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Corrosion Behavior of Organic-Inorganic Hybrid Coatings Fabricated by Electrostatic Method

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Abstract : Mild steels have a limited alloying content which makes them vulnerable to excessive corrosion rates in the harsh medium. To overcome this issue, some protective coatings are used to prevent corrosion on the steel surface. The use of specialized coatings, mainly organic coatings (such as epoxies, polyurethanes, and acrylics) and inorganic coatings (such as Polysiloxanes) is the most common method of mitigating corrosion of carbon steel. Incorporating the benefits of organic and inorganic hybrid (OIH) compounds for the designing of hybrid protective coatings is still challenging for industrial applications. There are advantages of inorganic coatings have, but purely inorganic siloxane-based coatings are difficult to use on industrial applications unless they are used at extremely low thicknesses (< 1-2 microns). Hence, most industrial applications try to have a combination of Polysiloxanes with organic compounds. A hybrid coating possesses an organic section, which transports flexibility and impact resistance, and an inorganic section, which usually helps in the decreasing of porosity and increasing thermal stability and hardness. A number of polymers including polyethylene glycol and polyvinyl pyrrolidone have been reported to inhibit the corrosion mild steel in acidic media. However, reports on the effect of polyethylene oxide (PEO) or its blends on corrosion inhibition of metals is very scarce. Different composition of OIH coatings was synthesized by using silica sol-gel, epoxy, and PEO. The effect of different coating types on the corrosion behavior of carbon steel in harsh solution has been studied by weight loss and electrochemical measurements using Gamry 1000 Interface Potentiostat. Coating structures were investigated by SEM. İt revealed a considerable reduction in corrosion rate for coated sample. Based on these results, OIH coating prepared by epoxy-silica sol gel-PEO and epoxy-silica sol-gel exhibit had a %99.5 and %98 reduction of (Corrosion rate) CR compares to baseline. Cathodic Tafel constant (βc) shows that coatings change both Tafel constants but had more effect on the cathodic process. The evolution of the Potentiostatic scan with time displays stability in potential, some of them in a high value while the other in a low value which can be attributed to the formation of an oxide film covering substrate surface. The coated samples with the group of epoxy coating have a lower potential along with the time test, while the silica group shows higher in potential with respect to time.

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