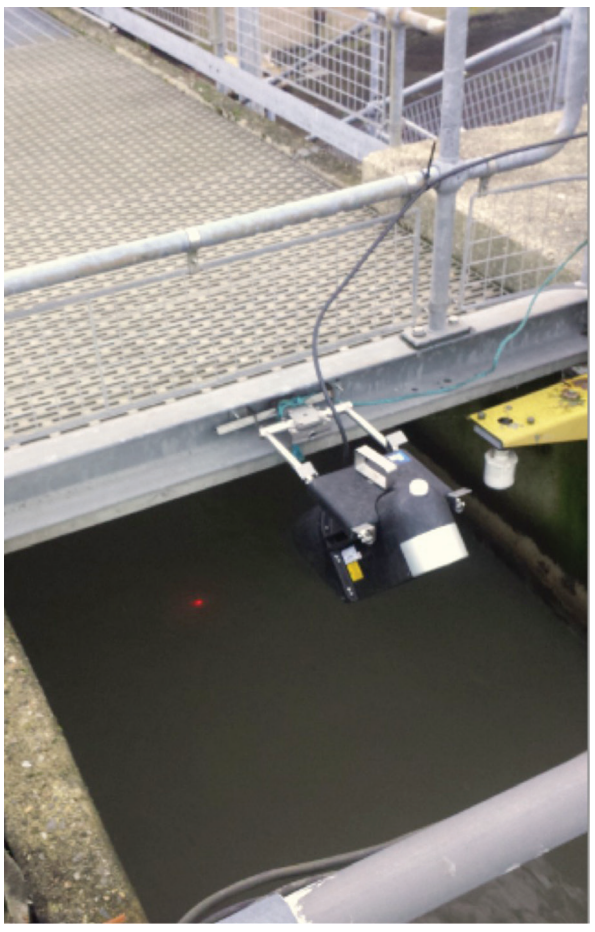
A Massive Step Change in Open Channel Flow Measurement Technology

RS Hydro have installed the first ISCO LaserFlows in the UK, in a market which has been requiring a high accuracy non-contact open channel area velocity flow meter for decades.



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In the UK, and in fact globally, investment in metering instrumentation within the wastewater industry is set to increase dramatically as smart networks, improved operational performance, carbon foot printing and environmental legislation all act to drive companies to reduce costs and improve performance. The industry has seen countless projects implemented to achieve very specific goals but are ultimately flawed from the outset because the data they depend on is of low or unverified quality. It's also all too easy to blame an instrument or infrastructure but as the old saying goes, 'an instrument is only as good as the person who installs it.' Experts would go as far as saying that a second class instrument will out-perform a first class product if the person installing it has the best training and experience in the market place. The critical issue of training and repeatability of correct installation is not the main subject of the discussion here but rather the technological approach to providing *accurate flow data in open channel wastewater applications.* The idea of this discussion always attracts professionals throughout the flow measurement industry but until now has been an application which is plagued with strict regimes of maintenance, H&S aspects, high capital cost of installation and a necessity to have an unrelentingly high standard.

Technologies Available...

The cost of installing or repairing a concrete flume or structure will make Metering and Environmental Managers shiver but in the wastewater industry it has been more or less a necessity of life that has to be carried out cost-effectively and by professional engineering companies. It is not uncommon for such a scheme to cost over £100,000 with significant downtimes and knock-on effects. The de-facto standard is to use ultrasonic level measurement in a stilling well 3-5 h_{max} upstream of the flume structure. Although this may appear fairly simple to achieve it is only one significant point in a whole list of requirements that must be near perfect to ensure that such flumes meet the Environment Agency's MCERTS standard for the self-monitoring of effluent flow discharges to water courses and sewers. A good installation is only part of a company's commitment to ensure that any such measurement system is accurate 24/7/365.

Ask any professional metering or environmental manager, and it is the holistic approach to whole of life cost, performance, maintenance, reliability and performance that will be the backbone of a good metering system. Unfortunately this approach is compromised by a lack of appropriate technology or financial funding. To date, any solution is either very expensive and accurate, or inexpensive with high maintenance and lower accuracy. To date many of these decisions have been based on a limited range of technological solutions which have principally been limited to:

(1) Conventional flumes using ultrasonic, pressure or radar level technologies to derive flow from level;

(2) Area velocity sensors which are wetted and typically mounted in the middle of a channel with a uniform geometry. Even with ADCP (acoustic doppler current profilers) flow meters, velocities are typically only measured in one thin vertical window;

(3) Radar based surface velocity systems which have been around for over 10 years and offer the ability to install sensors where it is too expensive or not possible to install flumes, area velocity or full-bore pipe technologies. However, they offer lower accuracies due to the fact that they can only measure surface velocity and they require a known and stable sub-surface profile. A typical installation involves manual profiling of the flow to ascertain a flow profile;

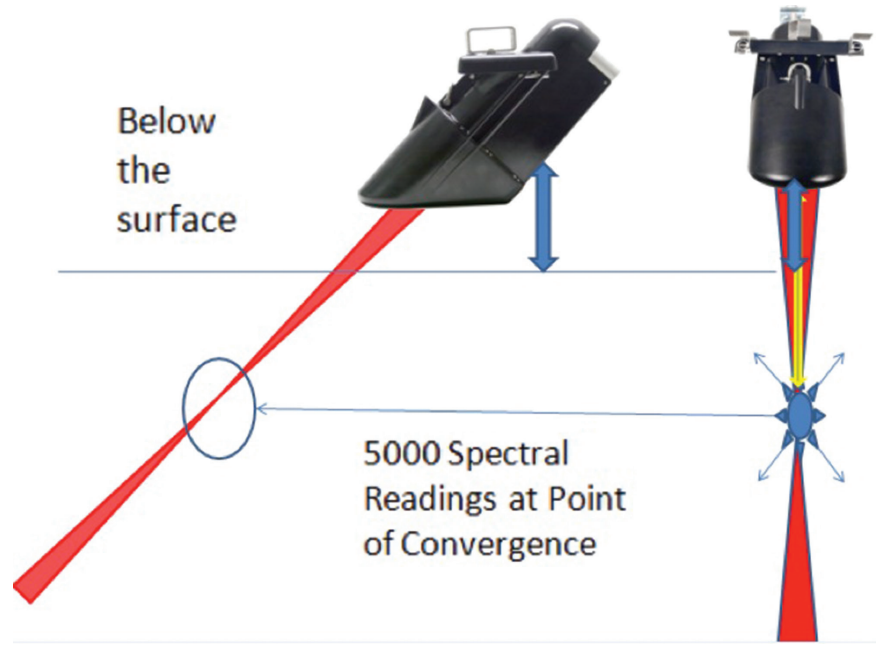
(4) Electromagnetic or ultrasonic (transit time) pipe flow meters where the pipe is always fully surcharged except for a couple of manufacturers who have managed to adapt these technologies to measure partially filled pipes. Beyond standard clamp on or electronmagnetic, hybrid technologies can be expensive but often only applicable to very niche applications.

Options 1 and 2 require regular maintenance (typically daily or weekly) so with potential risks, increasing regulatory requirements and finite resources is using a brush to clean sensors in a channel still practical or indeed necessary? In a world where there seems to be less time to do these regular jobs, 'the man and a brush' approach really needs to be abandoned.

That day has now come with the availability of highly accurate reliable, non-contact area velocity meters in the form of the LaserFlow™ from Teledyne ISCO which has been launched to solve all of the issues associated with open channel flow measurement.

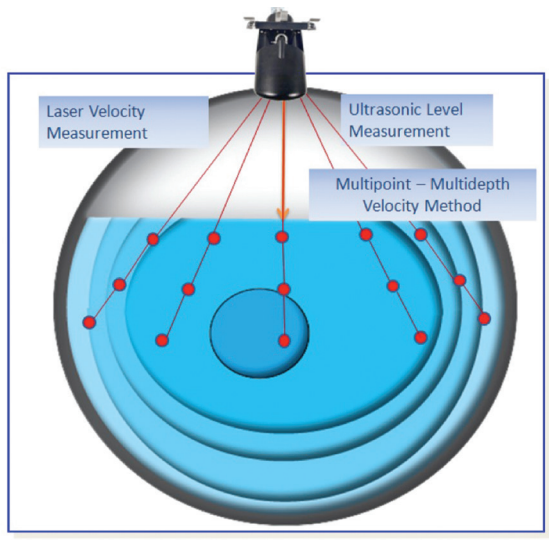
Introducing the LaserFlow

The LaserFlow™ combines an ultrasonic level sensor with a 45-degree reflector plate and a military grade 3R laser velocity sensor. The integrated ultrasonic sensor (or alternatively external sensor) provides continual level measurement whilst the laser focuses at a point below the surface and measures the reflected energy from up to 10,000 spectral readings per measurement

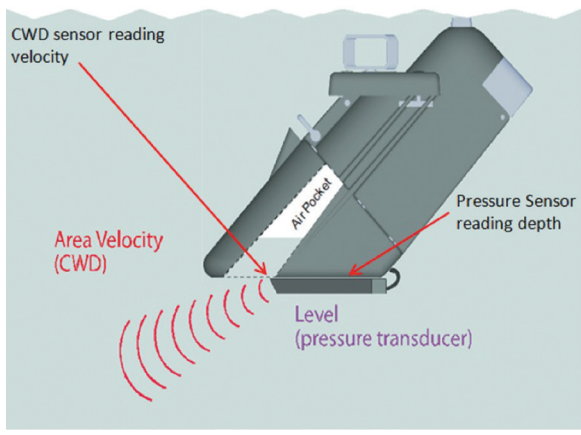


UK Focus - Water / Wastewater

point. The laser beam is focused at a specific location based on water depth and according to how many measurement points are selected. Although one or two velocity points are often enough, multiple points (up to 15) can be used in applications with turbulent, skewed flows or changing flow profiles. Reflected energy from the point of convergence is much higher than energy reflected back from the unfocused sections. The frequency shift between the transmitted and received indicates the flow direction whilst the magnitude of the shift provides velocity. The options for measurement include: (1) single point; (2) multi-depth; (3) multi-point; and (4) multidepth-multipoint. This allows the LaserFlow to measure up to 15 different locations in the flow profile to give very high accuracy



readings. In all applications to date RS Hydro have achieved results to within 1% of MCERTS flumes. The reasons for using these different techniques ultimately depend on how stable the flow conditions are. If very stable conditions exist then a single point measurement may suffice however if the flow profile is changing then multidepth-multipoint can be selected to optimise performance and if the LaserFlow is submerged a TIENet area velocity sensor mounted to the underside of the LaserFlow automatically takes over once submerged conditions are recognised.



Cost

Costs for repairing or installing traditional concrete flume structures can amount to more than six-figure sums and although wetted area velocity sensors can be used they require high maintenance and also suffer from a higher level of repairs due to their contact nature. It is therefore essential that the initial cost of a flow meter is put into perspective. Metering managers will concede, for one reason or another, meter 'x' was not maintained last month due to manpower resources and when they did they found that the sensor had stopped reading a week before or even that it was not actually there due to the ragging that ensued and caused its demise.

Secondary precautions like screens are then introduced at further expense, portable units can only be installed in raw wastewater applications typically for 1-2 weeks at a time due to the same issues and/or battery power but the LaserFlow™ is non-intrusive and requires little or no maintenance, even with a battery module, temporary deployments for up to 3 months at a time are practical.

The payback period of a LaserFlow™ can be 1/25th of traditional installations. The LaserFlow™ simply provides proven, risk free and accurate flow measurement.

Installation & Maintenance

Simplicity is one of the LaserFlow's™ strongest features – a sensor that can be installed facing upstream or downstream using simple adaptable brackets within 15 minutes using a temporary spreader bar or in just an hour or so for permanent installations - **without any interruption or adaptations to flow** and when the LaserFlow™ needs removing or reinstalling then it takes just a few minutes with the Street Level Installation Tool especially useful if the device is in a chamber or difficult location.

The LaserFlow™ has a much wider turn-down ratio compared to conventional flumes and is a proven candidate for retrofitting to flumes which are incorrectly sized/installed or whereby the uncertainty of measurement is unacceptable.

The capital cost of most instrumentation is outweighed by its maintenance; industry sources commonly use a figure of 50:1 over a 10-year period. It is therefore essential that companies move away from high maintenance instrumentation to instruments that can effectively be "fitted and forgotten" and only require routine verification. The LaserFlow™ requires no routine maintenance and is favoured to replace high or even low maintenance flow meters. Where traditional instruments are not maintained, errors occur and trust is lost. Although this is significant but worse still if the instrument are relied on for decision making of major infrastructural development using erroneous data; the associated costs of bad descisions far outweigh the cost of any flow meter installation.

Accuracy

It is an understandable thought that "quick and easy" instruments must have a lesser accuracy but not the LaserFlow™ which provides conservative accuracies of around 1-2% borne out by field tests in the UK compared to high-accuracy MCERT'd flumes. Due to its high accuracy, obvious applications include:

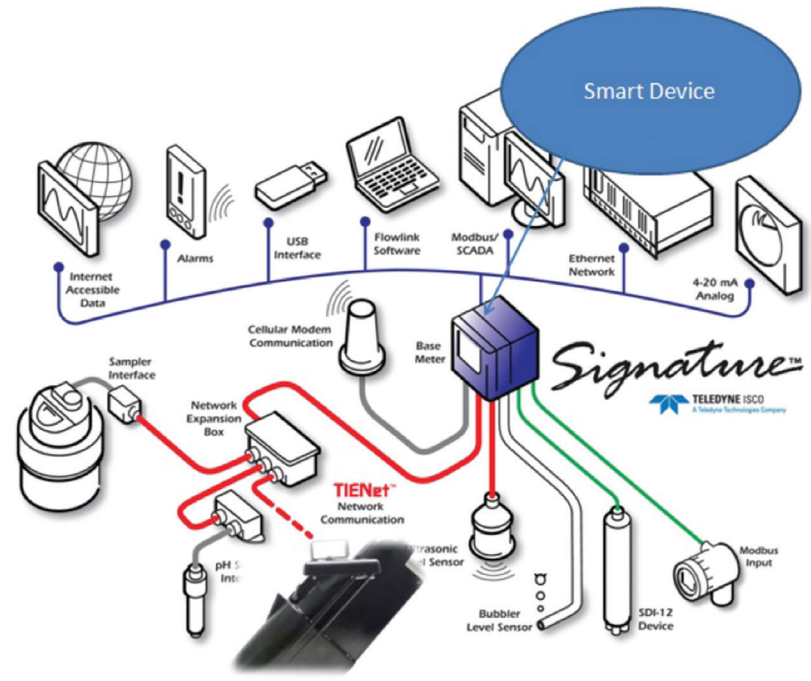
- MCERTS Discharge
- STW Inflows
- CSOs
- Rivers, Streams & Culverts

Health & Safety

Many installations are in sewers, confined spaces or where there is a danger of fast flowing unhygienic water. By installing the LaserFlow™, entry can be minimised and H&S concerns and costs are minimised. Furthermore as no profiling is required then there is no requirement to go near or in the water body. Installation is therefore very quick and safe and risks of wetted sensors breaking loose and causing blockages or indeed being flushed down sewers are eliminated.

Connectivity

The LaserFlow™ can be installed as a portable device using the ISCO 2160 flow module or with the permanent Signature™



Transmitter. The Signature is a SMART device and provides multiple input and output capabilities using ISCO's TIENet system. The Signature itself has a USB interface, datalogging (with variable rate logging), provides reports, alarms, Ethernet/ wireless connectivity and is FlowLink™ compatible. It is possible to connect multiple LaserFlows to one Signature. The Signature is SCADA-ready using analogue or digital outputs including Modbus. Furthermore, it is possible to connect modbus/SDI12 sensors along with other ISCO and third party sensors.

Real results from the field

Barry Pike, MCERTS Manager for Wessex Water commented: "We have been working with the LaserFlow and RS Hydro over the last few months and the accuracy and performance has been extremely impressive. We have used it to provide accurate flow measurement on the inlet to a number of our WWTWs. This flow meter has an incredible future in the wastewater industry and it allows Wessex Water to measure applications which could not be considered before. Beyond its accuracy and performance, the device also needs almost no maintenance. The LaserFlow is likely to revolutionise the approach to measuring open channel flow measurement in many applications."

Released in 2013 to address the demand for a high accuracy device with almost zero maintenance, low health & safety issues and high reliability, the LaserFlow™ represents a paradigm step change in open channel flow measurement and provides metering managers the long overdue ability to measure open channel flows without installing expensive, maintenance intensive flow measurement systems.

The image below shows a LaserFlow™ installed upstream of a recently MCERT'd flume. The data shows about a 1-2% difference between the meters using only a single point measurement rather than 15 which presents a challenging question- which technology is the most accurate?

If you would like to find out more or arrange a trial, simply log onto our website at www.rshydro.co.uk.