

Cerne Abbas keeps its head above water

Acrylate injection to solve groundwater inflow problems is keeping one of the UK's most picturesque villages open for business

THE ancient settlement of Cerne Abbas has a recorded history going back over 1,000 years. Nestled in the Dorset countryside along the banks of the River Cerne some six miles northeast of Dorchester, in England, the village is a popular tourist destination for visitors to the area who come to see the ruins of the Abbey, founded in 987 AD, and the famous fertility symbol, the Cerne Abbas Giant, carved into the chalk of a nearby hillside.

The position of the village in the bottom of the valley of the River Cerne, which runs through chalky ground, means that groundwater levels throughout the area are only just below the surface, if at all, with parts of the village boasting natural ponds and with river courses having to be culverted along some village streets. As the area is so close to natural water sources there has often been flooding at times of high rainfall.

DRAINAGE DIFFICULTIES

The groundwater situation does, of course, mean that, in the more recent years of the village's existence, when mains drainage systems were installed to serve the residents, most of the pipe work was laid well below the existing water table. As the pipes have aged and joints deteriorated over the years, this has led to a significant amount of infiltration through defective joints, with up to 30% of joints affected on any particular pipe length.

Infiltration can vary from a mere trickle to gushing flows depending on the prevailing groundwater situation and the degree of deterioration in the pipeline. This inflow of fresh water not only reduces the capacity of the drain to handle foul flows but also ultimately adds to the burden on the treatment plant into which these flows are fed.

Having investigated the existing situation in the Cerne Abbas area, Wessex Water, the water company responsible for the system's maintenance, decided to carry out repairs to minimise, if not eliminate, the infiltration occurring on the Cerne Abbas drainage network.

To this end, Wessex Engineering and Construction Services Ltd (WECSL), Wessex Water's construction division, undertook a study to establish the best way to complete the work.

ACRYLATE INJECTION SEALING

Investigations showed that most of the infiltration on the Cerne Abbas network was through defective joints, so WECSL undertook to find a system of sealing that would counter it without the need to excavate the whole pipeline system. There was also a need to ensure that, whatever system was chosen, the work would not interfere with the tourist activity that, during the summer months in particular, is so vital to this small rural community.

Ultimately it was decided to utilise the trenchless system known as Acrylate

The Cerne Abbas Giant, one of the village's main tourist attractions, is a figure cut into a local chalk hillside. Below: the picturesque main street of the village of Cerne Abbas, with buildings dating from as early as the 16th century. Inset, below right: one of the many narrow lanes in which the joint sealing work was to take place

Injection sealing (or Gel sealing). The contract to carry out this work was awarded to Hampshire-based drainage contracting specialist SDI-Unistride. The work was scheduled for seven weeks duration at a cost of some £70,000 (US\$1=£0.54).

SDI-Unistride is one of just five companies in the UK believed to carry out this type of work, with only three of these found in the southern part of the country. While the various contractors use different manufacturers' systems for their operations, the principle behind each is largely the same. In this instance, SDI-Unistride used its joint sealing rig, made by CUES Inc of Orlando, Florida, US, for the work.

Once a section of pipeline has been CCTV surveyed and cleaned to remove silt and obstructions within it, a typical sealing cycle involves the establishment of the Acrylate Injection system set up between



"The schedule of works for the Cerne Abbas Project was completed on time to finish before the main start of the tourist season at Easter 2006"



two existing manholes. With the sealing truck at one manhole and a control winch at the other, a winch cable is set up between the two access points. On this winch line, a CCTV camera is positioned so that all sealing work can be observed from within the pipeline by the operator who sits in the control cabin on the truck, ensuring accurate positioning of the sealing unit and enabling the operator to check the operation progress. Next to the CCTV camera is positioned the sealing unit or packer itself. This in turn is connected to compressed air, water and sealing resin feeder pipes. On the CUES rig, feed lines are specially designed as a single 'cable' to avoid any chance of entanglement in the pipe.

The sealing packer comprises a framework which carries a packer that can be inflated at the ends, with a mid-section that allows the sealing resin to be injected at a set point between the end seals. Each packer is designed to fit into a specific pipe diameter, in this instance a 150 mm-diameter packer was used as all the pipes across the Cerne Abbas project were this diameter.



A village of this age and history was, of course, well prepared should the joint sealing project not be as successful as it should have been, adding just a little pressure for the crew on site!

a static mixer which produces the final resin mix. The pressure pumping the resin into the annulus forces the mixture into the joint, filling it. As the resin mix cures and hardens this seals the defective joint against further infiltration. To test this, once the resin pass has been completed and the resin has cured, a further air pressure test is carried out. If the joint again fails to hold the air pressure a further resin sealing pass is made. This cycle continues until the joint is completely sealed, although it is rare that more than two passes are required.

The acrylate polymer sealing gel used on the Cerne Abbas project is known as AC-400 grout. It is a monomer system grout designed specially for groundwater control soil grouting, seepage control in concrete and infiltration control in sewer networks. Acrylate grout was introduced to the industry in 1980 after the removal of acrylamide grout as an accepted product in 1978 due to toxicity problems.

The gel time for the resin can be pre-determined by the operator and is established by varying

the concentration of chemicals in one part of the resin mixture. The gel time can be varied from just a few seconds to a matter of minutes depending on the situation at hand. Where large infiltration is experienced, the quicker the gel time the better, otherwise there is the risk the resin will be washed out of the joint before setting. Where less infiltration occurs but where the defect may need a significant amount of resin to fill it, gel time needs to be longer to allow for sufficient flow of resin to occur before curing takes place.

The speed and efficiency offered by the system means several joints can be sealed during the course of one shift and with the work being carried out through existing manholes, no excavation is required. This limits the duration of any road closures and other interference to everyday life for residents. There is also no need to block the pipeline during the sealing process as the sealing packer is hollow, allowing flows to continue running even while the work proceeds, so keeping customers on line at all times.

The system also uses a small crew of just three people on site, with just one needed to operate the system during a sealing run because the control cabin is set up to give the operator full control over both the truck-end operations and the remote winch end systems. This can mean that other sections of pipeline can be prepared and readied for sealing by the other crew members while the first is completed.

The truck has a full workshop facility on board for cleaning and on-site repair of the equipment, again limiting the potential for downtime during a project.

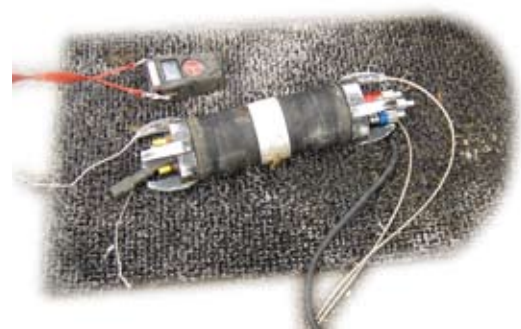
The schedule of works for the Cerne Abbas

Project, consisting of joint sealing over 960 m of pipelines, was completed on time to finish before the main start of the tourist season at Easter 2006.

Commenting on the project for WECSL, senior engineer Julian Britton said: "This is a fast, efficient and sustainable means of



The Acrylate Injection joint sealing truck with the sealing packer being prepared behind it and (inset top) the control cabin set up within it



The sealing packer used for the Cerne Abbas joint sealing work. The white coloured central area is the resin injection port section and the black rubber ends are the inflatable end seal sections

sealing our sewers using cutting-edge technology without the need for excavation in the highway. It therefore minimises the disruption to our customers. Preventing groundwater from entering our sewers is an important issue for us, as it means we use less electricity in pumping sewage to treatment at the works, again saving money."

For SDI-Unistrade, managing director James Fulker said: "Gel sealing is a quick and relatively inexpensive way of sealing pipe joints and manholes. Sometimes as many as 70 joints per day can be tested and sealed, or up to four manholes. Our rig is unique as it is completely self-contained and requires no other support vehicles or equipment to operate. For the customer, this means greater efficiency and even less disruption."

Commenting on the work for Cerne Abbas Parish Council, Mr Stenhouse, vice chairman, said: "The villagers are very happy with the way the work has been undertaken. The pre-start meeting, by Wessex Water at the Parish Council, explained the forthcoming work very well and the whole process has been carried out very professionally, with minimum disruption to both the village and its residents."

By Ian Clarke, TTC consultant editor – trenchless

SEALING CYCLE

To complete a single seal, the rig operator winches the camera/sealing packer arrangement into position over a pipe joint with the packer straddling the joint. In this way, when the end seals are inflated, the joint is in effect isolated from the rest of the pipe. With the end seals inflated air pressure is applied at the joint to test its state of repair. If after a pre-set time the air pressure has not dropped, the joint is taken as sound. If air pressure is lost, the joint has to be sealed as it is obviously leaking. Where major infiltration occurs a preliminary pressure test is not always used as the leak is obvious.

On the Cerne Abbas project, SDI-Unistrade and Wessex Engineering and Construction Services agreed a preset time for the pressure test of two minutes, although in some cases tests of up to five minutes may be used.

Once a joint has failed the pressure test, and with the end seals still inflated and sealed, the two-part resin is pumped into the annulus around the sealing packer between the sealed ends. Just before the resin is expelled into the annulus, the two parts pass through



A schematic of how the Cues acrylate injection process is achieved using the inflatable packer system

