Steel Mains Pty Ltd
ABN: 73 004 843 056

125-175 Patullos Lane
Somerton VIC 3062
Phone: +61 (0)3 9217 3110
Web: http://www.steelmains.com

Cement mortar lining for water pipelines – Why it's still the best!

The Australian Pipeliner — April 2007

Cement mortar lining has been used for internal protection of water pipes for over 150 years, and is the most commonly used lining for water pipelines around the world. It's widely regarded as the best lining for water pipelines. Why is this so?

History & Application

Cement mortar has been used to line pipe since the 1840s. In the 1920s the process of centrifugal spinning was perfected. This process allowed the rapid application of linings to the entire pipe surface by placing a mixture of sand, cement and water into the pipe and rotating it at high speed. The centrifugal forces distribute the lining around the pipe circumference and compact it against the pipe wall. At the same time excess water is spun out, leaving a smooth surface mortar, with a very low water to cement ratio. Together with the low void content this results in a strong, low permeability cement mortar lining. Note these linings perform much better than cast concrete, due to the high cement content, low void content, and low water content of cement mortar.

The long history and performance of cement mortar contrasts with that of the newer liquid applied polymeric linings, such as epoxy. Whilst suppliers claim epoxy has been used for up to 40 years, continual changes to formulations mean very few, if any, have remained without a formulation change over a 10 – 20 year timeframe.

Cement mortar linings provide demonstrated long-term protection at a low cost, and consequently they remain the standard lining for potable water pipes.

Alternative linings, such as liquid applied epoxy, have not gained as widespread acceptance because of concerns that they do not provide the longevity required for water supply pipelines.

A major benefit with cement mortar is the ease of application. The mixing and application of mortar is straight forward, leading to low risks in application. This is a significant advantage over epoxy linings, that require careful control of ambient conditions, mix ratios, curing, etc.

Mechanism of corrosion protection

Cement mortar linings provide active protection of the steel pipe by creating a stable hydroxide film at the steel-mortar interface. The corrosion protection is referred to as active, because it provides protection even where there are discontinuities in the lining.

This is in stark contrast to epoxy linings, which are barrier linings, and require 100 per cent integrity to achieve corrosion protection. Any discontinuity will result in corrosion; unless there is additional significant expenditure on cathodic protection systems which are not employed on most water pipelines.

Water quality

Cement mortar has a demonstrated track record in conveying water for long periods to required water quality standards, and currently meets all applicable standards throughout the world. Cement mortar does not support microbiological growth.

In situations where the conveyed water is aggressive and the flow rate is low (resulting in a long residence time), a high pH can develop with cement mortar lined pipe. Whilst this is not a health issue and is simply prevented by the use of seal coatings. Seal coats provide an elegant engineering solution, which maintains the best internal protection for water pipelines, at a low cost and provide a long service life, whilst ensuring all water quality requirements are met. They have a demonstrated track record of over 50 years.

It has to be noted that all pipeline materials, including epoxies, will leach some compounds into the water. Many epoxy linings are suitable for water contact, however it is critical that the mix ratios are carefully controlled, as any variation to the exact ratios can result in unacceptable organic compounds being leached into the water. This has occurred in the past.

Handling and Installation

Exponents of epoxy linings point to the weight of cement mortar as an advantage for their product. The weight of pipe is rarely a limiting factor for truck loading. In use the only possible cost is with handling and installing the pipe at site. As machinery is always required there is rarely a cost advantage with lighter pipe.

The biggest issue in installation of pipes with epoxy linings is the internal reinstatement of welded field joints. Such reinstatement requires entry into pipes via the epoxy lining, blasting and application at the joints, all to the same specification that applies for the pipe body. The poor damage resistance of such thin linings makes this a horrendous chore, which is likely to result in many repairs, and reduced performance at joints.

The controlling factor in determining the pipe wall thickness of water pipelines, especially for larger diameters, is pipe stiffness. One huge benefit of cement mortar is its high contribution to pipe stiffness. For example, in a 1 m diameter pipe, the contribution of cement mortar to pipe stiffness is equivalent to more than 2 mm of steel wall thickness. Conversely if one uses an epoxy lining, in place of cement mortar, the pipe would need an additional steel wall thickness of more than 2 mm to maintain the same stiffness. This can add a huge cost to the use of epoxy linings.

Performance

The long service history of cement mortar has allowed for continual assessment of performance. Recent tests have been undertaken on cement mortar taken from pipes that had been in service for 64 years (in NSW), for 40 years (in Tasmania), and for 34 years (in Victoria). Assessment of the samples verifies that a service life in excess of 100 will be attained, even when conveying aggressive waters.

This performance is in contrast to that experienced and predicted for epoxy linings. The literature indicates a life of 30 – 50 years for 0.8 to 1 mm minimum thickness epoxy. This information indicates a service life of 20+ years for epoxies that have a minimum thickness of 0.4 mm. Such predictions are in line with the deterioration experienced on a significant epoxy lined pipe that is now 25 years old.

Conclusion

The water industry in Australia generally requires a 100 year life for pipelines. For pipe lining this is achieved with cement mortar lining, a proven technology that meets all the customer requirements, and provides the best lining for the water industry by every measure.