Ultrasonics Enhance River Monitoring Project

Minimising the risk of river pollution and protecting a Site of Special Scientific Interest (SSSI) was one of the key objectives of a river flow measurement project involving flow monitoring specialists FLOWLINE. The location of the project was on the River Erewash, a tributary of the River Trent at the Attenborough Lakes Nature Reserve in Nottingham, England and at a point where the river is around 10 metres wide and a depth ranging from 0.5 to 2 metres.

The site owners CEMEX had to overcome the problems of various sewage works and other sites discharging into the river and causing contamination. The critical point was where the river passed through the site of a former aggregate quarry shortly before meeting the river Trent, an area designated of special scientific interest and home to a wildlife sanctuary. Therefore, a key requirement was to move the discharge point of the river to ensure that it would not continue to pollute the nature reserve.

After considering a number of flow measurement options, CEMEX asked Flowline to provide a metering station which would continuously measure the river flows to provide data for use in calibrating a hydraulic model of the Erewash and Attenborough lake system. Another important consideration was that the site was open and accessible to the public and incidents of vandalism had occurred, so any equipment installed had to be as robust as possible, without being too intrusive.

Following an initial survey and taking all the dynamics of the site into account, Flowline supplied a 4 path Ultrasonic flowmeter incorporating Ultraflux 'Time of Flight' sound pulse measurement device with GSM telemetry.

The complete supply package included initial site survey, selection of suitable metering point, installation of the system including support columns and cable runs and finally, commissioning the system. The application of the Ultraflux ultrasonic measurement principle at this site involved the use of a number of ultrasonic 'paths' located at approximately 45º to the river axis. The requirement for 'real time' monitoring and continuous recording of flows was satisfied by the use of a GSM modem which was connected directly to the flowmeter control unit. This ensured that flow could be read at any time and also meant that the built-in data logger could be downloaded when required.

This measurement principle and it's configuration at the River Erewash site provided accurate flow measurement data, despite the characteristics of the river, for example significant variations in velocity and turbidity. These factors often render other types of sensing technology ineffective as they would have been unable to provide accurate data such as accurate average velocity at different depths and widths of the river at the critical point.

The installation at the River Erewash site involves ultrasonic sound pulses being sent alternately between probes mounted on opposite sides of the channel / river. The pulses that travel 'with' the flow are speeded up, while the pulses that travel 'against' the flow are slowed down. The time between each pulse being transmitted and received is measured very accurately and the greater the time difference between transmission and reception, the higher the flow velocity.

Commenting on the Flowline installation, Chris Pointer, Senior Hydrogeologist within the Geological Services Department at CEMEX UK, said, 'The Flowline system has enabled hydraulic modeling work that ultimately led to the granting of planning permission for an extension to our sand and gravel operations at the Attenborough

Quarry'. He continued, 'In the past we have used Ultrasonic Doppler flow meters and these gave very noisy data due to low suspended solids content, so the data was virtually unusable and we also experienced difficulties with a fixed weir gauge'.

Chris confirmed, 'Overall we are pleased with the system which has been operating successfully, the problems associated with the Doppler flow meter have not occurred with the Flowline Ultraflux system. Also, we particularly appreciate the instantaneous direct flow measurement data without the need to use a rating curve, while the telemetry enables real time monitoring of flows and allows us to check on the system performance'.

The general specification of the key components of the Flowline system included; for the volumetric flow measurement, partially filled round and rectangular and other shaped conduits using from 2 to 6 velocity chords, for velocity measurement, time-of-flight ultrasonic providing accuracy of +/- 0.5% of reading with a range of 0.002 m/s to +5 m/s and with a probe frequency from 0.5 MHz (dependent on the application).

Level measurement was provided by 4-20 mA signal from the transmitter while the flow calculation method was conversion of water level and pipe size to fluid area with multiplication of fluid area by mean velocity to equal flowrate. Flow measurement accuracy was typically +/- 2 to 5%. The sensor probe units were field interchangeable with control units, the sensor housings rated to IP 68 and constructed using stainless steel casing, with twinax type sensor cables. The controller / display unit was field interchangeable with the sensor units and rated to IP 67. The enclosure housed a built-in data logger providing up to 32400 flow readings while the control unit was programmable via the supplied software, or via the key pad, with report generating software included as standard. The display provides flowrate / total, diagnostics, 3 off programmable relays, with a 4-20 mA output for flowrate.

The Flowline system at the River Erewash site, which is also being considered for use by the Environment Agency, exceeds the requirements of ISO 6416 and is also CE marked, although certification to ATEX standards is possible for hazardous areas, if required.

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