

## 22. LIFE CYCLE COSTS OF INDUSTRIAL PROTECTIVE COATINGS.

### INTRODUCTION

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

In any life-cycle costing assessment, the initial cost of the coating is an important component in doing and long-term cost analysis, as is the need to determine the likely maintenance free life of the coating and the future costs of maintenance.

### 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 \$500/tonne, a high performance coating system may be \$1000/tonne, and a special super-durable specification may cost \$1500/tonne.

This equates to an additional project cost of \$500,000 - \$1,500,000. 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, in the 21st Century, company tax is only 30% and interest rates are around 9%, so the Tax Office no longer subsidises maintenance costs to the same degree. In addition, expensed maintenance costs hit the balance sheet at a level that exceeds any interest benefits from the original saving.

Also, 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.

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 than 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.

For this reason, the selection of an appropriate protective coating system for steel, be it paint, galvanizing, or a combination of both should be based on the performance of the coating over time rather than its initial cost.

### FACTORS IN THE COST OF A COATING

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



*The maintenance painting of structures in public or environmentally sensitive areas required costly containment systems to meet EPA requirement. The cost of repainting this tourist observation tower in Newcastle, NSW exceeded its initial installation cost after only 12 years.*

environmental condition to provide an estimated service life for a range of coating systems.

### MATERIAL SELECTION

The choice between materials of construction will usually be a 'steel versus concrete decision', with a proportion of projects being a composite of both.

The decision may be based on familiarity of a designer of working with one material or another, the form of the structure, its location and most importantly, its installed cost.

While the protective coating costs are a relatively small component of the total projects cost, they can be a significant proportion of the structural steel cost. In addition, steel simply cannot be used (with a few exceptions) without protective coatings and these coatings will have a defined life that will determine future maintenance costs.

While steel and fabrication costs are volatile, benchmark costs obtained in mid-2005 indicate that the cost components are approximately as follows for standard medium structural steel:

|                               |                   |
|-------------------------------|-------------------|
| Medium structural steel cost: | \$1500/t          |
| Fabrication cost:             | \$3000 - \$5000/t |



*Industrial facilities like this coal treatment plant at Teralba, NSW process 800 tph of coal 24 hours/day, 7 days/week. The cost of down-time for coating maintenance is a bigger factor than coating cost.*

### COATING COSTS FOR NEW STEELWORK

The cost of coating new steelwork is made up of a number of factors. These are:

1. The type of steel – size, shape, section.
2. The quantity of steel
3. The location of the project with respect to the coating provider, the fabricator and the site.
4. The regional cost of labour
5. The material cost (paint components/zinc/chemicals)
6. The cost of surface preparation (abrasive blasting/chemical/mechanical)
7. The cost of application – number of coats, plant capability, processing time
8. Logistic costs – inspection, loading, transport, erection
9. Post erection costs – remediation of handling damage, on-site completion.

For applied coatings (paint, metallising) the surface area of the steelwork and the complexity of the fabrication will be the most significant factors influencing the cost. Logically, thin steel sections with high surface area per tonne will absorb more labour and materials than heavy structural sections.

For example, a 3 mm thick steel section has a surface area per tonne of over 80 m<sup>2</sup>, while a 10 mm section has a surface area of 25 m<sup>2</sup> per tonne.

For process-applied coatings (hot dip and continuous galvanizing, powder coating), material costs and fixed costs are important, making the profitability of these processes very volume sensitive.

### TYPICAL MATERIAL COSTS

Many of the materials incorporated in coatings are traded as commodities with supply and demand affecting prices above and beyond normal inflationary variations. The following indicative prices are for

generic materials used in coating in mid-2008, in commercial quantities

|                           |                  |
|---------------------------|------------------|
| Zinc                      | \$3.00/kg        |
| Zinc dust                 | \$4.00/kg        |
| Red oxide zinc phosphate  | \$10.0/litre     |
| Epoxy primer              | \$10-12.00/litre |
| High build epoxy          | \$14.00/litre    |
| Urethane – standard grade | \$12.00/litre    |
| Urethane GP3 grade        | \$25+/litre      |
| Polysiloxane              | \$35+/litre      |
| Acrylic – water based     | \$8.00/litre     |
| Acrylic – catalysed       | \$12.00/litre    |

### PAINT COATINGS

The true material cost of paint coatings is determined by how much of what is in the can ends up on the steel surface. This is determined by the volume solids in the paint, the applied thickness of the coating and the coating efficiency (over-spray losses).

Low volume solids will result in higher losses due to solvent evaporation. Simple solid structures (beams, tanks) will experience higher coating efficiencies than open structures (pipe work and trusses)

One litre of paint, applied to a wet film thickness of 100 microns will theoretically cover 10 m<sup>2</sup> of surface. In practice, the same paint applied to a dry film thickness of 100 microns, to medium structural steel by airless spray will cover approximately 5 m<sup>2</sup>.

All paint suppliers have product safety data sheets for each of their paints. These documents list technical specifications for the paint, including volume solids, recommendations for wet and dry film thickness requirements and theoretical coverage.

In addition to the paint cost, most solvent-based spray applied coatings require the addition of thinners, typically around 30% by volume) which becomes a component of the paint material cost.

An important point to note is that the paint cost is a relatively small proportion of the applied system cost. Based on a typical practical coverage rate of \$5.00/m<sup>2</sup>, the cost differential between a basic industrial epoxy or urethane and a high performance urethane or polysiloxane is in the order of \$3.00-\$4.00/m<sup>2</sup>.

The most significant single cost in paint coatings is surface preparation. Abrasive blasting is almost mandatory to ensure acceptable performance for industrial paint systems.

Fabricated steelwork is usually abrasive blasted with chilled iron shot, in a chamber that allows recovery and recycling of the blasting media. Abrasive blasting standards are defined in Australian Standard AS 1627.4. Class 2 ½ Blast is most commonly specified for industrial coating, with Class 3 (the highest level) being a requirement for specialised coatings such as zinc metal spray.

Abrasive blasting costs vary regionally, but generally fall in the \$15.00 - \$20.00/m<sup>2</sup> range. Large automated blasting facilities using wheelabrator equipment to process columns, beams and plates can significantly reduce this cost.

Where galvanized coatings are to be painted, Class 1 or whip blasting is generally specified. This involves using less aggressive media such as garnet or illmentite, at typical cost ranging from \$10.00 - \$15.00/m<sup>2</sup>, depending in the complexity of the fabrication.

Chemical preparation (pickling, phosphating) is rarely used as a method of preparing fabricated steel for painting, and is confined to process applied coatings such as powder coating and galvanizing.

Powder coating costs are usually charges on a 'window area' basis rather than surface area, as the area the item takes up on the powder coating line is the main factor in its cost of processing. For standard grades of polyester powder, powder coating costs are typically \$15.00 - \$20.00/m<sup>2</sup>, although large quantities of uniform manufactured product that can be loaded to high line efficiencies can be powder coated at lower cost.

With all costs included (labour, overheads, margins) indicative industrial painting costs for commonly specified systems are:

|    |   |                        |
|----|---|------------------------|
| 1. | Basic wire brush/Class1 blast and ROZP prime            | \$12.00/m <sup>2</sup> |
| 2. | Class 2 ½ blast + inorganic zinc primer                 | \$25.00/m <sup>2</sup> |
| 3. | Class 2 ½ blast + inorganic zinc primer + epoxy topcoat | \$35.00/m <sup>2</sup> |
| 4. | Class 2 ½ blast + inorganic zinc primer + urethane      | \$45.00/m <sup>2</sup> |

NOTE: These are indicative average prices only and will vary regionally and depending on the design of the items being painted.

### **GALVANIZED COATINGS**

The parameters governing the cost of galvanized coatings are quite different to those determining paint costs.

Continuously applied galvanized coatings applied to sheet, wire and tube are applied in facilities with high capital and operating cost, with large volumes of steel being able to be processed very efficiently.

For this reason, the galvanized coating cost component of these products is relatively small and driven by the material (zinc) cost. In addition, these technologies apply relatively thin zinc coatings – usually less than 30 microns per side for a material cost of about \$0.75/m<sup>2</sup> of surface.

Hot dip galvanized coatings applied to fabricated steelwork are priced on the basis of the tonnage that can be processed through the galvanizing bath. Surface area is thus not as significant in galvanizing costs. Thin sections that can be loaded into galvanizing jigs at high loading density will attract a relatively low galvanizing cost, while 3-D structural fabrications containing heavy universal sections may be more costly to process.

Hot dip galvanized coatings are almost always costed on a \$./tonne basis. Typical galvanizing costs per tonne will range from \$650/tonne for heavy, simple elements such as columns and beams in large project quantities, to \$1500/tonne for light fabrications. Items requiring double-end dipping will usually attract a 30% premium cost and small one-off fabrications (boat trailers, wrought iron, anchors etc) for non-account customers will be charged around \$2000-\$2500/tonne.

The cost per square metre for hot dip galvanizing reduces quite significantly as sections become thinner. The following examples illustrate this:

Medium structural steel – 10 mm average thickness

|                         |                          |
|-------------------------|--------------------------|
| Galvanizing cost:       | \$700/tonne              |
| Surface area per tonne: | 25 m <sup>2</sup> /tonne |
| Cost/m <sup>2</sup> :   | \$28/m <sup>2</sup>      |



Light fabrications - 3 mm average section thickness

|                         |                          |
|-------------------------|--------------------------|
| Galvanizing cost        | \$1500/tonne             |
| Surface area per tonne: | 85 m <sup>2</sup> /tonne |
| Cost/m <sup>2</sup> :   | \$18.00/m <sup>2</sup>   |

A fringe benefit of hot dip galvanizing, because it is an immersion process, is that all internal surfaces of hollow sections are coated uniformly. This may be an advantage or disadvantage, as the external surface area of a hollow section is only half that of an open section of the same section thickness.

Another fringe benefit of hot dip galvanizing compared to both paint coatings and continuously galvanized coatings is that the applied coating thickness almost always in excess of Australian Standard requirements.

This is a bonus for the customer, as additional zinc pick-up on steelwork cannot be accurately predicted by the galvanizer, as it is influenced by the surface condition, section thickness and chemistry of the steel. It can add \$50-\$100/tonne to the galvanizer's material costs, with the added bonus for the customer of the extra zinc addition proportionately to the service life of the coating.

### THE REALITIES OF FUTURE MAINTENANCE

Where maintenance coating is required on an infrastructure or industrial project, the real cost experienced in 2008 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 4 (Minimum) – For abrasive blast cleaning only – air penetrable walls, flexible framing, open entryways and natural air flow.
- Level 3 (Moderate) – For abrasive blast cleaning – air penetrable walls, rigid or flexible framing, partially sealed entryways and joints, exhaust air filtration.
- Level 2 (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.



*The cost of the coating materials for maintenance coating of rusting structures is insignificant compared to the cost of surface preparation, environmental management and access.*

### 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 may be 5-10 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.







# INGAL

**SPECIFIERS MANUAL**



|    |  |
|----|--|
| 01 | SPECIFIERS MANUAL  |
| 02 | INDUSTRIAL GALVANIZERS COMPANY PROFILE                                 |
| 03 | ADHESION OF PROTECTIVE COATINGS  |
| 04 | BOLTING GALVANIZED STEEL   |
| 05 | BURIED GALVANIZED STEEL  |
| 06 | CONCRETE DURABILITY & GALVANIZED REBAR                                 |
| 07 | CORROSION MAPPING  |
| 08 | COST FACTORS FOR HOT DIP GALVANIZED COATINGS                           |
| 09 | CUSTOM COATING PACKAGES  |
| 10 | CUT EDGE PROTECTION  |
| 11 | DESIGNING FOR GALVANIZING  |
| 12 | ILLUSTRATED GUIDE TO DESIGN FOR GALVANIZING                            |
| 13 | DEW POINT TABLES   |
| 14 | DIFFICULT STEELS FOR GALVANIZING                                       |
| 15 | DOCUMENTATION - CORRECT PAPERWORK ENSUES EFFICIENT PROCESSING          |
| 16 | ENVIRONMENTAL ISSUES FOR INDUSTRIAL COATINGS                           |
| 17 | ZINC, HUMAN HEALTH AND THE ENVIRONMENT                                 |
| 18 | DEFECTS IN GALVANIZED COATINGS   |
| 19 | GALVANIC SERIES  |
| 20 | GLOSSARY OF GALVANIZING TERMS  |
| 21 | GUARANTEES FOR HOT DIP GALVANIZED COATINGS                             |
| 22 | LIFE CYCLE COSTS OF INDUSTRIAL PROTECTIVE COATING SYSTEMS              |
| 23 | PAINING OVER GALVANIZED COATINGS                                       |
| 24 | POWDER COATING OVER GALVANIZED COATINGS                                |
| 25 | QUALITY AND SERVICE FACTORS AFFECTING GALVANIZED COATINGS              |
| 26 | RESTORATION OF PREVIOUSLY GALVANIZED ITEMS                             |
| 27 | REPAIR OF GALVANIZED COATINGS  |
| 28 | STEEL STRENGTH AND HOT DIP GALVANIZING                                 |
| 29 | STANDARDS - AS/NZS 4680:2006   |
| 30 | STANDARDS - AUSTRALIAN AND INTERNATIONAL STANDARDS                     |
| 31 | STEEL SURFACE PREPERATION  |
| 32 | SURFACE PREPERATION FOR PAINTING HOT DIP GALVANIZED COATINGS           |
| 33 | THICKNESS MEASUREMENT OF PROTECTIVE COATINGS                           |
| 34 | WELDING GALVANIZED STEEL   |
| 35 | AN INTRODUCTION TO THE HOT DIP GALVANIZING PROCESS                     |
| 36 | ZINC COATING PROCESSES - OTHER METHODS                                 |
| 37 | GALVANIZED COATINGS AND BUSHFIRE                                       |
| 38 | LIQUID METAL ASSISTED CRACKING OF GALVANIZED STRUCTURAL STEEL SECTIONS |
| 39 | GALVANIZING 500N GRADE REINFORCING BAR                                 |
| 40 | PREDICTING THE LIFE OF GALVANIZED COATINGS                             |
| 41 | CHEMICALS IN CONTACT WITH GALVANIZED COATINGS.                         |
| 42 | ATMOSPHERIC CORROIVITY ASSESSMENT                                      |
| 43 | GLOBAL WARMING - CLIMATE CHANGE AND GALVANIZING                        |
| 44 | STEEL - ITS CORROSION CHARACTERISTICS                                  |
| 45 | GALVANIZED STEEL AND TIMBER  |
| 46 | WHITE RUST PREVENTION AND TREATMENT                                    |

# 01 - SPECIFIERS MANUAL – THIRD EDITION

Industrial Galvanizers Australian Galvanizing Division (IGAG) operates nine galvanizing plants around Australia, ranging in size from large structural galvanizing facilities to specialised small plants designed to process small parts.

The Australian Galvanizing Division has galvanized in excess of 2 million tonnes of steel products in Australia since its first plant was commissioned in 1965 and is recognized for its ability to handle complex and difficult projects, as well as routine contracts.

This experience has been collated in the Specifiers Design Manual, to assist those involved in the design of steel products and projects to better understanding the galvanizing process and allow the most durable and cost-effective solutions to be delivered to these products and projects. All sections of this Third Edition have been completely updated and additional sections have been included to provide additional technical information related to the use of hot dip galvanized steel.

In addition to its Australian Galvanizing operations, Industrial Galvanizers Corporation has a network of manufacturing operations in Australia, as well as galvanizing and manufacturing businesses throughout Asia and in the USA.

The company's staff in all these locations will be pleased to assist with advice on design and performance of hot dip galvanized coatings and products. Contact details for each of these locations are located elsewhere in this manual.

This edition of the Industrial Galvanizers Specifiers Manual has been produced in both html and .pdf formats for ease of access and distribution and all documents in the Manual are in .pdf format and can be printed if paper documents are required.

The Specifiers Manual is also accessible in its entirety on the company's web site at [www.ingal.com.au](http://www.ingal.com.au).

Additional copies of the Specifiers Manual are available on CD on request.

## **PUBLISHER:**

Industrial Galvanizers Australian Galvanizing Division,  
PO Box 503, MOOROOKA  
QLD 4105  
Ph: 07 38597418

## **EDITOR:**

John Robinson,  
Mount Townsend Solutions Pty Ltd  
PO Box 355, JESMOND NSW 2299  
Ph: 0411 886 884  
Email: [mt.solutions@optusnet.com.au](mailto:mt.solutions@optusnet.com.au)

## **LAYOUT AND DESIGN:**

Adrian Edmunds,  
Nodding Dog Design  
Ph: 0402 260 734  
Email: [adrian@noddingdogdesign.com](mailto:adrian@noddingdogdesign.com)  
Web: [www.noddingdogdesign.com](http://www.noddingdogdesign.com)