

Bunkers Hill, Hook, Hampshire

new lining system renovates bursting water main

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South East Water's 6" diameter cast iron water main running along Bunkers Hill, Hook, Hampshire is susceptible to bursts with a minimum of twenty recorded incidents occurring over the past few years. The section most prone to bursts is approximately 700m long located in a rural area alongside the busy B3349 road. The main indirectly supplies some 600 properties and 4 directly. Pipe pressures vary between 10 to 12 bar. Pressure reduction was discounted as an option to relieve the problem due to the need to maintain level of service at the far end of the system. Any alternative supply could not maintain the level of service for prolonged periods. Analysis of pipe samples and the surrounding environment showed the pipe to be in excess of 50 years old, vulnerable to internal pressures and subject to excessive vibration from traffic. Excavation would fracture the main once the supporting ground was removed.



PE Liner prepared for insertion (courtesy Pipeway Ltd)



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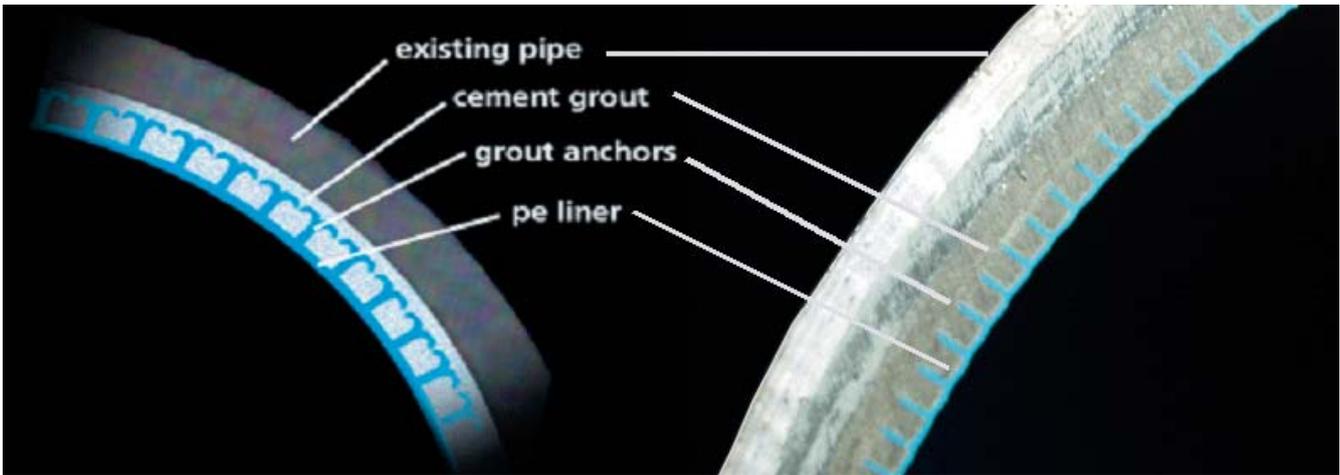
PE Liner prepared for insertion (courtesy Pipeway Ltd)

Within the water industry there are a number of systems for renovating water mains ranging from the non structural types such as epoxy resins and polyurethane relining to the structural such as pipe bursting, slip lining, hose lining and the traditional full pipe replacement by open cut techniques.

The most widely used of the non structural techniques is the application of a Resin lining developed to replace cement mortar lining for reasons of water quality and improved internal finish. Epoxy resin relining, whilst extending internal pipe life,

improving the pipe's hydraulic characteristics and enhancing water quality adds little to the internal structure of the water main. Relining has over recent years become highly regulated and requires relatively sophisticated equipment for its application.

At the other extreme, where the main is showing signs of structural failure, the two most commonly used techniques are pipe bursting and open cut replacement. Both are disruptive to the general public and damaging to other services in the locality of the main to be renovated, particularly in an urban environment.



Typical cross section (courtesy Pipeway Ltd)

Between these two extremes there are a variety of other structural or semi structural linings available for mains renovation (slip lining and hose lining). These systems, however, can lead to a substantial reduction of bore, or difficulties associated with sealing the inner pipe/liner to the host main, particularly at access points and service connections.

Bunkers Hill

A new system, designed to renovate small to medium diameter water mains (3" to 12") which have problems associated with internal corrosion and leakage either through joint or structural failure was chosen to overcome the Bunkers Hill problem.

The system, *CemPipe* consists of an extruded Polyethylene based membrane material, which is applied to the inside of the water main, backed by a cement grout. The Polyethylene membrane seals the water main, whilst the cement grout fills the annular gap between the liner and the host pipe and is forced into any structural defects that may exist in the host pipe. This cement grout when hydrated supports the liner giving great strength to the finished product and gives active corrosion protection and improved hydraulic conditions to the internal surface.

Installation procedure

- * site preparation including, excavations, survey, bypass, cleaning, pre-lining, inspection etc;
- * insert *CemPipe* tube followed by preliminary rounding to avoid twists and creases and to prove correct liner insertion;
- * trim the tube and position installation fittings;
- * mix cement mortar and pump required quantity between liner tube and the main;
- * initial "rounding" of the structural liner by means of the parachute swab;
- * install the inflation tube, pressurise and cure;
- * remove installation fittings and inflation tube;
- * fit end PE inserts to liner ends and install spool pieces sealing cut pipe ends;
- * carry out return to service procedures including water quality sampling;
- * remake service connections by normal tapping methods.

Technical envelope

The process developed by *Pipeway Ltd* (mains renovation contractors to the water industry) can renew pipes with holes, displaced joints, seal leaking joints offsets of no greater than 12.5% at each joint and used around long radius bends to a maximum of 22.5 degrees. Minor changes in diameter can be accommodated eg cement mortar lined repair pieces but major changes in diameter are not acceptable and need to be considered and taken account of during the planning stage.

The system has approvals to 25/1/A for the UK and NSF approval for the USA.

Lining lengths vary depending on site conditions, location of valves and hydrants, but lengths of up to 300 metres are achievable at any one time. Thus, making the application particularly cost effective in rural locations with a low number of service connections.

The *CemPipe* liner is capable of withstanding an internal pressure of 20 bar over an unsupported hole of 60mm in diameter or a crack with the circumference of up to 6mm without failure. The liner can be applied to a variety of host pipe materials including steel, cast iron, concrete, PVC, ductile iron, asbestos, cement and GRP and has 3mm minimum thickness. This may be greater depending on the diameter of the host pipe. The process relies on a cement based grout and should not be applied when the substrate temperature is below 3° centigrade.

Return to service procedures may commence following a period curing of the grout which, under normal circumstances is 16 hours after installation.

Bunkers Hill - case study

Over the course of the works a total of thirteen separate installations of *CemPipe* were completed in lengths of between 100 and 150m.

The lining lengths being dictated by traffic management restrictions and the positioning of valves and fittings. An overland feed enabled supplies to be maintained during construction.

During the lining works the system had to accommodate bends of up to 22.5 degrees and undersized main where concrete lined pipe had been used to repair previous failures,

To complete the works, the contractor *Pipeway* used a rack feed borer to clean the mains and a portable *Putzmeister* grout mixer and pump to prepare the cement grout. The only other specialist equipment used on the site was CCTV and a one tonne winch to install the liner.

The works were completed within six weeks and since the installation of the liner there have been no further failures on this length of main. Using the technique, South East Water were able to renovate approximately a further 30% of the main against the cost of a typical open cut replacement programme. ■

Note: The author of this article *Graham Webb*, is Project Director for *Dynamco Ltd*, Consultant Engineers to South East Water).