Corrosion – Solar Mounting Structures Perspective

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It is no exaggeration to say that in a solar power plant, one mounts all their investments on a steel structure which supports the energy generating solar panels for three decades. The role of mounting structures is two fold, one is to optimize the costs involved and make a solar power plant economically viable and the other is to ensure the durability of a solar power plant. In this context we dedicate this article to explore the mutliple aspects of corrossion in the mounting structures perspective.

Corrosion the Process:

Corrsion, in simple terms is degradation of ferrous material due to environmental condidtions. In this process, metal loses its strength and does not serve its design life and capability leading to material failure.

Corrosion is a process of metal degradation, where the metal when it comes in contact with an electrolyte, a localised battery is formed and the metal being anodic loses it electrons and thus its properties. The electrolyte can be rain water that is acidic, high humidity and saline air i.e. air having high amount of dissolved or suspended minerals like Calcium, Magnesium, etc.

Protecting the Mounting Structures- Theoritical and Practical

Observtions

(i) Standard Codes: Research on corrosion of steel and its prevention, has been an ongoing execrise for many years now and the codes and guides used to design structrues and fabricate them have been developed by our academicians based on this thorough research. First step towards prevention of corrosion is to employ these codes with precision through stringent quality norms.

(ii) Indian Codes and New Materials: Many newer variations of steel which are equally or even more capable of resisting corrosion need to be explored to optimize for economic viability. Codes and Standards for these newer material may or may not exist and have to be verified with testing centers. We at Nuevosol as a part of our continuous research to optimize have conducted several tests at reputed laboratories like TUV to ensure the same. These results have been shared in this article as a case study.

(iii) Post-galvanization: Theory and practice suggests that, a 70 micron and above coating thickness is required for 20 year or above corrosion proofing for components which are highly exposed to corrossive environments. This is achieved via hot-dip galavnization (HDG) of processed material. However in mounting structures base posts/ foundation memebers which are the most exposed to enviromnent in terms of wear and tear are maintained to be of HDG material with 70 micron coating thickness, while the rest of the components can be pre-galvanized or other newer material.

Limitations: Hot dip galvanization being a semi-automated process with lot of manual intervention, calls for quality manaegemnt at every level. In this semi automated process one must be aware that there cannot be machine made perfection in the coating thickness, leading to uneven surfaces. Hot dip galvanization is possible only at higher thicknesses, and can prove to be pricey, if it has to be used for complete strcuture.

(iv) Pre-galvanized Steel: Pre galvanized steel has been in use for many years now in developed countries for solar mounting. It comes in three main varieties namely 250 GSM, 375 GSM and 550 GSM. Pre gavlanized steel has been used in many industries, mainly the automobile industry and pre-engineered buildings as it is known for its formability. The features of availability at lower thicknesses and formability have made it a favourite for design of solar structures. Caution has to be exercised in the design and manufacturing using pre galavnized steel as the galavnization coating thickness is a maximum of 20 micron each side for 550 GSM steel. However the usage of these steels in solar structures is restrictired to components which are not very exposed to corrosive environment nor are prone to water stagnation. This has been ongoing practice for several years in Europe, where a maximum of 350 GSM steel is being used which proved to be resistant to corrossion. At Nuevosol we use 550 GSM pre galvanized material. Caution has to be exercised when bending, punching and handling the material, as any kind of wear and tear can expose unportected steel to atmosphere.

(v) Accessories:

In structures that are used for mounting panels, there will be vibrations due to wind loading; these vibrations in turn cause sliding of fasteners against the surface of the components at the mounting points, this sliding leads to rupture on the surface of the fastener and the component being fastened at the place of contact, exposing them to the elements and thus causing corrosion. This can be avoided by providing washers at the point of contact or providing appropriate spacing allowing a partial movement or by lubrication.

As a practise solar structures are to be assemebled using galvanized accessories or even better stainless steel accessories. Generally prefered grades are HDG 5.6 for structure assembly and SS 304 for module assembly.

Pre Galvanized and Post Galvanized Steel; A Comparative Study.

Nuevosol provides warranty on all the supplied material and therefore gets all its components tested and certified against corrosion by many laboratories. One such test we have conducted to compare corrosion in various types of steel used in solar structures, we took the assistance of TUV Rheinland.

Accelerated Salt Spray and Cyclic Corrosion Test.

To phrase it in simple manner, the test is to accelerate the corrosion process by simulating the harsh conditions to test for 25 years durability in a span of a few thousand hours.

It is a standardized method used to check corrosion resistance of metals/alloys and inorganic and organic coatings. It is a tool for evaluating the uniformity of thickness and degree of porosity of metallic and non-metallic protective coatings. A number of samples can be tested at once depending upon their size.

This method is considered most useful for measuring relative corrosion resistance of closely related materials (comparative test). It is widely used for process qualification and quality acceptance. The test method provides a controlled corrosive environment representing accelerated marine type atmospheric condition.

One test cycle consists of

1. Four spray periods each of 2 hour
2. Humidity storage period between 20 to 22 hours after each spray period;
3. Afterwards one storage period of 3 days under a standard atmosphere for testing at 23±2 0 C and 45% to 55% humidity.

There are a number of such cycles followed to test the sample. The following are the components that we got tested recently and the results and conclusions follow:

Sample	Result.
Column Post 550 GSM with Zn Spray	No sign of corrosion even after 2000 hours of exposure.
Column Post HDG 80 MS	No sign of corrosion even after 2000 hours of exposure
Column Post 550 GSM	No Sign of corrosion after 2000 hours of exposure.
Column Post 350 GSM	Sign of corrosion after 960 hours of exposure.
Zinc Alum Coated Steel	No sign of corrosion even after 2400 hours of exposure.

Observations of the experiment:

- Hot Dip Galvanized 80 Micron (HDG 80MS) coated steel is the most corrosion resistant material. Zinc Alum Coated Steel and Pre galvanized 550 GSM material have comparable resistance to HDG 80. Lower grade Pre-galvanised materials are corrosive compared to both HDG 80 MS, Zinc-Alum and Pre-Galvanized 550 GSM Steel.

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