

41 -CHEMICAL CONTACT WITH GALVANIZED COATINGS

INTRODUCTION

While the vast majority of hot dip galvanizing is used to protect steel from atmospheric corrosion, there are always particular applications where hot dip galvanized coatings will come in contact with chemicals, food products or minerals in the course of their transport and storage. While there is an enormous number of possibilities, this chapter of the Specifiers Manual reviews the effects of contact with the more commonly encountered bulk materials on zinc (galvanized) coating.

Table 1 is a corrosivity classification based on annual rate of coating loss that is used in Table 2 as the material's corrosion rating. Table 2 lists the type of chemical, its form (solid, liquid, vapour) and its concentration and its corrosion rating on zinc based on annual estimated coating loss. It should be noted that this corrosivity classification has been arbitrarily allocated to chemicals and materials in contact with galvanized steel, as a method of classifying their corrosivity with respect to each other, and is not related to the corrosivity classifications of atmospheres, that is covered in detail in Australian Standards AS/NZS 2312 and AS 4312.



Most commercial minerals are not particularly corrosive to zinc coatings. However, some like manganese dioxide produced in this plant will permanently stain zinc coatings.

Table 1

Annual rate of coating loss - Microns	Corrosivity classification
<2	Very low
<2-5	Low
5-10	Moderate
10-25	High
>25 -100	Severe
>100	Extreme

CHEMICALS – INORGANIC AND ORGANIC

Table 2

Material	Concentration	Phase	Corrosivity classification
Acetic acid	6%	Solution	Severe
	0.1 g/l in air	Vapour	Severe
Acetone	100%	Liquid	Very low
Ammonium sulfate (fertilizer)	100%	Solid	Severe
Superphosphate (fertiliser)	100%	Solid	Very low
Agricultural lime	100%	Solid	Very low
Nitrate-based fertilisers	95% (5% moisture)	Granulated solid	Severe
Urea	100%	Damp solid	Moderate
Aluminium chloride	25%	Solution	Extreme
Anhydrous ammonia	100%	Liquid	Low
Ammonium chloride	10%	Solution	Severe
Ammonium sulfate	10%	Solution	Severe
Gypsum plaster	100%	Dry	Moderate
Plaster of Paris	100%	Damp	Low
Cement	100%	Damp	Very low
Clay	100%	Solid	Very low
Quartz sand	100%	Solid	Zero

Red brick	100%	Solid	Zero
Portland Cement sand mortar	100%	Solid	Moderate
Calcium chloride (Detergent)	20%	Solution	High
Citric acid	2%	Solution	Extreme
Sodium carbonate (Detergent)	2%	Solution	Severe
Sodium-based detergents	0.5%	Solution	Severe
Commercial soaps and syndets (no phosphates)	0.2-0.5%	Solution	High
Commercial soaps and syndets (no phosphates)	0.2-0.5%	Solution	Extreme
Ethanol	100%	Solution	Low
Ethylene glycol	50%	Solution	Moderate
Formaldehyde	0.1g/l in air	Vapour	Moderate
Gasoline	100%	Liquid	Low
Glycerin	100%	Liquid	Very low
Magnesium chloride	1.2%	Solution	Severe
Methanol	100%	Liquid	Very low
Methyl ethyl ketone	100%	Liquid	Very low
Naphtha	100%	Liquid	Severe
Fuel oil/crude oil	100%	Liquid	Very low
Phenol	100%	Solid	Low
Potassium chloride	Any concentration	Solution	Extreme
Potassium dichromate	15%	Solution	Low
Potassium fluoride	5%	Solution	Very low
Potassium nitrate	0.5-10%	Solution	Moderate
Sodium carbonate	0.5%	Solution	Severe
Sodium chloride	3%	Solution	Extreme
Sodium hydroxide	0.5%	Solution	Severe
Trichloroethylene	100%	Liquid	Extreme
Non-acidic organic chemicals – Alcohols, aldehydes, Aryls, polyethylene glycols, esters, Ethers, Plasticisers, glycol ethers, ketones, monomers, acrylics, vinyl esters, alkyl amines, nitriles etc.	100%	Liquids	Very low

OTHER MATERIALS

Galvanized steel comes in contact with a wide range of bulk materials, including grains, fruit and other farm produce, as well as minerals such as coal, iron ore and many commercial minerals.

Galvanized coatings have been widely used in the coal industry for both coal handling and treatment. The corrosivity of coal with respect to galvanized coatings is generally very low, although there is an exception where ex-mine high sulfur coal is stored in bulk and is subject to rainwater leaching through the coal stacks. This can give rise to low pH run-off ground water that can be aggressively corrosive to both zinc and steel.

Because all grains need to be dry for transport and storage, hot dip galvanized coatings perform well for this purpose. The relatively hard and abrasion resistant hot dip galvanized coating also provided an additional performance benefit in for grain handling.



These galvanized conveyor stringers have been largely unaffected after being covered in coal spillage for over 10 years at North Goonyella.

The use of galvanized steel for the bulk handling of some fruit and products such as sugar cane has some limitations, as because of the acidic nature of the juices associated with the fruit. This may reduce the service life of the galvanized coating where liquid fruit residues can accumulate on the galvanized surfaces.



Galvanized coatings perform well in contact with petroleum products such as diesel fuel.

Iron ore itself is relatively benign in contact with galvanized steel. Studies of structures used in WA's Pilbara iron ore operations indicate that corrosion rates of galvanized steel in contact with iron ore are very low.

The performance of galvanized coatings with other ores and commercial minerals will depend on the specific nature of the material in general, and its moisture content in particular. Many sulfide ores that are produced by floatation processes (copper, lead, zinc...) may also contain chemical residues from the floatation process that can impact on the durability of the galvanized coatings with which they come in contact



*File name; Fertiliser
Blockline: Most fertilisers are aggressive to zinc coatings and with few exceptions, may cause rapid corrosion of galvanized coatings, particularly when damp.*

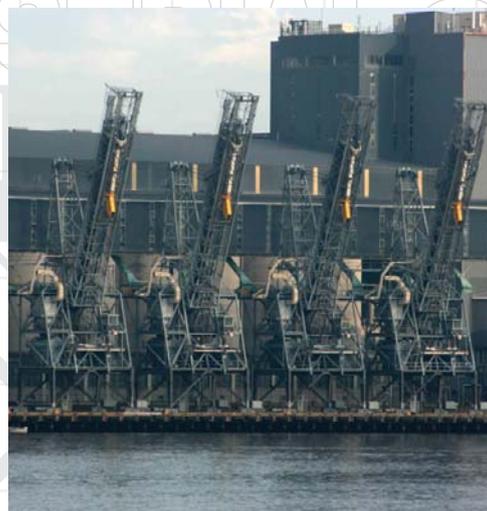
SUMMARY

In general, galvanized coatings will perform well in contact with most petroleum-based products and minerals such as coal and iron ore. Most organic chemicals, with the exception of organic acids and a few specialised products, are benign to galvanized coatings, while the majority of inorganic chemicals are corrosive to zinc and galvanized coatings.

Fertilisers and detergents tend to be corrosive to zinc, although there are some exceptions as shown in Table 2. Building materials such as cement and mortar, and plaster, particularly gypsum plaster, can be corrosive to zinc while damp (during curing) but are benign once dry or cured.

The majority of information in the chapter has been derived from Zinc: Its corrosion resistance, by C.J.Sundler and W.K Boyd, published by the International Lead Zinc Research Organization Inc, New York, 1986.

A further useful reference is 'Corrosion Resistance of Zinc and Zinc Alloys' by Frank C Porter published by Marcel Decker Inc, New York, for the International Lead Zinc Research Organization Inc, North Carolina, 1996.



Galvanized coatings work well in storage and handling of dry grains, but not with other horticultural products such as fruit with acidic juice.



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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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