17. ZINC, HUMAN HEALTH AND THE ENVIRONMENT

INTRODUCTION

Zinc is the most widely used metal for the protection of steel from corrosion as well as being present in a range of other manufactured products and in the natural environment. About 7 million tonnes of zinc metal are produce annually, of which about 20% is from recycled material and the rest from mining and refining.

From this, about 70% is used for coatings for corrosion prevention, 15% goes into brass, about 5% goes into rubber tyres (as zinc oxide) while the balance is used for zinc chemicals, dry cell batteries and diecasting.

As coatings and tyres are consumable products, it is logical to assume that the zinc in these products will eventually end up dispersed into the environment. Is this a health hazard? Does it represent a risk to the natural environment?

HOW MUCH ZINC MIGRATES INTO THE ENVIRONMENT?

Emissions of zinc from point sources (factories, sewage treatment) have decreased dramatically since the 1970's to a level expected to be reduced by more than 80% by the early 21st Century.

Significant decreases from diffuse sources (coatings, run-off from zinc coated products) have also occurred in developed countries, particularly in Northern Europe, due to dramatic reduction in sulfur dioxide emissions, again since the 1970's. Acid rainfall arising from high sulfur dioxide levels has not been such a problem in Australia as has been the case in the Northern Hemisphere, where environmental controls have reduced sulfur dioxide emissions by up to 90% in some industrialised regions.

It is estimated that in Sweden, where a major study has been done in the 1990's, zinc gets into the environment from the following sources and in the following volumes:

Source	Tonnes/year
Corrosion and run-off	400t
Tyre wear	150t
Asphalt wear	50t
Brake lining wear	50t
Sewage	50t
Landfills and mining activities	400t
Sundry sources	50t

Zinc is the 24th most common element in the earth's crust and is always present naturally at various levels depending on local soils and other environmental factors. In Sweden the average zinc concentration in soil is around 60mg/kg. In Australia, with its ancient soils, very low zinc levels occur in many areas that contributes to the infertility of these soils for cropping, in particular.

The Swedish investigators have estimated that about one quarter of the zinc that ends up in the waterways and lakes comes from natural sources while the balance derives from human activity.

An interesting observation made by the researchers is that the atmospheric deposition of zinc in the forested areas of the country from industrial activity has contributed to maintaining the zinc levels in the humus layer in forest soils. As pollution controls continue to reduce the atmospheric zinc levels, there is now a risk of zinc deficiency becoming an issue in the future in Sweden's forest soils. In Australia, where 95% of the continent is not subjected to industrial activity of any kind, zinc in soil levels are generally very low.

ZINC REQUIREMENTS FOR PLANTS, ANIMALS & HUMANS

In human and plant biology, there are both essential, non-essential and toxic metals. These individual characteristics may not apply to all organisms and at all concentration levels, and even the most beneficial compounds may be toxic if their biological uptake is excessive.

Zinc is one of the essential metals and plays a central role in the function of a number of proteins in living organisms. Zinc participates in many vital biochemical reactions such as detoxification, maintenance of DNA and RNA genetic codes, protein synthesis and particularly in reproductive functions.

Many plants are prone to zinc deficiency that dramatically reduces their fertility and productivity. The higher up the food chain, the greater the organism's ability to regulate its zinc intake and even in high natural zinc environments, mammals (including humans) and birds do not accumulate zinc in their tissues.

It appears from research done to date, that the life forms most susceptible to toxic effects from zinc are lower forms of plant life (micro-organisms, algae). This phenomenon is used deliberately through the addition of zinc oxide pigment to paint to inhibit fungal growth on painted surfaces.

It is for this reason also, that zinc is used in many ointments and medications, particularly for the treatment of skin disorders.

While the research is incomplete, current findings indicate that levels of five times the background zinc level may have detrimental impact of these lower plant life forms.

While zinc is often classified with the so called 'heavy metals' such as lead and cadmium when environmental standards are discussed, zinc is in fact one of the most beneficial metals. There would be 'no life without zinc' to quote Prof. Heinrich Vahrenkamp from the Institute of Inorganic and Analytical Chemistry, University of Freiburg, Germany from a paper of the same title presented at International Zinc Day, 1994.

The human body contains about 2.5g of zinc and more than 200 enzymes are known that require zinc to function correctly. This is a far higher number than any of the other metals essential to healthy body functions. (e.g. iron, magnesium, calcium, sodium and trace metals such as copper). Zinc has been identified as essential in wound healing, digestion, reproduction, kidney function, breathing, diabetes control, inheritance functions, tasting and skin health.

High levels of zinc are not required in humans or plants and they do not accumulate zinc, with one or two notable exceptions. Oysters have 10 times as much zinc as the next highest source (red meat), and a small flower, silene vulgaris can accumulate up to 3% of its dry weight of zinc. Some plant species can tolerate very high levels of zinc, and vulgar knotgrass (polygonum) has been found to extract over 300 kg of zinc per hectare per year from zinc contaminated soils.

In humans, zinc is found in the highest concentrations in the reproductive system and lowest in the nerves and brain. Mother's milk, sperm and ova have very high concentrations of zinc and humans require around 20 mg/day of zinc, which is available in a normal balanced diet with a supply of fruit, vegetables, cereals, red meat and seafood.

The most dramatic effect of zinc deficiency is on the reproductive system in humans, particularly in the Middle East. Extreme growth retardation in adolescents and the skin disease, acroder-matitis enteropathica, which is a very painful and potentially lethal condition, have both been immediately

cured by simply adding zinc supplements to severely zinc deficient diets.

Zinc in soil is vital for cereal crops and the well being of a wide range of vegetation. For this reason, zinc compounds are widely used as additives in fertilizers. Excess levels of zinc in soils can produce reduction in yields and unhealthy plant growth just as zinc deficiency will detrimentally affect similar plants.

All of the oxidised zinc residues produced throughout Australia by Industrial Galvanizers galvanizing operations, along with the zinc residues of most other Australian zinc users, are processes into zinc oxide for the fertilizer industry.

CONCLUSION

Zinc is such an important industrial material, particularly in respect to making steel a durable construction product, that any constraint on its use would have a costly and dramatic impact on almost every aspect of manufacturing, building and construction.

It is unfortunate that zinc is almost always mentioned in conjunction with those other 'heavy metals' of ill environmental repute, cadmium and lead, and up-to-date quality research is the best way to clarify the real issues related to zinc and its impact on the environment.

The information referring to zinc usage in the Northern hemisphere in this article was derived from the following publication:

Zinc in Society and in the Environment - an Account of the Facts on Fluxes, Amounts and Effects of Zinc in Sweden, by Lars Landner and Lennart Lindström. Published by Swedish Environmental Research Group (MFG), Fryskta, Sweden 1998 160 pp.

All Australian environments are zinc deficient. For other than simple plants (algae, mosses) which are zinc intolerant, all food plants and humans require zinc as an essential element for fertility and health.


INDUSTRIAL GALVANIZERS
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SPECIFIERS MANUAL

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.

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

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