Managing corrosion risk

How best to maintain high-value infrastructure assets? **Corrie Cook** outlines some solutions arising from the recent Australasian Corrosion Association's seminar.

Risk-based inspection plans are increasingly accepted in organisations that understand the importance of extending the life of high-value assets as long as possible.

Such plans can show owners the downstream dollar cost of deferring maintenance, as well as comparing the cost effectiveness of a range of protective options and offering optimal maintenance plans for each.

The recent Australasian Corrosion Association's (ACA's) one-day seminar in Auckland on infrastructure and asset protection looked at many examples of this ongoing challenge for asset owners and managers as well as for corrosion specialists.

Delegates were reminded that regular inspection carried out by qualified professionals should be an integral part of identifying risk to assets. All defects should be captured and recorded, and their risk scored against potential failure in order to allocate funding priorities.

How long can the asset's deteriorating condition be managed, especially if its load capacity has already been reached? If it can't be reasonably managed, what interventions will be needed and when – or is complete replacement the answer?

Designing out corrosion issues is the ideal solution for any new construction, so long as the design engineers understand corrosion, how and where it might start, and how to select materials and protective mechanisms that are appropriate to the particular application and environment.

In Auckland, the Council expects that population growth in the region will increase to over two million or 38 percent of the national total within 20 years. Infrastructure, however, needs to serve the region effectively for much longer than that – and a reliable water supply underpins everything.

What materials are used for the pipes carrying potable and fresh water?

Sean Ryder, principal consultant at Phoenix Solutions, points out that because all materials deteriorate, it is critical

to select those that deliver the best return on investment. But maintenance is also a critical factor: "durability doesn't happen by accident", he points out.

Pipes for this type of project need to withstand major forces to ensure sufficient water pressure remains available for the end user. These large-diameter pipes (1575mm or 1965mm outside diameter) go through a complex construction process.

Mild steel is spiral formed and welded on both sides, using an automatic submerged arc process to form the pipe.

"It's agreed that doing appropriate maintenance before corrosion is visible to the naked eye is usually the most cost-effective way to extend an asset's life."

Integrity of both pipe and welds is then rigorously tested through a combination of hydrostatic testing, ultrasound and x-ray. The design is expected to withstand triple its working pressure at 60 percent of yield.

A multi-layer polyethylene tape coating system is then applied to the outside and finally a 20mm concrete layer is centrifugally applied using custom-designed equipment to line the pipe. Both are designed to inhibit corrosion.

Cathodic protection is additionally applied as in-ground corrosion protection for the pipes. This means a DC current continuously passes along the pipe, powered by an external DC power source. Should it be interrupted, there is a risk the current can travel through the ground and away from the pipe. The point at which the current leaves the pipe will be the point where corrosion could begin.

PLANNING MAINTENANCE

Maintaining any large plant or complex can mean a huge outlay every few years, and potentially a complete plant shutdown – unless the site is divided into "blocks" or sections and a rotating maintenance plan is developed. In this way, maintenance is ongoing and frequency of inspection is managed by the risk factors found in each area, as well as by the ease of access to each section. In this way, areas that are more prone to corrosion can be inspected and maintained more regularly than those presenting a lower risk.

"It's more economical to hire access equipment once, for example, and save on manpower and access equipment. An ad-hoc maintenance system couldn't deliver that," explains Ross MacKenzie, maintenance manager of International Paint. "When blocks are scheduled for re-coating they can

Corrosion concrete sewer.

PHOTO COURTESY OF: JONATHAN MORRIS.

be done at times that will pose minimal disruption to clients and their customers."

It's agreed that doing appropriate maintenance before corrosion is visible to the naked eye is usually the most cost-effective way to extend an asset's life. By the time concrete corrosion is visible, for example, it's already well advanced and remediation options or even replacement need to be urgently considered. For wastewater systems, these can include chloride extraction; re-alkalisation; protective coatings; crystalline surface treatments; patch repairs including sacrificial anodes (to prevent incipient anodes forming); and cathodic protection.

At the ACA's international conference Corrosion & Prevention 2015, Brendan Murray of IXOM Operations (formerly Orica Chemicals) outlined the work his company has been doing with major sewer lines in Australia.

While the science behind corrosion of concrete sewer pipes is reasonably well understood, he pointed out that seawater ingress into sewers can increase the sulphate concentration within the sewage itself, resulting in an increase of hydrogen sulphide in the pipes. This can lead to increased sulphuric acid production, degrading the concrete into the soft and porous compound calcium sulphate more quickly than may have been expected. Murray has developed a sacrificial alkali coating to combat this.

He believed that an economic evaluation comparing different rehabilitation methods confirmed such sacrificial alkali coatings were the lowest life cycle cost option for managing Sydney Water's large 'avoid fail' sewers.

"This project has resulted in a cost-effective method for protecting critical sewer assets, without the need to divert sewage flows and with minimal disruption to our customers," he said. "Initial monitoring results indicate the product continues to provide a sacrificial coating to protect the integrity of the concrete sewer walls for two to three years."

Balancing available funding against potential asset failure is always a challenge, but a robust risk management plan helps show a clear way forward. **WNZ**

- The ACA is a not-for-profit, membership Association that aims to reduce the impacts of corrosion. It provides an expert knowledge base and disseminates information on corrosion and its control across New Zealand and Australia. The Corrosion & Prevention 2016 conference will be held in Auckland from 13-16 November 2016, bringing researchers and practitioners from around the world into the country. For further information or to register, go to www.corrosion.com.au