

RUST CONVERTER WITH IMPROVED ADHESION FOR TOPCOATS

Sanja MARTINEZ¹, Boris MIKŠIĆ², Ivan ROGAN³, Antonio IVANKOVIĆ¹
¹University of Zagreb, Faculty of Chemical Engineering and Technology, Croatia, sanja.martinez@fkit.hr
²Cortec Corporation, USA, boris@cortecvci.com,
³CorteCros, Croatia, ivan.rogan@cortecros.hr

PROTECTION OF 'AGED' INDUSTRIAL STRUCTURES BY COATINGS

1 Surface preparation before application of protective coatings to 'aged' industrial facilities is particularly challenging on constructions, that for a variety of reasons, may be unsuitable for abrasive or water blasting. Rust converters applied to hand/power tool cleaned surfaces, which together with topcoats, offer corrosion protective characteristics matching those of blasted surfaces are of imminent technological and economical interest. Performance of VpCl CorrVerter and commercial tannin and phosphoric acid based rust converters applied to specimens cut from an aged, heavily rusted industrial structure, has been investigated.



Typical appearance of degraded coating on a badly maintained 'aged' industrial structures.

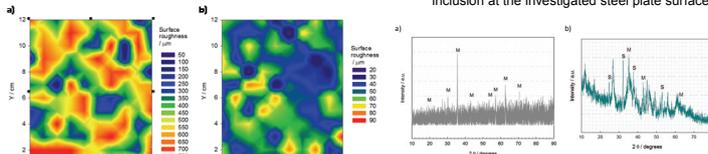
SUBSTRATE CHARACTERISATION

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Specimen appearance a) before and b) after sandblasting.

a) SEM image and b) EDS map of MnS inclusion at the investigated steel plate surface.



XRD spectra of a) black and b) brown-rusted corrosion product samples removed from the rusted steel specimen (M-magnetite, S-siderite).

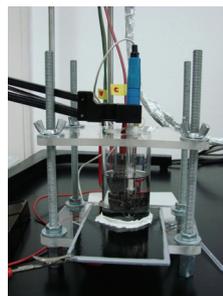
Surface roughness of specimen: a) before and b) after sand blasting.

TEST SAMPLES AND CELL SETUP

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Specimens with rust converters and polymer coatings applied to surfaces prepared by different cleaning methods.

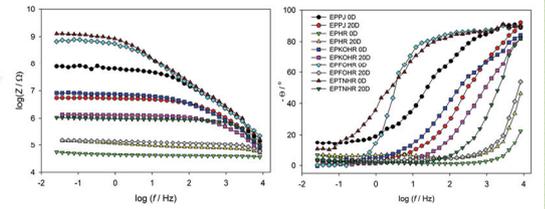


Electrochemical cell for EIS measurements.

System abbreviation	Substrate	Rust converter	Polymer coating 1 layer - 100 μm
EPPJ	Steel sandblasted to Sa 2 ½	-	epoxy
EPHR	Hand tool cleaned steel	-	epoxy
EPKOHHR	Hand tool cleaned steel	VpCl CorrVerter	epoxy
EPTNHR	Hand tool cleaned steel	tannin	epoxy
EPFOHR	Hand tool cleaned steel	phosphate	epoxy
ALKOHR	Hand tool cleaned steel	VpCl CorrVerter	alkyd
POKOHHR	Hand tool cleaned steel	VpCl CorrVerter	polyurethane

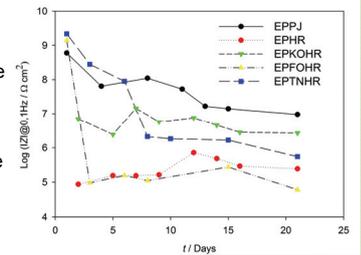
EIS RESULTS

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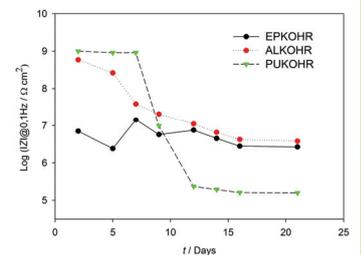
Bode plots of epoxy coated specimens, immediately after exposure to 3.5% NaCl electrolyte and after 20 days of exposure.

Single layer polymer coating, applied over substrate or rust converter covered substrate, has been investigated in order for the impedance to reflect the protective ability of the rust converter, more than the coating itself. Therefore, the impedances are fairly lower than those usually obtained for the multilayer coating systems. Correspondingly, phase angle plots, start at approximately -90° and rise to almost 0, at low frequencies.



Time dependence of coating impedance at 0.1 Hz for epoxy coating systems combined with various rust converters and substrates.

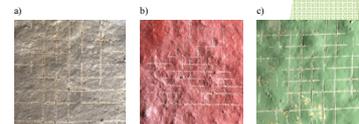
Epoxy coating applied to the sand blasted surface shows the highest final value of impedance after 20 days of exposure, approximately equal to $10^7 \Omega \text{cm}^2$. Epoxy applied to the rusted hand tool cleaned surface shows impedance approximately equal to $10^{5.5} \Omega \text{cm}^2$. Impedance of systems with rust converters are between those two values.



Time dependence of coating impedance at 0.1 Hz for various coating systems combined with CorrVerter and rusted hand tool cleaned substrate.

ADHESION TEST

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Cross-cut test results for a) epoxy, b) alkyd and c) polyurethane coatings on hand tool cleaned rusted surface treated by VpCl CorrVerter.



Example of premature adhesion failure on a hand tool cleaned structure protected by epoxy coating system without the use of rust converters.

CONCLUSIONS

Various combinations of substrate, rust converters and polymer coatings have confirmed beneficial influence of VpCl CorrVerter and tannin type converter on overall system protective ability. For phosphate converter, the improvement over converter untreated surface was not observed. Among all the tested systems, systems with VpCl CorrVerter, applied to hand tool cleaned steel covered with epoxy and alkyd coatings, had impedances closest to those obtained in the case of epoxy applied to Sa 2 ½ sand blasted surface. The improvement of impedance of the epoxy system with VpCl CorrVerter over the epoxy system without VpCl CorrVerter is >93%. All three types of coatings investigated, epoxy, alkyd and polyurethane, applied over the VpCl CorrVerter layer, adhered well to the hand tool cleaned substrate. Extremely rough surface profile may significantly reduce the efficiency of rust converter and coating systems. Following a detailed specification describing appropriate technique of rust converter and coating application is imminent for attaining their synergistic protective ability.