Asia Pacific Edition
GALVANIZING IN ENGINEERING AND THE ENVIRONMENT

ZINC

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GALVANIZED REINFORCEMENT

In this issue

Editorial
George Thomson
Rosemary Scott

Prepared by
Galvanizers Association of Australia

Galvanized reinforcement in major infrastructure

Where it is considered that normal reinforced concrete will not have adequate durability, galvanized reinforcement is often used in preference to conventional steel reinforcement.

While concrete itself provides natural corrosion protection to steel this may be lost as a result of aggressive species from more severe environments through the coating cover.

Galvanized steel reinforcement was first used on marine piers in 1953 and has become widely used for increased protection in such circumstances.

The following article is an example of this use.

Hot dip galvanized coatings are usually applied to steel that is already fabricated. However, in a major project now under construction in Singapore, this convention is being reversed. For this project, steel in the form of loosely-coiled wire bar, is being galvanized then formed around large mandrels into cages that become the steel reinforcement for sections of large diameter concrete pipe.

The pipes are part of the Deep Tunnel Sewage System (DTSS) which was conceived as a long term solution to meet the needs for used water collection, treatment and disposal to serve the development of Singapore through the 21st century.

An integral part of the project is a large treatment plant at Changi from where a deep-sea outfall will discharge treated effluent into the Straits of Singapore at a distance of 5km from shore. The outfall comprises two parallel under-sea pipelines, constructed from reinforced concrete sections laid end-to-end in a trench in the sea-bed. Each concrete pipe section measures 3m in diameter and 8.0m in length and contains 7-8mt of galvanized reinforcing bar (rebar). In all, the pipelines will require 1300 individual pipe sections and will use a total of 10,000mt of galvanized rebar.

The project has presented many engineering and technical challenges for both contractors and suppliers. In the case of the ocean out-falls the need to ensure integrity and longevity of the pipelines under the service conditions encountered has required serious consideration and a deal of ingenuity.

The corrosivity of seawater coupled with the need to design for a service life of 100 years, dictated that the rebar should be coated to protect it against corrosion that could lead to spalling of the concrete, compromising pipeline integrity. The choice of galvanizing to coat the rebar was not made lightly as any coating had to be capable of withstanding site handling as well as being formed into the circular cage shape before placement in the moulds used to cast the concrete pipe sections. The method of forming the reinforcement cages required that the rebar was of reasonable length and so it was decided to use coils of rebar rather than straight lengths.

Considerable work by both the contractor and the galvanizer was necessary before the optimum rebar size was established. The decision to use coils as the start material required specialised handling techniques through the galvanizing process but too large a bar diameter would make the coils too "inflexible" for galvanizing. On the other hand, too small a diameter would not provide the rigidity required of the cage when the rebar was formed. Further, formability of the rebar was an issue as dimensional consistency of the finished cages was important to ensure the correct thickness of concrete cover.

Galvanizing was finally chosen over other alternative coatings because of its resistance to site handling damage and the ability to provide long sections of rebar that would minimise joints and cuts that could potentially compromise corrosion protection.

The Changi outfall contract was awarded to the Dutch dredging contractor Boskalis International bv with pipeline construction by its affiliate Archirodon Group nv.

INDUSTRY ENVIRONMENTAL LEADERSHIP PROJECT

NSW Environment Protection Authority Cleaner Production

Industry Partnership Program

Department of Environment and Conservation (NSW) and Galvanizers Association of Australia's NSW member companies

Introduction

These Partners initiated an industry-wide process of education, methods of assessment, environmental cleanliness and cleaner production improvement for all plants.

The galvanizing industry's objective was to improve resource use and reduce waste generation. This was achieved through the commitment of members and with the assistance of consultants, Environment Essentials, with the staunch support of the Department of Environment and Conservation (NSW).

A major aim of the work was to develop ownership of the program in shop floor operators. This reinforced the total commitment of member companies from the ground up. The responsibility across all employees for environmental management and awareness has been a significant factor in the galvanizing industry's progress in this area over the past 15 years.

The galvanizing industry has been operating for about 170 years and is committed to making a socially responsible contribution to our community and the environment.

As an illustration of our progress, we have recorded some typical improvements in NSW which are leading to measurable efficiencies as well as a cleaner industry.

General Outcomes

Four plants achieved considerable reductions in resource usage during the program. Two other companies previously involved also achieved a parallel drop in waste generation and had already made resource and efficiency gains at the earlier entry point.

The progress achieved from the training program by our consultants included plant maintenance and adjustments, procedural improvements and strict retention of process tanks at appropriate chemical concentrations.

This discipline and diligence included detailed attention to zinc recovery from the galvanizing process.

A further successful innovation was the integration of environmental and safety procedures data into existing production and quality management systems, to which some basic milling mechanics facilitated further recoveries; work which is still proceeding.

Redesign and replacement of insulation equipment reduced gas consumption per tonne of steel galvanized.

Aggregate annual saving over the audited period

	Resource usage
Zinc	89 tonnes
Acid	97.6 kL
Water	5.4 ML
Natural gas	1590 GJ
Green house gas	94 tonne CO_2-e
Electricity	32.3 MWhr
Green house gas	47 tonne CO_2-e

Annual reduction – Waste generation

Dross	33.3 tonnes
Ash	11 tonnes
Waste acid	225 kL

Galvanizers Association of Australia has been engaged with both State and Commonwealth environmental authorities since the late 1980's in a proactive endeavour to pursue a publicly responsible position on both environmental and sustainable practice.

In this we have been considerably assisted by the progress of our European and North American galvanizing colleagues and the research and development input of the world's major zinc producers through the International Zinc Association (IZA).

Galvanizing Industry Environmental and Cleaner Production – Continuous Improvement

South Australia	Clean air production grant	1999
	Industry cleaner production program	2002-2003
Western Australia	Waste management & recycling contract for cleaner production	2002-2003
Victoria	Cleaner production assessment and action • Environmental Management Module • Environmental Accounting Module • Energy Management Module	2001-2002
	Cleaner Production Partnership Program	2002-2003
New South Wales	Profiting from Cleaner Production – Industry Partnership Program	2003-2005
Queensland and Northern Territory	Progressive plant environmental improvements and process efficiencies	

International Zinc Association Sustainability Charter

ZINC IS NATURAL

Zinc, like all metals, is a natural component of the earth's crust and an inherent part of our environment. Zinc is present not only in rock and soil, but also in air, water and the biosphere – plants, animals and humans.

Zinc is constantly being transported by nature, a process called natural cycling. Rain, snow, ice, sun and wind erode zinc-containing rocks and soil. Wind and water carry minute amounts of zinc to lakes, rivers and the sea, where it collects as sediment or is transported further. Natural phenomena such as:

- Volcanic eruptions
- Forest fires
- Dust storms
- Sea spray

all contribute to the continuous cycling of zinc through nature.

During the course of evolution, all living organisms have adapted to the zinc in their environment and used it for specific metabolic processes.

The amount of zinc present in the natural environment varies from place to place and from season to season. For example, the amount of zinc in the earth's crust ranges between 10 and 300 milligrams per kilogram, and zinc in rivers varies from less than 10 micrograms. Similarly, falling leaves in autumn lead to a seasonal increase in zinc levels in soil and water.

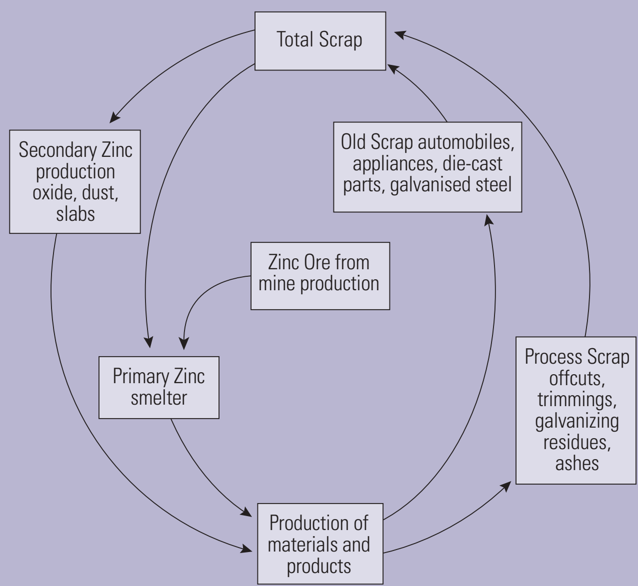
Zinc recycled

Zinc is a recyclable material. At present, about 30% of the world's zinc supply comes from recycled zinc. In other words, some 2 million tonnes of zinc are recycled every year (European Zinc Institute 1990).

Zinc is recycled from zinc-containing products which are recovered after use: post consumer waste such as brass fixtures and fittings (brass is an alloy of zinc and copper), diecast zinc parts and galvanized steel, recovered from automobiles, household appliances or electrical components. Zinc is also recovered from process scrap, such as galvanizing residues, furnace dust and ashes, offcuts, foundry returns and brass machining scrap. The brass industry alone recovers more than 600,000 tonnes of zinc each year.

It is difficult to estimate precisely the recovery rate of zinc since many zinc products have a very long life span. For example, zinc sheet used for roofing can be expected to last for over 100 years without maintenance before it becomes available for recycling. Nevertheless, estimates based on historical consumption and product life cycles suggest 80% of the zinc available for recycling is in fact recycled. Zinc can be recycled indefinitely without any loss of its physical or chemical properties.

Zinc Recycling Circuit



For further information about zinc, please visit www.zincworld.org
or contact International Zinc Association,
168 Avenue de Tervueren, Box 4, 1150 Brussels, Belgium.
Telephone +32 2 7760070 Facsimile +32 2 7760089
info@iza.com