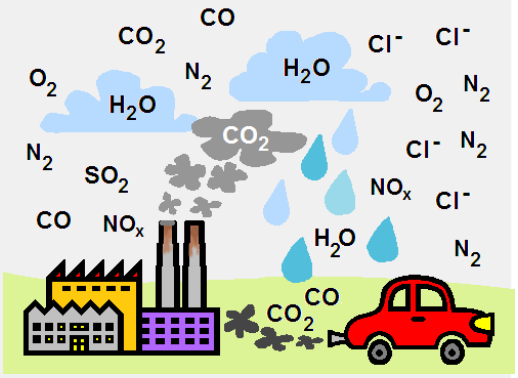
INORGANIC ZINC SILICATE PRIMERS

WHAT ARE INORGANIC ZINC SILICATE COATINGS?

Inorganic zinc silicate (IOZS) coatings comprise metallic zinc held in a glassy silicate matrix. The zinc metal provides galvanic corrosion protection to the mild steel substrate, whilst the coating's porosity provides voids that contribute to ongoing protection to the mild steel.

Compared with hot dip galvanising, IOZS coatings provide superior galvanic corrosion protection to steelwork, particularly in corrosive coastal environments. To understand how IOZS coatings work and why they offer superior corrosion protection, you need to understand some environmental corrosion chemistry. Here's how it works.

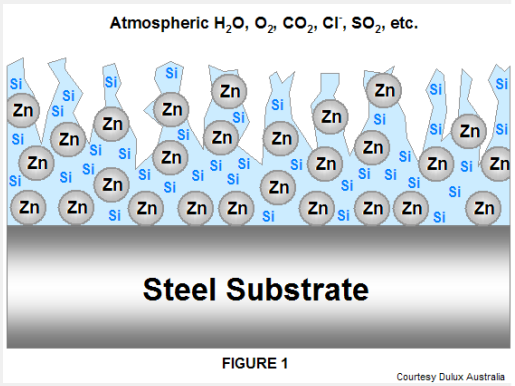


Corrosion of steel is caused by water, oxygen and ions present in abundance in our atmosphere

Environmental Corrosion Chemistry

Corrosion of metals, such as steel and zinc, requires the presence of water (H_2O), oxygen (O_2) and ions such as chloride ions (Cl^-), all of which exist on the atmosphere. Atmospheric chloride ions are in greatest abundance anywhere near the coastline.

In addition to these, the atmosphere also carries emissions from human activity, such as carbon dioxide (CO_2), carbon monoxide (CO), sulphur dioxide (SO_2), nitrous oxide (NO_2) and a bewildering number of other chemicals.



Diagrammatic representation of an inorganic zinc silicate coating on steel

Mechanism:

CO_2 acts as a weak acid thus:

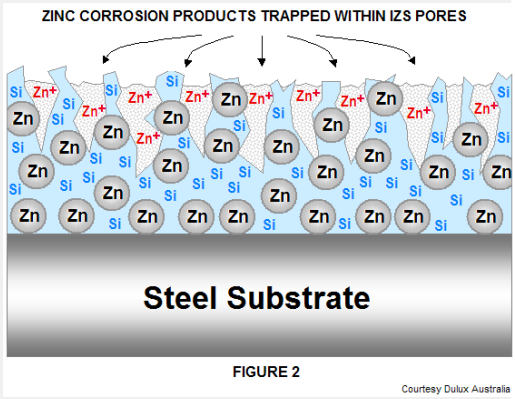
$H_2O + CO_2 \rightarrow H_2CO_3$ (Carbonic Acid)

The carbonic acid then reacts with the **zinc metal** on the surface of the IOZ matrix:

H_2CO_3 (Carbonic Acid) + χ**Zn** + O_2 → $(\mathbf{Zn})_\chi (OH)\ CO_3$

(zinc hydroxy carbonate - insoluble)

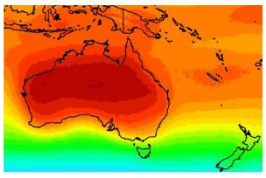
The insoluble and inert zinc hydroxy carbonate is then locked into the surface pores of the IOZ, creating an effective barrier to further oxidation. The zinc hydroxy carbonate is shown as Zn^+ in figure 2.



Zinc corrosion products are trapped within the glassy matrix, forming a layer that prevents further oxidation

If the steelwork is coated, then the zinc hydroxy carbonate barrier prolongs the life of the coating system by providing stability in the substrate. This longevity is not provided by the zinc metal, but by the pores and the stable zinc hydroxy carbonate particles locked within.

HDG and electrolytically applied zinc do not have this porosity, and therefore cannot produce a barrier with their zinc corrosion products. This surface corrosion simply delaminates from the surface, so zinc depletion continues at the same rate. Subtle difference in behaviour – big difference in performance, particularly in the case of coated steelwork, where the coating may be pushed off by the increasing volume of zinc corrosion products between the zinc and the coating.

INORGANIC ZINC SILICATE PRIMERS

WHEN SHOULD YOU USE IOZ?

IOZ primers should be used for all steelwork that:

- Is intended for use in moderate to severe coastal areas
- Is intended for structures with very long service lives, such as buildings, public spaces and infrastructure
- Requires an extremely tough coating, particularly for friction-grip bolting
- Is too large or long to fit in a hot dip galvanizing bath
- Can be properly prepared by abrasive blast cleaning (Refer to Dulux Protective Coatings Tech Note 1.1.2 – Mild Steel Surface Preparation)
- Where long term corrosion performance is required in a single coat

ADVANTAGES OF IOZ PRIMERS

The advantages of IOZ primers over hot dip galvanising are:

- The cured film is harder and more damage-resistant than HDG steel.
- Highly effective galvanic corrosion protection with more effective use of zinc metal than HDG.

WHEN SHOULD YOU NOT USE IOZ?

Good surface preparation of steelwork is absolutely essential for the IOZS primer to perform as designed. IOZS is not appropriate for steel that:

- Cannot be abrasive blast cleaned, such as thin-gauge steel or tubular steel, as the surface profile of the steel must be sufficient to provide a good mechanical key for the coating to adhere to.
- Cannot be prepared and coated in shop under controlled atmospheric conditions.
- Cannot be coated by spray for access reasons and is therefore to be coated using brush or roller application
- Is to be exposed to acidic and certain chemical environments. (Consult Dulux Protective Coatings)

IOZS is not suitable for touch-up of damaged hot-dip galvanised steel – touch up of damaged areas musbe be done using an organic zinc-rich primer. (See Tech Note 3.8.2 – Organic Zinc Rich Primers)

IOZS may be somewhat of an “over-specification” if the structure to be coated is only temporary (for example, constructed for a special event), and may be adequately protected from corrosion by a fast cure, single-pack zinc phosphate primer. Having said that, however, many such structures have in fact become permanent (such as the Eiffel Tower in France)!

Edith Cowan University’s unique steel fins were coated with Zincanode® 402 and Ferreko® No 3

Federation Square, Victoria’s hidden structural steelwork was painted in Dulux Zincanode® 402

The Green Bridge steework was coated with Zincanode® 402 and Ferreko® No 3

INORGANIC ZINC SILICATE PRIMERS

DISADVANTAGES OF IOZ PRIMERS

- Certain coating types, such as alkyd enamels, cannot be applied directly over IOZS coatings, as the zinc metal saponifies the alkyd resin and causes delamination (this also occurs on hot dip galvanised steel and can can be rectified by changing the coating to another resin type)
- Higher applicator skill is required to spray IOZ than some other types of anticorrosive primers
- Longer cure time and overcoat time compared with other types of anticorrosive primers. Typically IOZ's take 24 hours to cure for recoat; other paint chemistries operate on faster recoat times
- Curing of IOZ's typically rely on the weather conditions. Certain products require humidity to cure, while others will cure below 50% relative humidity
- Must be applied between the minimum and maximum recommended dry film builds; less and the dry film will not fulfill AS2312 requirements and may compromise corrosion protection. Greater than the maximum recommended dry film build may cause mud-cracking and/or delayed curing

Overall, the use of IOZS primers offers excellent corrosion protection over abrasive blast cleaned steel, and can be used without a topcoat where a decorative finish is not required. In areas of public scrutiny, an epoxy intermediate coat and polyurethane topcoat offer added protection and aesthetics.

Spraying inorganic zinc silicate primers require a higher level of expertise and experience than zinc-rich epoxies

TYPICAL SYSTEMS

MICACEOUS IRON OXIDE FINISH

Substrate:	Mild steel
Surface preparation:	AS1627.4 - Class 2½ "Near White Metal" blast cleanliness, and to generate an angular surface profile of 30 to 60 µm
First coat:	Dulux Zincanode® 402 @ 75 µm
Second Coat:	Dulux Ferreko® No 3 @ 125 µm
Third Coat:	Dulux Ferreko® No 3 @ 125 µm

POLYURETHANE FINISH

Substrate:	Mild steel
Surface preparation:	AS1627.4 - Class 2½ "Near White Metal" blast cleanliness, and to generate an angular surface profile of 30 to 60 µm
First coat:	Dulux Zincanode® 402 @ 75 µm
Second Coat:	Dulux Duremax® GPE @ 125 µm
Third Coat:	Dulux Weathermax® HBR @ 90 µm

FURTHER READING

For a comparison of the processes of applying HDG and applying IOZ, particularly from an ESD point of view, please refer to Tech Note 2.3.4 - ESD and Corrosion Protection.

For more information, please contact the Dulux Protective Coatings Technical Consultant in your state.