Technical Note

Protection of Tile Substrate by Gerard Roofs Coatings

Galvanised steel and Zincalume Steel have been used as substrates for Gerard Roofs products. The majority of galvanised steel samples have employed conventional coil coating primer systems to improve the adhesion of the basecoat to the substrate. With the introduction of Zincalume steel a coating of tinted acrylic has been developed that provides a surface suitable for the basecoat adhesion.

To understand why Gerard Roofs tiles perform exceptionally well in all environments you need to understand how the galvanic coatings (Zinc or Galvanised steel and the alloys of Zincalume) provide protection to the steel substrate.

Galvanised steel

Galvanised steel utilises zinc as the material that is consumed first in the corrosion cell that occurs between steel and zinc when in the presence of an electrolyte – water and oxygen. The reaction that occurs results in the zinc forming a complex layer of zinc carbonates, hydroxide and oxide. This reaction occurs over the entire surface however it is increased at the edges or on areas where the steel is exposed. The rate of formation is dependent on the time in contact with moisture and contaminants such as salts.

The corrosion products of zinc are commonly referred to as white rust. The corrosion products form a protective layer that reduces further corrosion, however these products are removed by the washing action of rain, which results in more of the zinc being consumed. The life of a zinc-coated substrate is therefore dependent on the amount of zinc applied to the steel, as the rate of corrosion is constant in a given environment. In dry environments zinc coated steel will last longer than in wet environments. High salt levels from coastal or industrial situations or areas that do not receive washing (unwashed areas) where salts can build up will corrode even faster.

Zincalume steel

Zincalume steel uses an alloy of aluminium 55% and zinc 43.5% as the protective coating for the steel. This coating's protection mechanism utilises the zinc's sacrificial protection in the same way as does the galvanised steel, as well as having a barrier protection provided by the aluminium portion.

The Zincalume coating make up is such that the aluminium portion of the coating is the continuous phase material, with the zinc portion being encapsulated by the aluminium. The Zincalume coating differs from the zinc protection mechanism in that the aluminium forms a very stable oxide that is not removed by weathering as quickly as the zinc corrosion products.

It therefore acts as a barrier keeping moisture away from the steel substrate eliminating corrosion. In areas where steel is exposed the zinc portion provides sacrificial protection. Its corrosion products are also retained for a longer period as they are trapped within the Zincalume coating matrix. This results in Zincalume coating of a similar thickness to a zinc coating lasting a projected 4 to 19 times longer than the zinc coating, depending on the environment.

Edge or scratch damage corrosion spots are protected by the zinc that is close to the damaged area as well as the little understood small cathode/large anode principle where little corrosion occurs to a small cathode (edge of steel) in the presence of a large anode (galvanic coating surface). This also helps explain why nails that have little protection from the elements remain in good condition for so long.

Gerard Roofs coating systems

It allows the natural reactions of the galvanic coatings to occur without effecting the protection offered to cut edges or scratches. The acrylics used are not totally impermeable to oxygen or water vapour transfer and as such allow the reactions to take place, but they do however reduce the loss of the protective oxides and as a result prolong the life of the substrates. In the past, primers contained chromates to reduce the corrosion that occurred with galvanised steel. Zincalume steel has not required this material to be included as the barrier protection offered by the aluminium provides superior protection.

The Gerard Roofs coating system offers better protection as it differs from most coil coated steel. Coil coated materials provide a barrier that encapsulates the galvanic surface. They are usually impermeable to moisture and this reduces the size ratio of the anode available in relation to the cathode (the exposed steel at the edges of a sheet). As a result corrosion occurs at a greater rate. Corrosion can continue to occur under the paint film as the film reduces the release or drying of moisture. The effect of underfilm corrosion is seen as blisters or peeling of the coatings at the edge or at damaged sections of the steel. This effect can result in Zincalume corroding much quicker than a zinc protected steel as the continuous presence of moisture does not allow the formation of the very stable aluminium oxide barrier to form.

The manufacturers of Zincalume will not provide a Zincalume steel coated with an impermeable coating for use in an extreme marine climate, because the formation of edge corrosion occurs rapidly under the coating systems that they use for these situations. They also recommend that the edges of each cut edge be sealed so that there is no moisture contact with the zinc or steel of the substrate.

Under film corrosion on a coil coated section of galvanised steel. Exposed on GI roof for 15 years.

Edge of Al Zn steel acrylic tile. Exposed on GI roof for 22 years.

The protection offered by Gerard Roofs coatings systems lays in their ability to maintain the highest possible anode (galvanic surface area) / cathode (small cut edges) ratio as physically possible. Other coatings finishes reduce this ratio, increasing the rate of galvanic corrosion where steel is present.