Protective coatings for historic wrought iron: epoxy resins versus oil-based systems

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The heritage ironwork community is debating the practical and moral disadvantages of coating wrought iron with two-pack epoxy coating systems versus their potential for corrosion prevention. Their promotion by manufacturers as highly engineered, long-lasting 'wonder-coatings' is being called into question and weighed against the issues of cost, requirement for blasting substrates to Sa2.5 (near white metal), a relatively short pot life, reversibility challenges, and the lack of compatibility between the inflexible cured polymer and the dimensionally thermo-responsive ironwork which is reported to cause cracking of the epoxy resin at joints with resultant ingress of water. Currently absent from this discussion is empirical evidence of the impact of epoxy resin coatings on the corrosion rate of wrought iron as compared with other coating types.

A project investigating the surface treatment and protective coating of historic wrought iron is under way at Cardiff University with sponsorship from Historic Scotland. The effect of surface preparation methodology prior to coating on the corrosion rate of the uncoated substrate was reported at EUROCORR 2012. Current work aims to provide a cost benefit comparison between the use of two-pack epoxy resin coating systems and oil-based systems. This paper presents the results of corrosion rate investigations and electrochemical impedance spectroscopy (EIS) analyses of samples coated with a commonly used epoxy resin system and two household name oil-based systems.

Mid-19th century rolled plate wrought iron samples were prepared by blasting to Sa2.5 (near white metal) with aluminium oxide powder or by wire brushing, as per the coating manufacturers' recommendations. Similarly prepared samples were contaminated with synthetic seawater (BS3900-F10:1985) to simulate wrought iron exposed to a coastal environment. All three coatings were applied as per the manufacturers' instructions.

The samples were sealed within individual glass reaction vessels containing silica gel conditioned to 90% RH. Depletion of oxygen within the vessels over 12 months was remotely recorded using a World Precision Instruments OxyMini oxygen meter to measure the quenching of fluorescence of an oxygen sensor spot attached to the wall of each vessel. Oxygen consumption of the coatings was determined using controls and subtracted from that of the wrought iron samples to give the corrosion rates of the metal substrates. Comparative performance of the coatings was investigated using EIS to support the real time long-term tests employing oxygen consumption.

Interpretation of the outcomes will build towards evidence based advice for contractors choosing coatings for corrosion prevention of heritage wrought iron monuments in coastal and inland contexts.