1 Decision Tools

This review provides an overview of the current state of practices and the state of protective coating technology and performance of coating in sewer, specifically ***sprayed and trowel applied*** coatings. The key items that were examined included the decision tools and approaches for the design of the protective system. This included coating specifications, the water utility industry use of field demonstration in testing emerging technologies, condition assessment of coatings, standards and QC/QA for and procedures for accepting installations.

This review was undertaken from 2009-2010.

1.1 Coating Specifications

- There are currently four types of coating specifications available within the water utilities surveyed in this study. Two qualifies polymeric and two qualifies cement based lining materials. *At the time of this study Water utilities from Brisbane and Gold Coast areas were non participants in this study*.
- In addition, water utilities are implementing both short term (6 months – 1 year) and long term (3-13 years) trials to **validate** the performance of the coatings in sewer environment.

Assessment

- The **coating specifications** varied among the various industries and reflected the individual approaches taken by the asset owners to sewer rehabilitation.
    - SW recently introduced two new specifications, AM SS204 and Standard Specification 208 (AMSS204 2009, Standard-Specification-208 2011) qualifying coatings based on material composition requirements, chemical and physical testing methodologies to reflect both short and long term performance of the coatings.
    - Specification used by SA Water, Melbourne Water and Water Corporation, APAS 214, qualify the coatings based only on performance of the coating in the Bolivar biochamber. SA Water TS 137 built the standard around two specific industry products (CAC and calcareous aggregate cements) rather than desired performance from the coatings(APAS 2003, TS3C 2007).
    - Examination of UK and US coating specifications also reflects individualised approaches.
    - At the time of this study *ASTM* was in the process of *developing an international standard to evaluate high performance protective coatings for sewer environment*. The testing will involve accelerated chemical testing,

which only recognises the effect of sulphuric acid in the liquid phase and H_2S, CO_2 and CH_4 in the gas phase.

- Field studies, which provide real sewer environment test is limited by the environment of the specific sewer tested and may be difficult to extrapolate to other sewer environment.

1.2 Quality Control (QC) and Quality Assessments (QA)

- The principle mode of failure of the coating, apart from the natural degradation of the coating, may be introduced by the installation.
- A range of (quality control/ quality assurance) QC/QA clauses are written into the specifications to address this pathway for failure.

Assessment

- It appears there are certain shortfalls in these specifications linked to lack of jurisdictions and structure to implement particular amendments. It may also be linked to the reliance that what may not be specified would be captured in the warranty clause. Specific examples include:
  - *i)* No accreditation over the training processes for applicators
  - *ii)* No independent assessment of applicator competency in application and knowledge of the coating system. Although Melbourne Water relies on PCCP (Painting Contractors Certification Program) accredited contractors, who must comply with most of the requirements stipulated in ISO 9001, it is based on quality management rather than technical requirements.
  - *iii)* QC on surface preparation and application does not integrate the requirements for cleaning and preparing the surface to the needs of the coatings (e.g., moisture content)
  - *iv)* QC on material (e.g., use of dip card) not in place in some specifications.
  - *v)* Warranty over long periods (15-50 years) may be difficult to enforce on supplier and applicators.

1.3 Post installation monitoring

- Post monitoring is used by the water utilities to gauge the performance and life of the coating and to implement repairing once coating has achieved its service life.
- Assessments of coatings by all major utilities are based on visual inspection.

Assessment

- Visual test is inadequate in providing a true measure of coating performance.

- SW has been undertaking one of the first quantitative approach.
- The test methods are based on recommendation in the Sydney University research report for the Scientific Assessment of Epoxy Resins to Protect Sewer Concrete, Tender No. 0310022211.
- The test are destructive tests based on the extraction of cores of coating and subjecting the linings with a series of tests to reflect their adhesion strength, chemical and physical state and the extent of acid permeation.

1.4 Inspection and condition assessment standards for coatings in service

- Grading the extent of deterioration of the lining system has been challenging for the industries.
- There are currently no common standards for inspecting, noting defects and classifying of conditions of coating in sewer pipes. This is largely attributed to lack of fundamental understanding of coating degradation.

1.5 Recommendations

The challenges that will be placed on the cost of rehabilitation and technical issues imposed as sewer conditions becomes more aggressive requires the water utilities to take on a more pro-active and integrated approach in dealing with sewer rehabilitation.

This will require more than improvements but a step-change in the decision tools and in the management of knowledge and information that are currently based in different water utilities.

Some of the key gaps that were identified in this review include the lack of:

i) Integrated industry knowledge base and experience in regards to coating selection and performance. Each water utility approaches its rehabilitation independently of each other and the potential to learn from their experiences has been missed.

ii) National approaches for the design and decision tools for sewer rehabilitation (including specifications in selection of coating materials that is fit for purpose, material thickness, structural and or protection, life cycle of the lining material). National coating specification should address compositional requirement and testing (inclusive of short and long term trials) to reflect both the short and long term performance requirements of the coating. Such an initiative would give the asset owners the confidence to try new coating systems.

iii) Assessment protocols and monitoring strategies that provide more than visual validation that the coating is degrading. Quantitative performance indicators

including chemical and physical state of the coating, adhesion strength and acid permeation.

iv) Standards for inspecting, noting defects and classifying of conditions of coating in sewer pipes

v) Accreditation of applicator training and competency assessment

vi) Review and standardisation of QC/QA for accepting surface preparation, application, materials, and warranty

Further Information

ARC Linkage Final Report- SP2 Report 2 Survey Report Part 1 Decision Tools.