Unique coated TMT rebars: Zn+Ni Alloy formation

By Tata Steel Limited | Category: Dare to Try

Tata Tiscon is one of the premium brands of Tata Steel, for supply of uncoated construction rebar. This project met the customer's need for a high-end, techno-commercially superior product with regards to existing corrosion-resistant rebar products / solutions. For an enhanced life of rebar in concrete media, a double layer alloy metallic coating of two different metals i.e; Zinc and Nickel through a plasma process was achieved. The salt spray life of the material is quite good when put in straight form, but the life of the product is not satisfactory (<100 hours) when kept in a bent condition. However, the product has high corrosion resistance, is suitable to Indian construction conditions and has high abrasion resistance.

The Context

Based on customer surveys and feedback for the last few years, this product met the customers' expectation for a corrosion-resistant rebar, both in pre-application and post-application stages. In the past, TSL has tried to explore various organic coatings, but was unable to reach commercial production. Globally, stainless steel and hot-dipped galvanised rebar used is in a higher price band, making it unaffordable for a larger section of users. Epoxy-coated rebar used in India, suffers from various demerits like peeling off during bending and damage during handling at construction sites.

Potential Impact of the Innovation

revenue impact

₹0.9 bn

Overcoming Challenges

Regenerating the Nickel metal in a continuous electrolyte process was innovated where, not only was a quick replenishment of Nickel achieved, but at the same time, the required electrolyte properties for plasma stability were achieved as well. A special catalyst (additives) was developed to achieve the above, and is proprietary in nature. A special rare earth oxide alloy was developed to sustain the anode surface in extremely severe acidic environment of Nickel plasma.

The Innovation

There are various products in the market with either sacrificial protection or barrier protection, but these are either expensive or have performance-related issues. Using plasma technology, TSL innovated a product called Zn-Ni. In Zn-Ni, there is a double layered metallic alloy coating that is combined with sacrificial and barrier coating - a process done for the first time in the world. The plasma process consists of chemical etching, mechanical cleaning, cleaning through plasma process and coating of Zinc and Nickel through plasma technology. Unlike cleaning of flat surfaces, there were a lot of challenges as the rebar surface was ribbed, round, and abrasive with non-uniform scaling, for which various sets of experiments and trials were conducted.

Uniqueness of the plasma-based Zinc coating system:

In this system, multiple rebar travel through a Zinc and Nickel-based electrolytic bath. The coating thickness depends on the uniformity of the current density across the rebar, for which various sets of experiments and trials were conducted. In the process, Zinc deposited under the hydrogen plasma atmosphere would form a sacrificial coating that prevented the rebar from corrosion. Nickel barrier coating was then done over Zinc to protect the Zinc i.e.; the highly alkaline cement atmosphere.

The barrier coat kept the Zinc and rebar intact, resulting in a very high extended rebar life. Zn-Ni was a combination of sacrificial as well as barrier coating. Regenerating Nickel metal in a continuous electrolyte process was innovated where, not only a quick replenishment of nickel was achieved, but at the same time the required electrolyte properties for plasma stability were also achieved. A special catalyst (additives) was developed to achieve this, which is proprietary in nature.