

Zinc's pivotal role in long performing life of structures

Corrosion in India causes staggering 2-3 % losses to National Gross Domestic Product (GDP). Indian economy suffers astounding Rs 2 trillion (\$40 billion) due to corrosion of infrastructure, industrial equipment and vital installations.

Though the corrosion map of India has always been alarming on its three-sided exposed coastal area, no policy has been framed to curb effects of corrosion and provide for sustainable solutions to enhance the service life of performing steel structures.

Various conventional methods are used to delay the initiation of corrosion on steel structure by: slowing the electrochemical process through use of inhibitors; modifying the electrode through cathodic protection; and providing painting / coatings to the steel.

Some of the essential requirements of a good coating are: adequate bonding to steel; free from localized defects; good abrasion resistance; good impact resistance; ease of patch repair; ease of application; and economical.

Why "Hot Dip Galvanizing" is preferable for steel durability? Since it is based on: Integrity, Performance, Economics, and Environment.

Integrity & environment

Zinc as a metal is one of the most abundant resources available in the earth's crust making it a convenient input in all its



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applications. 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, by a process called natural cycling.

Zn characteristics

The properties & characteristics of zinc include: zinc can be recycled indefinitely - without loss of its physical or chemical properties; reactivity with iron; corrosion resistance; ductile & malleable; wide range of resistance from pH 6 to pH13; barrier and cathodic protection for 40 - 75 years with almost zero maintenance, depending upon environment; complete coverage and coating integrity even in hard-to-reach places; abrasion resistance.

Performance

By protecting steel, zinc reduces loss of this valuable resource on a sustainable platform. Galvanizing is the process of protection of steel against corrosion by metallurgically bonding zinc to steel. This is the most important application of zinc, both in terms of volume and economic benefit to society.

Steel is still one of the most widely used materials on the planet and thanks to zinc, steel's durability can be prolonged. By protecting steel from corrosion, zinc performs an invaluable service. It helps to save natural resources by significantly prolonging the life of steel goods and capital investments, such as homes, offices, cars, buildings, bridges, port facilities, power lines (for thermal, hydro & solar energy), water distribution, telecommunications, industrial

structures, etc.

Zinc-coated steel has many benefits including long service life, low maintenance costs and minimal service interruption. In the case of public infrastructure, these benefits contribute to lower maintenance budgets, thereby freeing up public funds for other priorities without compromising safety or aesthetics. Increased attention to whole-life costing is causing designers, specifiers and investors to opt for zinc coated steel in many traditional and new applications, from automobiles to construction to renewable energy, from electricity distribution poles to roof top & ground based solar mounting structures.

Zinc-coated steel can remain in service for minimum 40 years or much longer, and in case of transmission towers for over 70 years. Based on the steady and predictable performance of galvanizing, roof top & ground mounted PV solar projects have started using galvanized structures supporting solar panels for a performing designed life of 25 yrs.

Construction is one area where huge quantum of steel is consumed. However corrosion of steel reinforcing bars is inevitable as it weakens concrete members, reducing load bearing capacity and safety factors. It further results in failure of reinforced concrete members, partly because of loss of strength due to corrosion of the reinforcement itself, and partly because of the breaking up of the concrete surrounding the reinforcement. When steel reinforcement corrodes, the corrosion product occupies more than three times the volume of the original steel, exerting great disruptive tensile stress on the surrounding concrete, leading to further cracking, more weather access and further corrosion. In mild cases rust staining occurs. In more serious cases, severe spalling of concrete may

occur and ultimately concrete members may fail completely. It is therefore imperative for longevity and maintenance free life of structures, buildings, bridges, utility structures, etc, be protected by appropriate corrosion resistant treatment. Galvanizing stands as one of the most environmentally friendly & cost effective treatments to steel.

Galvanizing reinforcements

The benefits of galvanizing reinforcements include:

- Protection to the steel during storage and construction prior to placing the concrete.
- Diminished effect of variations in concrete quality.
- Safeguards against poor workmanship, especially misplacement of reinforcement, poor compaction, and inadequate curing.
- Increase in bond strength of steel leading to saving in the lap lengths of reinforcements
- Delayed initiation of corrosion and the onset of cracking.
- Reduced likelihood of surface staining.
- Increased structural life of concrete, particularly where chloride contamination is likely.

Economics

When the costs and consequences of corrosion damage to buildings / structures are analyzed, the extra cost of galvanizing is small as galvanizing slows down the rate of corrosion to 1/8th time the normal rate of corrosion. It can be regarded as an 'insurance premium', but a premium which is low and needs to be paid once only. While the cost of galvanizing may be up to 50% of the cost of the steel, the cost of galvanized steel as a percentage of total building / structure / installation project cost is as little as 2%. Since the maintenance cost diminishes after application

of galvanized steels your first cost can be regarded as your last cost. Therefore, with galvanizing the life cycle cost can be considered as the lowest in comparison to other coatings and treatments provided to steel.

Zn consumption

Interestingly, only 7-8 % of steels in India are galvanized as compared to 35 - 38 % of steels in developed countries. The contributing factors in most developed countries have been consistent participation of zinc & steel producers with policy makers in market development. Further, the policy makers & ultimate users are proactive in using galvanizing based on the data and research available contributing to expected design life of structures & steel in construction. Various pilot projects have been set up on test performance basis, for the assessment of public utilities through corroborated efforts by zinc producers & steel manufacturers.

India on the other side has a very diversified topography with major coastal areas surrounded by sea on three sides prone to severe corrosions. Irrespective of being a huge landmass with growing infrastructure there is no unified system or awareness at various levels of decision making for corrosion protection of utility structure or general constructions in severe corrosion areas. Multilevel functioning & gradients at all levels of decision making for departments like New & Renewable Energy, PWD's, Surface Transport, Indian Road Congress, utilities like MCGM, MMRDA, MSRDC, Metro Rail Corporations, etc have been deterrent in assessing the life cycle advantages & sustainability of structures using galvanized steels. Lack of geo-political consensus is also a factor undermining public utility policies.