SENSORS FOR SMART LINING QUALITY CONTROL

Key points

The University of Technology Sydney, as part of the Smart Linings Project, have developed four new quality control sensors for liners:

- Defect size measurement for CIPP and Spray Liners.
- Spray Liner thickness measurement.
- CAC and Geopolymer thickness measurement.
- Acid permeation depth measurement for CAC and Geopolymers.

Quality control measurements on these key parameters provide users with a high level of confidence that the product was installed correctly and will achieve its design life.

Introduction

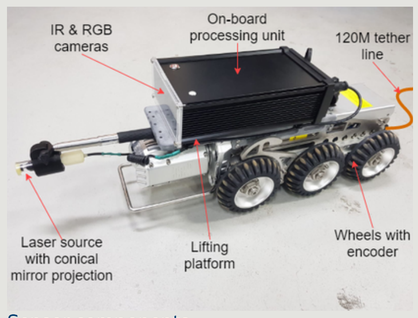
Many water utility assets are approaching the end of their useful life, and with over 350,000 km of water and sewerage infrastructure, new methods to extend the life of these assets can help utilities do more with less.

The Smart Linings for Pipe and Infrastructure Project has researched and trialled the effectiveness of four key lining product types: cured-in-place pipe (CIPP) and polymeric spray liners for water mains and calcium aluminate cement (CAC) and geopolymers for wastewater assets.

For each product type, the key parameters identified to measure for quality control were: the size of defects in CIPP liners, the applied thickness of spray liners, and for both CAC and geopolymers the applied thickness and the depth of acid permeation.

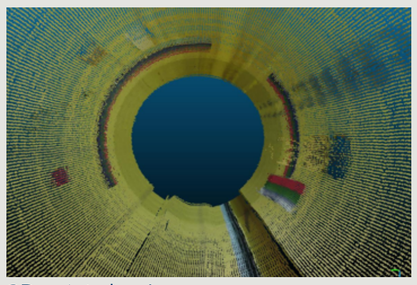
Through the University of Technology Sydney developing sensors to accurately measure these key parameters, the water industry can confidently assess installation quality and ensure the design life of the products is met. The ability to provide quality control reduces the risks associated with these new and exciting rehabilitation options and assists to make them a viable alternative to more conventional replacement techniques.

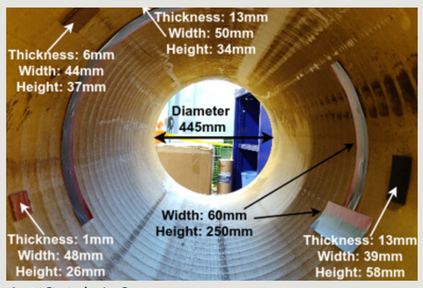
CIPP and Spray Liner Defect Size Measurement Sensor (Robot Mounted)



Sensor components


Lab trial


3D point cloud



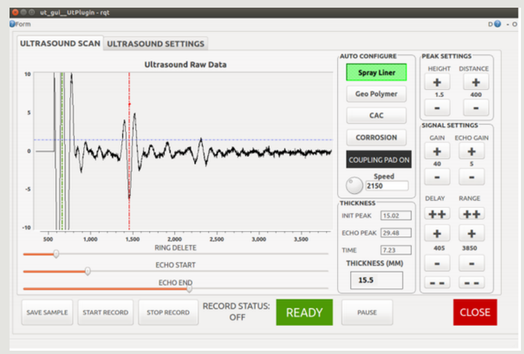
Artificial defects

Pipe size range: DN450 to DN600

For CIPP liners the size of defects was identified as a key quality control criteria. A sensor to measure defects in water liners (CIPP and spray liners) was developed using a combination of an infra-red laser ring projector, cameras, and an on-board computer. This sensor can measure folds, wrinkles, dimples, and bulges. It is mounted on a mini Pipe Inspection Robot (developed under a Sydney Water funded project). Accurately measuring the size of the imperfections in the liner is not possible using conventional CCTV and it is important to determine if the installed liner is acceptable for service, or if it should be replaced. Often a difficult decision for project managers. The development of this sensor includes a graphical user interface to allow interpretation of the scan and measurement of any user identified defects.

Spray Lining Thickness Measurement Sensor (Robot Mounted)

Sensor components

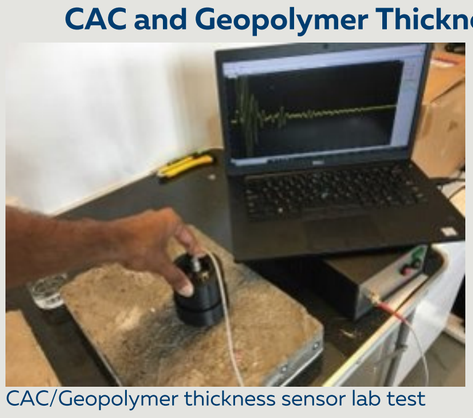


User interface

Pipe size range: DN450 to DN600

In spray lining a key measurement identified for quality control (QC) was the thickness of application. Spray lining machines generally provide quality assurance (QA) data including the amount of resin used and rate of advance through the pipeline which can be used to provide an estimated thickness of application. Combining this QA data with QC testing will provide high confidence that the products have been correctly applied. The key area of measurement is at the obvert of the pipe, where typically the liner will be thinnest (if any slumping occurs). As spray liners are generally applied at a thickness of 3mm, sub-millimetre accuracy for measurements is required. UTS developed a thickness sensor using ultrasound technology. This sensor has been trialed both in the laboratory and at a Sydney Water test site. The accuracy achieved by the equipment is: within 0.5 mm in the lab (samples in the lab were very accurately scanned with other equipment to confirm their thickness) and the field trial results were within 1mm of the planned spray lining thickness (the exact applied thickness in field samples is more difficult to determine to validate the accuracy).

CAC and Geopolymer Thickness Sensor (Handheld)


CAC/Geopolymer thickness sensor lab test


CAC/Geopolymer thickness sensor field test

Pipe size range: personnel entry (DN1500+) and maintenance structures

Application thickness is a key quality control check for CACs and geopolymers. UTS developed a sensor using ultrasound technology that can measure the thickness of the CAC or geopolymer application by detecting the interface between the liner and the host material. This allows spot measurements to be taken at any location, whereas using a cover meter requires the installation of a metallic bar prior to liner installation – limiting the ability to check the liner thickness to a small area.

This sensor is designed for initial non-destructive post-curing quality control. CACs in particular can gain thickness over time, so using this sensor years after application will not provide relevant data.

Acid Permeation Thickness Sensor (Handheld)

Acid permeation sensor probe


Acid permeation sensor field test

Pipe size range: personnel entry (DN1500+) and maintenance structures

CAC and geopolymer liners provide corrosion resistance for wastewater assets. Knowing when the acid has permeated the liner and started to attack the host structure was identified as a key measurement for long-term performance and asset management decision making. A very low impact measurement device was developed to measure the pH level at various depths on the liner to determine how far the acid has penetrated.

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www.waterportal.com.au/smartlinings