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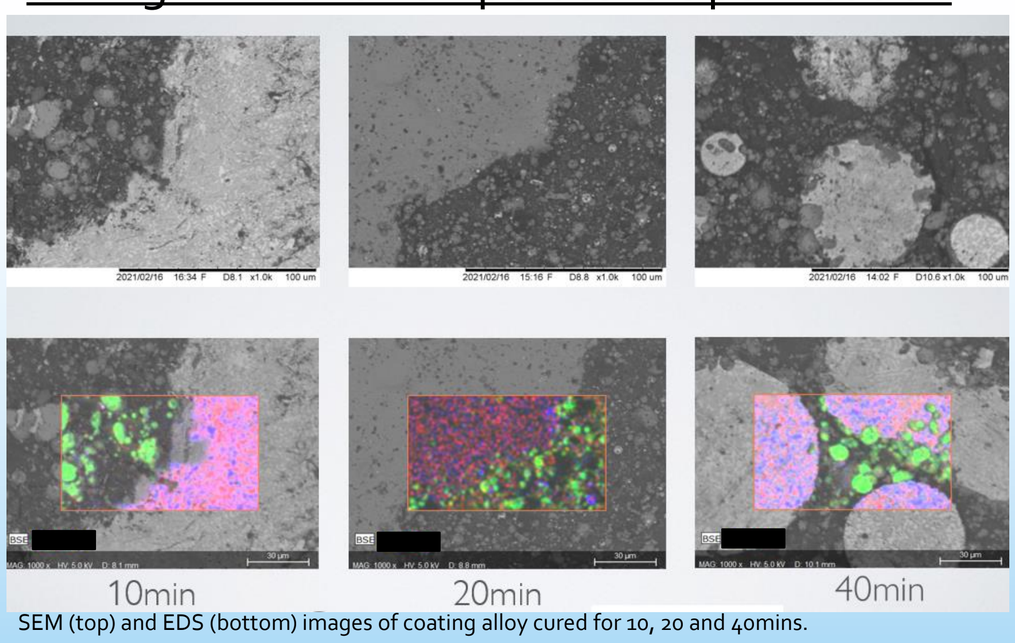
Novel Galvanic Coatings for Ground Support Equipment

ABSTRACT: Hot Dipped Galvanising (HDG) is an expensive and time-consuming batch process for large Ground Support Equipment (GSE). The current work focuses on developing a lower-temperature alternative process. The aim is to provide a corrosion-resistant coating which can bond to the substrate at lower temperatures, that can be applied on-site at the sponsor company's facility. Currently Zinc Rich Paints are used, can sometimes fail due to UV degradation, or the oxidation of zinc particles within the paint, reducing electrical conductivity. In this novel coating, we hope to solve those issues. The galvanic properties of one constituent are utilised to create a novel fusible, corrosion protection coating.

Curing Time and Temperature Optimisation



SEM (top) and EDS (bottom) images of coating alloy cured for 10, 20 and 40mins.

SEM and EDS images were used to analyse a range of heat treatments and compositions. The key factors that needed to be assessed were mixing and wetting of their constituents. The optimal heat treatment was established for the desired microstructural properties and further testing.

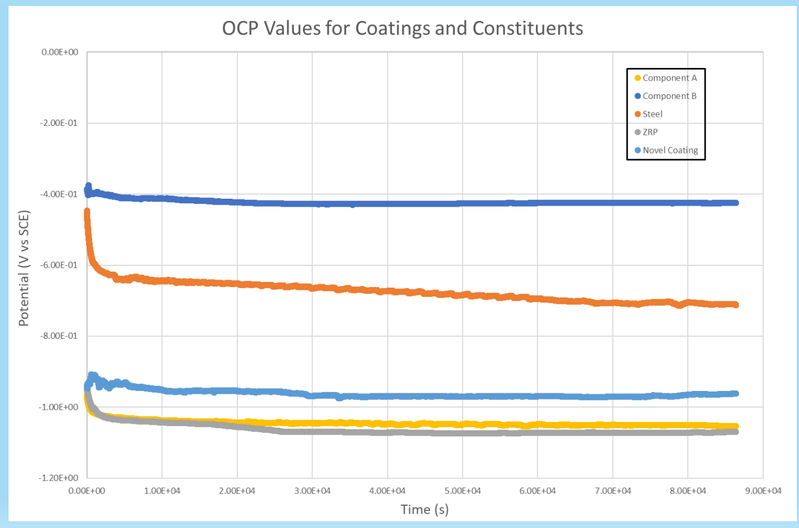
Substrate Application and Alloy Wetting

Optical Micrograph of coating bar-coated on steel substrate

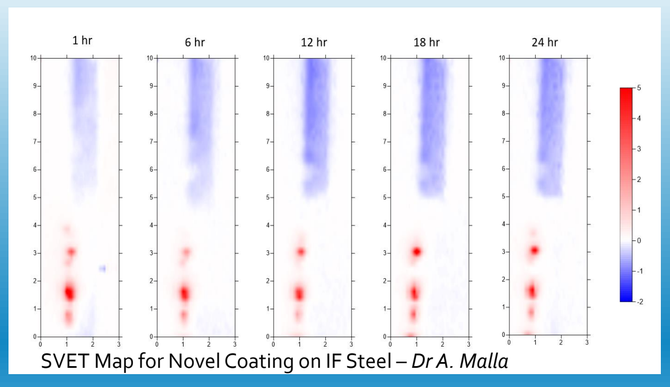
Bar-coating has been used for application. It is found that this gives a more uniform coating. Alternatives for industry will be explored e.g. spraying.

Open Circuit Potential

The figure to the right shows the Open Circuit Potential curves for A, B , bare steel, Zinc Rich paint and the novel coating measured against a Saturated Calomel Electrode. The values for Steel (~ -650mV to ~-700mV) and "A" (~-1V) are in agreement with widely known values for these materials, as seen in literature. The value for "B" is the highest (most positive value), showing a stable value around -428mV. The curve for the novel Coating begins at a similar value to "A", then rises slightly before plateauing for the remaining test.
The comparative OCP values of the novel coating and Zinc Rich Paint show they offer a similar level of protection to the steel substrate. This shows that the Zn is acting sacrificially in both cases and protecting the substrate.

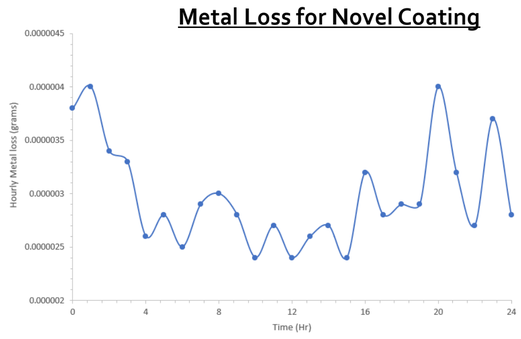


SVET Corrosion Testing



SVET Map for Novel Coating on IF Steel – *Dr A. Malla*

Metal Loss for Novel Coating



Electrolyte: 1 wt.% NaCl p 7

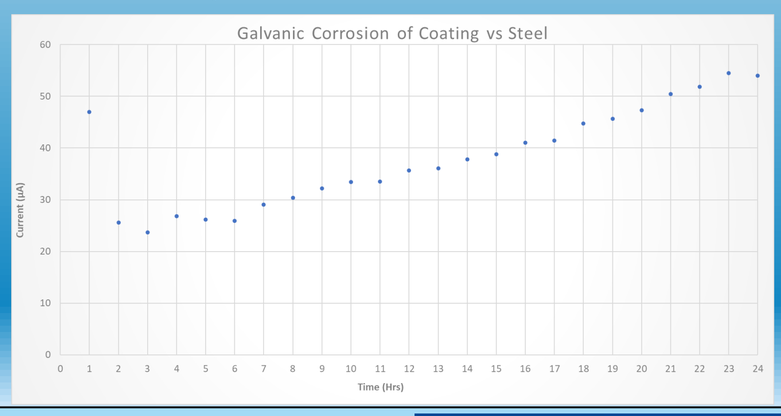
Time: 24 hours

Metal Loss: 0.0744 mg

Scanning Vibrating Electrode Technique (SVET) was used to determine anodic and cathodic activity of the coating system, as well as metal loss over a 24hr period. Results show that the coating offers galvanic protection to Interstitial-Free (IF) Steel, with the one particular composition coating exhibiting anodic behaviour that corroded preferentially to the substrate. The metal loss values are also encouraging with results comparable to, or better than, industrial HDG product.

Zero Resistance Amplitude

ZRA monitors the direction and magnitude of current flow between two working electrodes corroding in solution. This can be seen in the ZRA data over 24 hours for the novel coating connected to the steel (below).The figure shows that electrons flow from the coating material to the steel electrode, demonstrating galvanic protection of the steel by the coating. Over the 24 hour tests, the current increases, which indicates activation control.



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