LIFE CYCLE COSTING AND CRYSTAL BALLS

John Robinson – Editor

INTRODUCTION.

The concept of life cycle costing is not a new one. Standards Australian produced its first AS/NZS Standard in 1999; AS/NZS 4536 - *Life cycle costing – An application guide.*

It is much easier to apply life cycle costing models to plant and equipment and similar assets that have relatively short lives, that it is to coatings that may have to perform their protective coating function for 25 years or more.

The challenge for the designers of major industrial or infrastructure projects is to figure out how to get the best value out of their investment in protective coatings at the front end (capital cost) of the project without saddling the owner/operator with unacceptable maintenance costs and process disruption in the future.

A BIT OF HISTORY

Protective coating costs on most projects are a relatively small component of the total project cost; typically less than 2%. On a major steel project containing, say, 1000 tonnes of structural steel, the cost of a basic protective coating system may be in the order of $300/tonne while a high performance coating system may be $600/tonne.

This equates to an additional project cost of $300,000. If a project accountant applied a net present value analysis to this in the 1980's, when interest rates exceeded 15% and company taxation was well over 40%, the option of using the cheaper coating and expensing accelerated maintenance costs would seem a sound financial decision.

However, at this moment of the 21st Century, company tax is only 30% and interest rates are around 5%, so the ATO no longer subsidises maintenance costs to the same degree and expensed maintenance costs hit the balance sheet at a level that exceeds any interest benefits from the original saving.

In addition, the labour costs of the 1980's did not include the on-costs of superannuation, higher workers compensation and other statutory obligations for employers. Nor were the OH&S and environmental obligations anything like they are today.

A good example also lies in developing countries, where the perception that labour is cheap has resulted in the use of less expensive protective coatings. In the September 2004 issue of the Journal of Protective Coatings and Linings (p 6), a case history study on a petrochemical plant in the Malaysian state of Sarawak (on the north shore of Borneo) is featured.

This major Petronas facility – the world's largest LNG complex, is undergoing a major maintenance program after less than 20 year of operation. This enormous job involves the repair and repainting of 200,000 m^2 of structural steel involving the erection of 350,000 cubic metres of scaffolding along with major containment structures. The paint system is a heavy-duty inorganic zinc-based system on a Class 2 ½ blasted surface and all work needs to be scheduled outside the monsoon season.

There are many existing examples throughout the world of similar petrochemical facilities that were originally hot dip galvanized being still in good condition after 25 years of service.

It is thus very difficult to foretell the distant future for the purposes of life-cycle costing for protective coatings, and conditions in 2025 will have changed as much in that 25-year cycle as they did between 1950, 1975 and 2000.

The other reality faced by asset owners, particularly of infrastructure assets, is that their service life is often far longer that originally anticipated. Many power distribution and transport structures are now well over 50 years old and are subject to numerous maintenance cycles to maintain their functionality.

The other issue with maintenance coatings is that they add very little value to a business. They make no contribution to efficiency or productivity.

FACTORS IN THE LIFE CYCLE OF A COATING

When an investment is made in selecting a protective coating system, the first question that needs to be asked should not be "How much will it cost?", but "How long does it need to last?".

Australian Standards such as AS/NZS 2312:2002 –

Guide to the protection of iron and steel against atmospheric corrosion contains comprehensive guidelines related to coating selection versus environmental condition to provide an estimated service life for a range of coating systems.

Once a system has been selected (based on the technical characteristics of the components of the coating system), the application of the coating introduces the next (but frequently overlooked) factor in the life cycle cost equation.

With the exception of hot dip galvanized coatings, the supplier of the coating is never the applier of the coating. The experience and qualifications of the applicator are thus a critical factor in the ability of the applied coating to meet its technical performance standards.

Where statistical methods have been used to determine reliability factors for coatings, process applied coatings such as hot dip galvanizing and powder coating rate very highly while manually applied coating get a much lower (typically 4X – 5X times) rating for reliability in service. This reflects the higher likelihood of early failures occurring because of variables in application conditions, plant and equipment performance and operator skill.

Some of the major factors influencing coating reliability include:

1. Initial surface condition of the steel
2. Surface preparation
3. Timing between surface preparation and application
4. Environmental conditions affecting application – temperature, humidity, dew point.
5. Coating characteristics – mixing, pot life
6. Application requirements – coating thickness specification, over-coating time between coats.
7. Access issues – Accessibility of surfaces, shadowing, sharp edges, handling between applications.
8. Youth period – time to full cure.

Coating systems that minimise these variables offer the highest level of reliability for the whole of their design life.

THE REALITIES OF FUTURE MAINTENANCE

Where maintenance coating is required on an infrastructure or industrial project, the real cost experienced in 2004 would not have been even considered 25 year ago.

The major cost factors impacting on maintenance costs include:

1. Access
2. Containment
3. OH&S management
4. Productivity.

It is worth looking at each of these factors in more detail.

1. Access

It is now mandatory in most jurisdictions in Australia to use scaffolding systems when working over 2 metres from the ground. Ladders and trestles are no longer acceptable for commercial coating contractors.

The cost of erecting, hiring and dismantling scaffolding is a major component of any maintenance coating operation. Since the introduction of more stringent safety requirements on residential building sites, few houses are now built that do not require scaffolding to be erected during their construction. While this is not directly connected to the life-cycle costing of industrial coatings, it is worth noting that the value of the residential scaffolding market in Australia now exceeds $250 million annually.

On industrial projects, much larger scaffolding systems may be required to provide the needed access for maintenance.

In assessing the likely maintenance costs, access factors can be applied to life cycle costing models to more accurately estimate costs on a specific structure.

It is possible to classify structures for assessing access issues. The following is an example:

Level 1 – Simple structure to 15 m. Maintenance able to continue while structure is operational. Easy access for scaffolding or lifts.

Level 2 – Simple structure 15-30 m. Greater scaffolding requirements. Maintenance able to be done while structure operational.

Level 3 – Simple structure over 30 m. Specialised external access required. Operating requirements of other plant and equipment must be considered.

Level 4 – Complex structure to 15 m. Internal and external access required. Operating requirements of other plant and equipment must be considered.

Level 5 – Complex structure 15 – 30 m. Internal and external access required. Staging at each level may be required. Operating requirements of other plant and equipment must be considered.

Level 6 – Complex structure over 30 m. Staged internal and specialised external access required. Operating requirements of other plant and equipment must be considered.

2. Containment

Like access, containment costs will vary with the complexity of the requirements for containment. As with access, models can be developed to classify containment levels and factor in the costs of containment for a specific containment requirement.

An example of classification of containment factors is as follows:

None – No recovery of residues or paint.

Level 3 (Minimum) – For abrasive blast cleaning only – air penetrable walls, flexible framing, open entryways and natural air flow.

Level 2 (Moderate) – For abrasive blast cleaning – air penetrable walls, rigid or flexible framing, partially sealed entryways and joints, exhaust air filtration.

Level 1 (High) – For abrasive blast cleaning – air impenetrable walls rigid or flexible framing, fully sealed joints, airlock entryways, negative air flows and exhaust air filtration.

A good example of high-level containment is the maintenance painting program currently being undertaken on under-road steelwork on the Sydney Harbour Bridge, which also incorporates very complex staging and access systems.

Where lead based paints are concerned, additional environmental management systems may be required to monitor local soil and water system during the remediation activities.

3. OH&S Management

Worker safety is now the first priority in any business and where heights are involved, stringent requirements for personal safety equipment are mandatory. Industrial manslaughter laws are being considered in most Australian states, and while managers should not need the threat of such legislation to care for the welfare of their workers, it is an indication that the most stringent risk assessments must be applied to any hazardous activity.

Certified safety equipment is mandatory when working at height, and approved safety harnessing and attachment systems have to be provided by contractors. Other Workcover regulations related to working in enclosed spaces places further onus on employers to ensure that no cost-cutting shortcuts are taken in the provision of maintenance coating services.

4. Productivity

Each of the above factors will have an impact on productivity. With new steelwork, labour costs represent about 75-80% of the coating cost. For on-site maintenance, the labour cost component is far greater and for this reason material costs (paint costs) are less significant and more expensive surface tolerant paints will have little impact on the overall costs of a maintenance project, and represent better value given the expectation of higher levels of performance..

Surface preparation is the most labour-intensive part of the process. Surfaces may be contaminated with soluble salts so may require water washing/blasting prior to mechanical removal of the rusted surface or failed paint coating.

As a guide, the cost per square metre for maintenance coating a rusted steel structure is 3-5 times the cost of applying an equivalent coating to new steelwork.

SUMMARY

Regardless of the protective coating used, there is a strong case, particularly in the present environment of low interest rates and decreasing company taxes, to use the longest life coatings available commensurate with the design life of the asset.

This may mean more stringent inspection with applied coatings, the use of QA certified applicators or the insistence in a coating performance guarantee from the supplier to better manage the risk and avoid the inevitable and more costly than expected future maintenance costs.

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An industrial facility such as this coal treatment plant, that operates on a 24-7 basis and processes over $30,000 worth of coal per hour requires careful life-cycle costing analysis for its protective coating systems.

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Editor.

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COVER:

This acid tank is a prime example of a very difficult surface for recoating. Severe steel corrosion, 24-hour operating environment, high levels of humidity and a chloride contaminated surface at low pH is a challenge for any industrial coating.

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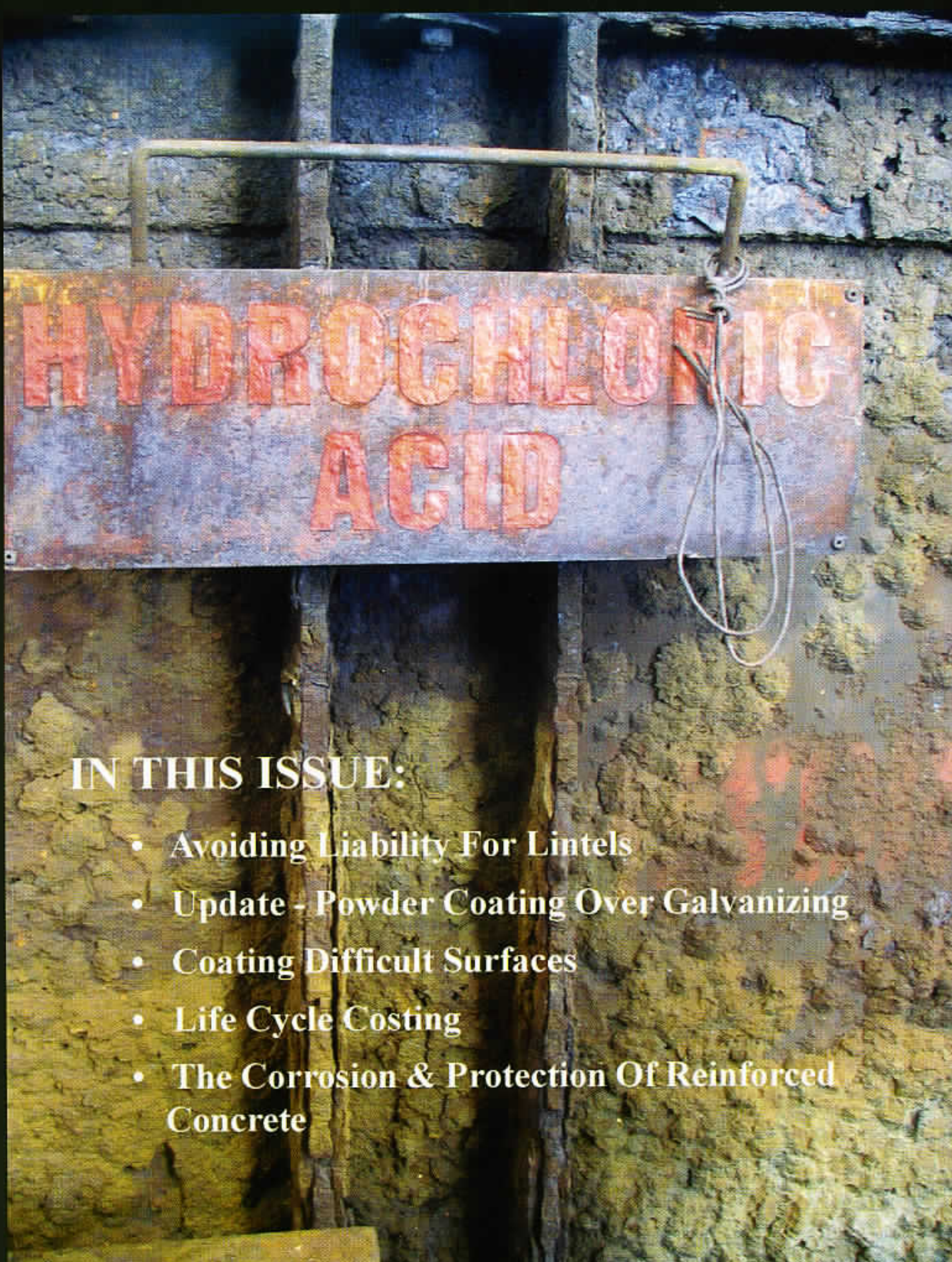

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