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Zinc in construction & galvanizing

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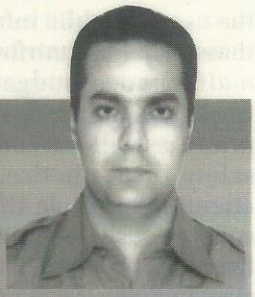

The most important application of zinc, both in terms of volume and economic benefit to society is galvanizing. Galvanizing stands as one of the most environmentally friendly & cost effective treatments to steel. Construction is one area where huge quantum of steel is consumed. It is therefore, imperative for longevity and maintenance free life of structures, buildings, bridges, etc.to be protected by appropriate corrosion resistant treatment.

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 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. Rain, snow, ice, sun and wind erode zinc-containing rocks and soil. Wind and water carry minute amounts of zinc to lakes, rivers and the sea, where it collects as sediment or is transported further. Natural phenomena such as volcanic eruptions, forest fires, dust storms and sea spray all contribute to the continuous cycling of zinc through nature. During the course of evolution, all living organisms have adapted to the zinc in their environment and used it for specific metabolic processes. The amount of zinc present in the natural environment varies from place to place and from season to season. For example, the amount of zinc in the earth's crust ranges between 10 and 300 milligrams per kilogram, and zinc in rivers varies from less than 10 micrograms per litre to over 200 micrograms.

Properties & characteristics of zinc

- Zinc can be recycled indefinitely - without loss of its physical or chemical properties
- Reactivity with iron
- Corrosion resistance
- Electrochemical
- Ductile & malleable
- Amphoteric with wide range of resistance from Ph 6 to Ph 12.5
- Barrier and cathodic protection for 40 - 85 years without maintenance, depending upon environment
- Metallurgical bond strength > 3600 psi (25 MPa)
- Complete coverage and coating integrity inside tubular sections and in hard-to-reach places
- Uniform edge / corner coating thickness
- Abrasion resistance

Steel is 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, cars, buildings, bridges, port facilities, power lines water distribution, telecommunications and transport.

Corrosion is a significant drain on the economy and is estimated

to cost over 6% of GNP each year. By protecting steel, zinc reduces this loss. 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.

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 construction to automobiles, from electricity distribution poles to safety barriers.

The life of zinc-containing products is variable and can range from 30 - 35 years for cars or household appliances, to over 85 years for zinc sheet used for roofing. Street lighting columns made of zinc-coated steel can remain in service for 40 years or much longer, and transmission towers for over 70 years.

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, etc. be protected by appropriate corrosion resistant treatment. Galvanizing stands as one of the most environmentally friendly & cost effective treatment to steel.

The benefits of galvanizing reinforcement 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.

When the costs and consequences of corrosion damage to buildings /structures are analyzed, the extra cost of galvanizing is small. 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 reinforcement as a percentage of total building / structure / construction cost is much lower than generally realized. It can be as little as 0.5%, depending on the nature of the structure. For most structures, even in the most aggressive environments, the use of galvanizing can be confined to the exposed surfaces and critical structural elements.

Interestingly only 7-8 % of steels in India are galvanized as compared to 30 - 36 % 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 much 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 CPWD, PWD, Surface transport, offshore, onshore, etc have been deterrents to assess the life cycle advantages of structures using galvanized steels. Lack of political consensus is also contributing factor determining public utility policies.

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