BOOK OF ABSTRACTS

PractiCORR 2025

Conference venue

Mercure Warszawa Centrum, Złota 48/54, 00-120 Warsaw, Poland

Organizers

Polish Corrosion Society (PSK) • European Federation of Corrosion (EFC)

POLISH CORROSION SOCIETY

EFC EUROPEAN FEDERATION OF CORROSION

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Session type: PS - poster session
Presentation language:
Title: Degradation Mechanism of zirconate based thermal barrier coatings
Topic: Poster session
Author / Authors: Ayesha Amjad[1], Amjad Iqbal[1]
[1]Silesian University of Technology
Abstract:
Thermal barrier coatings (TBCs) are sophisticated protective layers designed to shield high-temperature components, such as those in gas turbines and aerospace engines. Extensive studies have been dedicated to advancing TBC technology, with a focus on deposition methods, ceramic material innovations, and resistance to hot corrosion.
This study highlights a breakthrough in TBC design through the development of dual-phase coatings, a class of composite systems engineered for superior performance. While conventional approaches often rely on yttria-stabilized zirconia (YSZ) blended with ceramics like lanthanum cerate to form composite structures, the new dual-phase approach aims to enhance functionality.
Analytical techniques, including Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD), validated the high-quality microstructure of coatings produced via atmospheric plasma spray. Hot corrosion evaluations revealed greater stability under pure oxidative conditions compared to exposure to molten sulfates. The research further pinpointed high-temperature-stable corrosion byproducts that drive degradation in these composite systems, offering critical insights for improving durability.

Session type: PS - poster session
Presentation language:
Title: Simulation of corrosion of stainless steel in soil under laboratory conditions
Topic: Poster session
Author / Authors: Agnieszka Brojanowska[1], Hubert Adamczyk[1]
[1]Warsaw University of Technology, Faculty of Materials Science and Engineering
Abstract:
The study of the corrosion properties of metals in the soil environment is important for many industries (e.g. the construction, road or petrochemical industries), but also for many scientific fields, such as archaeology. Metals in long-term contact with soil can corrode unpredictably. A wide range of factors influencing the corrosive aggressiveness of soil are responsible for this (soil grain size and moisture content, degree of oxygenation, chemical content including aggressive ions and agricultural and industrial pollutants, pH, soil permeability, presence of microorganisms, etc.). Studies simulating the corrosion of materials in soils are carried out in various ways. Common methods include tests on working structures under natural conditions in soil and laboratory tests in soil samples taken under natural conditions, in artificial soil in solid form and in solutions simulating soil. However, replicating natural soil conditions in the laboratory is a challenge.
This paper focuses on a comparison of laboratory test results for the corrosion properties of stainless steel as a function of the type of soil simulation environment used (aqueous solution, bentonite, commercially available soil) and the configuration of the measurement system.

Session type: OS - oral session
Presentation language:
Title: PODOBIEŃSTWA I RÓŻNICE W OCENIE JAKOŚCI POŁĄCZEŃ SPAWANYCH KONSTRUKCJI STALOWYCH. PODEJŚCIE SPAWALNICZE I ANTYKOROZYJNE
Topic: Surface preparation session
Author / Authors: Mateusz Buńka[1], Sławomir Piłat[2]
[1]BM INSPECT
[2]EURO-DARMAL Sp. z o.o.
Abstract:
Celem wystąpienia jest porównanie sposobu oceny połączeń spawanych przez inspektorów antykorozyjnych oraz spawalniczych. Wprowadzenie charakteryzuje krótko złącza spawane, sposoby ich oceny i badań. Następnie szeroko omówiony zostaje etap badań wizualnych. Poprzez porównanie oceny według norm ISO 8501-3 oraz ISO 5718 oraz norm powiązanych, wskazane zostały różnice oraz podobieństwa w podejściu do inspekcji i odbioru połączeń spawanych. Omówione zostały również prace szlifierskie, które, zlecone w celu naprawy – nasuwają pytania odnośnie słuszności ich zastosowania oraz rzetelności badań je poprzedzających.

Session type: OS - oral session
Presentation language:
Title: Certification CFR by the CEFRACOR – Feedback after five years of certification for coating applicators.
Topic: Standards, regulations and requirements session in various countries
Author / Authors: Pascal Collet[1]
[1]Cefracor
Abstract:
The content of this presentation is based on the background of the certification, the scope of works covered by this certification and the today situation and benefits of its implementation for the French operators and the administration.

Session type: OS - oral session
Presentation language:
Title: INTERNAL CORROSION DAMAGES CLOSE TO MONOLITHIC ISOLATION JOINTS PLACED ABOVE GROUND IN A PIG TRAPS
Topic: Anti-corrosion protection session in the petrochemical industry, Corrosion problems in practice session
Author / Authors: Marco De Marco[1], Elisa Ferrari[1], Eduardo Adile[1], Fang Fang Wu[1]
[1]Istituto Italiano della Saldatura - IIS
Abstract:
This work summarizes a Failure Analysis activity carried out with destructive tests and aimed at characterizing an internal damage of n° 2 carbon steel pipes that occurred close to isolation joints placed above ground. The components from which the joints affected by internal corrosion were taken were installed on PIG traps serving underground pipes at a hydrocarbon treatment site.
The analysis was structured through the visual examination of the components and laboratory tests for the characterization of the damage and subsequent study of the problem to identify the most probable causes and define some possible corrective actions for mitigation and prevention.

Session type: OS - oral session
Presentation language:
Title: Bristle Blaster, green technology for surface preparation of steel structures
Topic: Surface preparation session
Author / Authors: Martin Durcik[1]
[1]MONTI - Werkzeuge GmbH
Abstract:
Abstract
In the EPRG report of David Norman and Colin Argent of 2003, the external pipeline coating is the first line of defense against corrosion caused by the environment around the pipe including natural soil, waste materials and seawater. The second line of defense is cathodic protection and this is designed to prevent corrosion at sites of damage to the coating. The long-term performance of an external pipeline coating may therefore be defined as its ability to prevent active corrosion of the pipeline steel either directly or in combination with the applied CP.
Coating degradation can take many forms.
Active corrosion on buried pipelines can occur where the coating is defective and the corrosion process may be driven by one the following conditions:
Ineffective CP
CP Shielding
This can create the conditions in which pitting and general corrosion occur and in anaerobic soil conditions the rate of corrosion attack may be accelerated by bacterial or microbial activity.
External Drivers such as electric interference, stray current, or galvanic effects.
Stress Corrosion Cracking
Stress corrosion cracking on buried pipelines is most commonly found beneath a coating that has become porous or has lost adhesion.
The approach taken in by David Norman was to answer the following questions:
Can a pipe coating be applied and operated in such a way that none of these failure modes critically impairs the integrity of the pipeline within the original design life?
If there is evidence that pipe coatings are showing premature failure what measures are required to prevent it in the future?
What measures can be taken to quantify the degradation of coatings on pipelines that are approaching, or have exceeded the original design life?
In this paper the focus is on surface preparation.

Session type: OS - oral session
Presentation language:
Title: Successful Repairs of chloride-induced corrosion in Reinforced Concrete Marine Assets
Topic: Anti-corrosion protection session – infrastructure & offshore structures
Author / Authors: Hakan Ekim[1]
[1]Endura Engineering Ltd (www.enduraltd.com)
Abstract:

Successful Repairs of chloride-induced corrosion in Reinforced Concrete Marine Assets
Exploring case histories, addressing challenges, the importance of specifications, common practices and lessons learnt.

This topic explores the strategies, case histories, and techniques employed to *address chloride- induced corrosion, a prevalent issue in reinforced concrete marine structures*. It highlights the importance of thorough planning, effective materials, and proven methods in ensuring durable and sustainable repairs.

Many marine structures begin to exhibit signs of concrete deterioration due to corrosion well before reaching their intended design lifespan. Early failures of structural assets lead to significant financial losses, both in terms of revenue and associated risks. As marine facilities age and funds for reconstruction become scarce, the focus on cost-effective concrete repairs, ongoing maintenance, and protective measures becomes critical for prolonging the lifespan of these structures and mitigating risks.

This presentation highlights the importance of practically significant technical details, emphasizing their application and real-world relevance rather than delving deeply into scientific principles. It draws upon the speakers' extensive hands-on, real-time experiences, enriched with detailed case histories, illustrative photographs, and references to internationally recognized codes of practices and standards. Together, these elements create a thorough and engaging perspective.

Session type: PS - poster session
Presentation language:
Title: Bio-Based Surfactant Blends for Steel Corrosion Inhibition in Pickling Environments
Topic: Poster session
Author / Authors: Shadrach Ibhafidon, Bo Gu[1], James Perry[1], Amir Al Ghatta[2], Jason Hallett[2]
[1]imperial College London
[2]Imperial College London
Abstract:

Bio-Based Surfactant Blends for Steel Corrosion Inhibition in Pickling Environments
Shadrach Ibhafidon[1]*, Bo Gu[1], Amir Al-Ghatta[1], James Perry[1], & Jason Hallett[1]
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Corrosion control during acid pickling remains a critical industrial challenge, where highly aggressive environments accelerate steel dissolution and hydrogen evolution. Conventional petrochemical inhibitors, though effective, face environmental restrictions that motivate the transition toward sustainable, bio-derived alternatives.
This study explores the corrosion inhibition performance of binary formulations composed of a furan dicarboxylate (FDCA)-based cationic surfactant and vanillin alcohol ethoxylate (VAE) non-ionic surfactant, both synthesized from renewable feedstocks. Gravimetric analyses in 1 M and 5 M HCl revealed inhibition efficiencies exceeding 94% at optimal concentrations, outperforming/at par with several commercial benchmarks.
The singular surfactant(s) and blended formulations demonstrated superior surface film stability and adsorption behavior, following Langmuir isotherm trends with high adsorption constants indicating chemisorptive film formation. The observed synergy between ionic and non-ionic components enhanced surface coverage, reduced corrosion rates, and improved resistance under severe pickling conditions. These findings highlight the potential of renewable surfactant blends as eco-efficient corrosion inhibitors for sustainable industrial metal treatment processes.

Session type: PS - poster session
Presentation language:
Title: Odporność korozyjna powłok DLC teksturowanych laserowo
Topic: Poster session
Author / Authors: Artur Kalinowski[1], Norbert Radek[1], Martin Vicen[2], Maria Radek[3]
[1]Politechnika Świętokrzyska
[2]Uniwersytet Żyliński
[3]Politechnika Krakowska
Abstract:
W pracy omówiono wpływ teksturowania laserowego powłok DLC naniesionych na podłoże ze stali łożyskowej 100Cr6 i nierdzewnej 4H13 na ich odporność korozyjną. Do badania właściwości antykorozyjnych zastosowano metodę zapisu potencjodynamicznych krzywych polaryzacji elektrodowej w układzie trójelektrodowym z nasyconą kalomelową elektrodą odniesienia SCE i platynową elektrodą pomocniczą Pt w roztworze NaCl 3,5%. W badaniu porównano potencjał korozyjny, gęstość prądu korozyjnego oraz szybkość korozji wybranych materiałów podłoża oraz zmianę tych parametrów poprzez naniesienie na nie powłoki DLC oraz jej mikroobróbkę laserową. Wyniki badań potwierdzają, że powłoki DLC posiadają wysoką odporność korozyjną w odniesieniu do materiału podłoża, natomiast ich teksturowanie laserowe może powodować nieznaczne pogorszenie właściwości antykorozyjnych.

Session type: PS - poster session
Presentation language:
Title: The influence of Si_3N_4 and Al_2O_3 nanoparticle modification on the functional properties of hard anodic oxide coatings
Topic: Poster session
Author / Authors: Anna Kozik[1], Marek Nowak[1], Kamila Limanóka[1], Anna Trelka[2], Anna Góral[2]
[1]Łukasiewicz Research Network Institute of Non-Ferrous Metals
[2]1Institute of Metallurgy and Materials Science, Polish Academy of Sciences
Abstract:
In recent years, the increased use of aluminum and its alloys in various industries has led to a growing interest for hard anodic oxide coatings (TAPT) with low friction coefficient and self-lubricating properties. Due to the characteristic structure of the oxide layer, the surface of TAPT coatings is absorptive. Therefore, its porous structure can be modified by introducing solid particles (e.g. Al_2O_3 or Si_3N_4) or particles that acting as solid lubricants (e.g. PTFE or MoS_2). Depending on the modifier type, the coating's mechanical properties, wear resistance or self-lubricating properties can be improved.

Several methods exist for introducing modifying particles into the porous TAPT structure, generally classified into two groups. The first involves forming a separate layer of particles primarily on the coating surface (for example, by spraying particles onto the anodic oxide coating surface or by ultrasonic impregnation). In the second approach, particles are added to the electrolyte and incorporated into the porous oxide structure. Other techniques also exist, but are more expensive.

This study aimed to produce TAPT with increased microhardness and improved abrasion resistance by incorporating Al_2O_3 or Si_3N_4 nanopowders into its porous structure. This was achieved using two methods: the direct one and the duplex method, in which a TAPT with an appropriate structure is first produced and then subjected to ultrasonic impregnation in a nanoparticle suspension. The influence of the production method and the type of modifying nanoparticles on the properties of the coatings was analyzed. The results showed that coatings modified with Si_3N_4 particles using the impregnation method exhibited higher microhardness and better abrasive wear resistance than conventional TAPT.

Session type: PS - poster session
Presentation language:
Title: The accuracy of coating thickness measurements – can it be reliably determined under the given experimental conditions?
Topic: Poster session
Author / Authors: Kinga Krawczyk[1], Maria Opuchlik[1]
[1]Łukasiewicz Research Network – Institute of Polymer Materials, 55. M. Skłodowska-Curie St., 87-100 Toruń, Poland
Abstract:
The determination of coating thickness is the most common and fundamental test used to evaluate the properties of protective coatings, as this parameter directly determines their corrosion resistance, service durability and aesthetic and functional performance. However, the final assessment of coating thickness depends on the appropriate selection of both the number and distribution of measurement points, since their representativeness determines the reliability of the obtained results.

The aim of this study was to analyze the influence of the distribution of measurement points and the number of measurements on the reliability of coating thickness determination. The investigations were carried out on two samples, for which the coating thickness was measured on a regular 10 x 10 mm grid. Based on the obtained data, 100 measurement series were generated with varying numbers of measurement points per series, arranged either randomly or in an ordered manner. The analysis of the results allowed for the evaluation of the influence of point distribution and number of measurements on the repeatability of the results and the measurement uncertainty.

The obtained findings form the basis for establishing good practices in optimizing the number and distribution of measurement points when assessing the thickness of protective coatings.

Session type: PS - poster session
Presentation language:
Title: Weak cationic polyeletrolyte as an anti-corrosion paint component
Topic: Poster session
Author / Authors: Maria Opuchlik[1], Kinga Krawczyk[1], Anna Mielańczyk[2], Małgorzata Gnus[1], Grażyna Kamińska-Bach[1]
[1]Łukasiewicz Research Network – Institute of Polymer Materials, 55. M. Skłodowska-Curie St., 87-100 Toruń, Poland
[2]Department of Physical Chemistry and Technology of Polymers, Faculty of Chemistry, Silesian University of Technology, 9. M. Strzody St., 44-100 Gliwice, Poland
Abstract:
Corrosion is a common phenomenon influenced by many factors such as precipitation, humidity, environmental pollution, inappropriate pH, the presence of bio-organisms, or contact with soil. Corrosion processes are accompanied by a series of reactions that change the composition and properties of both the metal surface and the local surrounding environment (e.g., oxide formation, diffusion of metal cations into the coating matrix, local changes in pH). An approach to prevent the spread of corrosion on metal surfaces is to suppress the accompanying physicochemical reactions. To prevent corrosion, protective coatings are most often applied to metal surfaces to create a passive barrier between the metal and the aggressive environment.

Multilayer polyelectrolytes are of great interest in the field of corrosion protection. Polyelectrolytes are macromolecules containing a relatively large number of functional groups that are charged or can be charged under appropriate conditions. A multicomponent nanonetwork formed by multilayers of polyelectrolytes using the layer-by-layer (LbL) technique may offer new possibilities for anti-corrosion coatings. The LbL deposition procedure involves the stepwise electrostatic assembly of oppositely charged compounds on the surface of the substrate and enables the creation of a coating with multiple functions. The properties of the coating can be controlled by the number of deposition cycles and the types of polyelectrolytes used.

A methacrylate-based weak cationic polyelectrolyte was used in obtaining an anti-corrosion paint. The star polymer was added to the paint at the manufacturing stage instead of the anti-corrosion pigment, which eliminated the step of gradual electrostatic deposition of charged particles on the substrate surface.

Session type: PS - poster session
Presentation language:
Title: Coumaric acid coatings as a method of protecting Zn against corrosion in NaCl
Topic: Poster session
Author / Authors: Aleksander Kucharek[1], Elżbieta Kuśmierek[1]
[1]Lodz University of Technology, Faculty of Chemistry, Institute of General and Ecological Chemistry
Abstract:
Due to the number of historic heritage artefacts made of brass, it is important to develop an efficient and ecological method of protecting this alloy against corrosion. Zn alongside Cu is a component of brass. Finding a proper method of corrosion inhibition for its' components that does not have an impact on artefacts' appearance is extremely crucial due to their cultural value.
Coumaric acid (CA) is alongside caffeic and ferulic acids one of the derivatives of cinnamic acid. These compounds have proved to be effective corrosion inhibitors for metals (Fe) [1] and alloys (steel) [2]. Little reports however are to be found in literature related to the effect of these inhibitors on Zn.
In this study, the inhibition efficiency of coumaric acid's coatings on Zn has been tested with the application of electrochemical methods like open circuit potential measurement, potentiodynamic polarisation (PDP) or electrochemical impedance spectroscopy (EIS). CA layers were deposited from ethanol solutions of different concentrations. Best results were obtained for 30 layers deposited from 20 mM CA solution. Additionally, the impact of the corrosive medium modification has been investigated. The best results were obtained for the corrosive medium (0,1M NaCl) modified with 1 mM of CA. The EIS measurements confirmed the result obtained from PDP method.
Acknowledgement: This work has been completed while the first author was the Doctoral Candidate in the Interdisciplinary Doctoral School at the Lodz University of Technology, Poland.
References
[1] Roncevic I. S., Vladislavic N., Buzuk M., Buljac M., Podrug M. *Curr. Top. Electrochem.* **2021**, *23*, 11-24
[2] Quites D., Mantione D., Monaci S., Somers A. E., Forsyth M., Paulis M. *AC Appl. Eng. Mater.* **2023**, *1*, 546-555

Session type: OS - oral session
Presentation language:
Title: Assessment of Final Machining Effects on Stress Corrosion Cracking of Austenitic Stainless Steel AISI 316L and AISI 321
Topic: Corrosion problems in practice session
Author / Authors: Marek Kudláč[1], Mária Dománková[1], Katarína Bártová[1], Matúš Gavalec[1], Dávid Slnek[1]
[1]Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Slovakia
Abstract:
It is known that final machining can cause residual stresses in austenitic stainless steels, but it also influences the roughness or hardness of the surface of such a material. It is precisely these parameters that subsequently have a significant impact on the formation and propagation of corrosion cracks created in the process of stress corrosion cracking. This work aims to evaluate and compare the effect of final turning on stress corrosion cracking susceptibility of AISI 316L and AISI 321 austenitic stainless steels. The turning tool was a replaceable sintered carbide cutting plate with a positive cutting geometry characterized by a sharp cutting edge. By combining cutting parameters, cutting speed (100 and 250 m min^{-1}) and tool feed (0.12, 0.2 and 0.3 mm), six samples were prepared for each type of steel. The depth of the cut was constant (0.8 mm). To determine susceptibility to stress corrosion cracking, the ASTM G36 test was used, where samples were exposed in a boiling $MgCl_2$ solution for 96 hours. Subsequently, the samples were taken out, rinsed and observed using SEM. The surface density of cracks and the length and depth of cracks penetrating the steel were observed. In relation to crack density, the results for both steels were very similar. On the other side crack density increased with increasing feed as well as cutting speed.
Acknowledgment: This work was supported by the Slovak Research and Development Agency under the Contract no. APVV-22-0146. This work was supported by the call for doctoral students and young researchers of Slovak University of Technology in Bratislava to start a research career (Grant 23-06-09-A).

Session type: PS - poster session
Presentation language:
Title: Bio-based UV-curable anticorrosive coatings for metal protection
Topic: Poster session
Author / Authors: Ewa Langer[1], Małgorzata Zubielewicz[1], Bartosz Kopyciński[1], Kinga Krawczyk[1], Leszek Komorowski[2], Izabela Kunce[2], Damian Wojda[2], Norbert Pietschmann[3], Marc Entenmann[3]
[1]Łukasiewicz Research Network – Institute of Polymer Materials
[2]Road and Bridge Research Institute
[3]Fraunhofer Institute for Manufacturing Engineering and Automation IPA
Abstract:
The advantages of UV curing technology (low energy consumption, no volatile organic compounds, high production speed, etc.) are already widely known in the furniture, graphics, and polymer processing industries. The presented solution allows for the extension of this particularly cost-effective and environmentally friendly technology to metal substrates. Well-crosslinked, tight coatings provide good corrosion protection, but they do not show adequate adhesion to metal substrates due to shrinkage during coating formation due to free-radical polymerization, which can range from 5% to 25%. Therefore, it is necessary to use acidic adhesion promoters – usually compounds esterified with acrylic acid and phosphoric acid – which are potential corrosion stimulants and, moreover, they interact in an undesirable way with the usual (mostly basic) corrosion inhibitors and render them ineffective. For the same reason, acidic adhesion promotors cannot be used in anticorrosive primers, as they would react with the amine hardeners. As the result of research carried out within the CORNET/36/67/2024 project, acronym BiBACoM, special adhesion promoters were developed based on bio-based raw materials – phytic acid and glycidyl methacrylate. The synthesized adhesion promoters were used in a range of UV-cured coatings – based on a mixture of highly reactive epoxyacrylate in a solution of dipropylene glycol diacrylate and a low-viscosity amine-modified polyetheracrylate oligomer – achieving very good adhesion to steel surfaces.

Session type: PS - poster session
Presentation language:
Title: Silver-free epoxy powder coatings with antimicrobial properties
Topic: Poster session
Author / Authors: Ewa Langer[1], Michał Jaczewski[2], Urszula Paszek[2], Sławomir Piłat[2], Leszek Komorowski[3], Agnieszka Królikowska[3], Izabela Kunce[3], Damian Wojda[3], Katarzyna Zacharuk[3], Małgorzata Zubielewicz[1], Sebastian Jurczyk[1], Grażyna Kamińska-Bach[1], Bartosz Kopyciński[1], Barbara Pilch-Pitera[4], Michał Kędzierski[5], Marta Przybysz-Romatowska[5], Irena Grzywa-Niklińska[5], Katarzyna Krawczyk[6], Michael Hilt[7]
[1]Łukasiewicz Research Network – Institute of Polymer Materials
[2]Polish Corrosion Society
[3]Road and Bridge Research Institute
[4]Rzeszow University of Technology
[5]Łukasiewicz Research Network - Institute of Industrial Chemistry
[6]Fraunhofer Institute for Manufacturing Engineering and Automation IPA
[7]Forschungsgesellschaft für Pigmente und Lacke e.V.
Abstract:
Silver is most often used in paint coatings with antimicrobial properties, including in the form of nanoparticles. Despite its high antimicrobial activity, the use of silver in paint products is not an optimal solution, among others due to the high cost of the precious metal and its limited resources, immunotoxic potential and bioaccumulation. The obtained powder paints contain natural and synthetic substances with biocidal properties, including chitosan derivatives, amino acids and peptides, which are additionally immobilized on layered carriers such as montmorillonite and hydrotalcite. Intercalation of the biocide contributes to the increase of its antimicrobial activity, and improvement of thermal stability, and facilitates the dispersion of the biocide in the powder paint. Controlled release of the biocide from the carrier extends the duration of antimicrobial action. The coatings are assessed for their biocidal activity, structure, degree of biocidal dispersion, mechanical and resistance properties, including resistance to UV radiation and water absorption. The test results will allow for the selection of a promising concept for obtaining powder paints cured at lower than conventional temperatures, characterized by good biocidal and protective properties, which can be an ecological alternative to solvent-based antimicrobial paints containing silver.

Session type: PS - poster session
Presentation language:
Title: Waterborne camouflage paints for coating plastic surfaces
Topic: Poster session
Author / Authors: Bartosz Kopyciński[1], Ewa Langer[1], Małgorzata Zubielewicz[1], Mariola Bodzek-Kochel[1], Andrzej Hudecki[2]
[1]Łukasiewicz Research Network - Institute of Polymer Materials
[2]Łukasiewicz Research Network - Institute of Non-Ferrous Metals
Abstract:
Camouflage painting, using paints with appropriate spectral characteristics, ensures the appropriate level of camouflage for equipment and instruments used by the armed forces. Eco-friendly, waterbased paints based on aliphatic polyurethane dispersion were developed in the colors green, brown, and black. Coatings obtained from these paints were tested for adhesion and flexibility, which were crucial due to their application on a flexible substrate, thermoplastic polyurethane.
The appropriate pigmentation of the developed paints allowed for achieving color and re-emission coefficients consistent with the requirements for camouflage coatings. The developed products were used to paint protective masks made using 3D SLS printing technology from thermoplastic polyurethane. The coatings demonstrated excellent adhesion, flexibility, and resistance to repeated flexing.

Session type: PS - poster session
Presentation language:
Title: Evaluation of Microbiologically Influenced Corrosion on 316L Stainless Steel under Aerobic and Anaerobic Conditions
Topic: Poster session
Author / Authors: Aleksander Lesar[1], Alen Radolič[2], Mojca Blaznik[2], David Stopar[2], Barbara Šetina Batič[1], Matej Hočevar[1]
[1]Institute of Metals and Technology
[2]Biotechnical faculty Ljubljana
Abstract:
Microbiologically Influenced Corrosion (MIC) refers to the deterioration of metals and other materials caused by microbial metabolic processes. Microorganisms such as bacteria, fungi, and algae adhere to surfaces, form biofilms, and generate corrosive by-products—including acids, sulfides and ammonia—that accelerate material degradation [1].
For experiments involving aerobic microorganisms, 316L stainless steel specimens were mechanically polished to a surface finish of 1 μm and subsequently placed in Petri dishes containing nutrient-rich media inoculated with *Pseudomonas fluorescens.* The samples were incubated at 37 °C for periods of one, three and six months, with the culture media refreshed weekly. For experiments involving anaerobic microorganisms, 316L stainless steel specimens were placed in Hungate tubes containing Postgate C medium or artificial seawater (ASW), inoculated with *Desulfuvibrio desulfuricans*. The samples were incubated at 30 °C for 14 days or one month, with the culture refreshed weekly. Following aerobic and anaerobic incubations, the specimens were examined using Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-ray Spectroscopy (EDS).
In aerobic experiments, no visible signs of corrosion were observed after one or three months of exposure, confirming the high resistance of 316L stainless steel to microbiologically influenced corrosion (MIC). After six months, corrosion products were detected on the metal surface; however, no evidence of pitting corrosion was observed. Under anaerobic conditions, surface deposits containing sulfur were detected, and bacterial cells were observed within a thin biofilm layer. Nonetheless, no pitting corrosion was identified.

Session type: OS - oral session
Presentation language:
Title: Engineered Protection: Coating Advancements to Address Corrosion Under Insulation
Topic: Oil & Gas session
Author / Authors: Chris Magel[1]
[1]PPG
Abstract:
Corrosion Under Insulation (CUI) represents the most critical issue facing plant operators, contributing to an estimated .2 trillion in global corrosion costs and accounting for 40–60% of pipe maintenance expenses. This damage is extremely difficult to mitigate because CUI risk is extreme under cyclic temperatures between -20°C and 320°C due to trapped moisture, oxygen, and soluble salts. Effective mitigation depends on the selection of specialized coating technologies, such as those meeting the rigorous testing requirements of ISO 19277-2018, with the final choice always determined by the asset's specific operating temperature.

Expect to walk away from this presentation with a better understanding of:
- CUI Impact and Risks: Corrosion Under Insulation is extremely difficult to mitigate, accounts for **40–60% of pipe maintenance costs**, and is a most critical issue for plant operators.

- Standards Governing Coatings: Key criteria for coatings serving in insulated conditions are defined by standards like **ISO 19277-2018**, which specifies various tests including neutral salt spray and thermal cycling.

- Temperature Dictates Technology: The specific **operating temperature** of the insulated asset is the determining factor when selecting the appropriate coating technology required for the job and potential solutions from PPG.

Session type: PS - poster session
Presentation language:
Title: Corrosion and Degradation of Metallic Components in Molten Carbonate Fuel Cells and Electrolyzers
Topic: Poster session
Author / Authors: Karolina Majewska[1], Pavel Shuhayeu[1], Olaf Dybiński[1], Aliaksandr Martsinchyk[1], Monika Łazor[2], Katsiaryna Martsinchyk[1], Arkadiusz Szczęśniak[1], Jarosław Milewski[1]
[1]Warsaw University of Technology
[2]Institute of Power Engineering - National Research Institute
Abstract:
Molten Carbonate Fuel Cells (MCFCs) and Molten Carbonate Electrolyzers (MCEs) represent promising high-temperature electrochemical systems for CO_2 separation, hydrogen production, and synthetic fuel generation.

However, the commercialization of these technologies is limited by the corrosion and degradation of metallic components, such as current collectors, bipolar plates, and interconnects, when exposed to molten carbonate electrolytes at 600–700 °C. These harsh environments accelerate oxidation, carburization, chromium migration, and electrolyte contamination, leading to increased internal resistance, mechanical instability, and reduced durability.

Recent work has provided a comprehensive review of degradation mechanisms in MCFC and MCE systems, identifying key corrosion pathways and their impact on long-term performance. Protective strategies—including alloy optimization, surface engineering, and application of ceramic, metallic, and multilayer coatings—have been critically evaluated in terms of electrochemical stability, scalability, and cost. Current results indicate that no universal solution exists; instead, zone-specific and multifunctional protection methods are required.

The key studies involve accelerated lifetime tests of single MCE cells with reduced active area, diagnostic analysis of corrosion products, and evaluation of system stability under both fuel cell and electrolysis modes. The ultimate aim is to define effective mitigation pathways that extend cell lifetimes toward industrial requirements while maintaining high efficiency in synthetic fuel generation.

Session type: OS - oral session
Presentation language:
Title: Optimizing Coating Integrity Through Adhesive Bonding – A Viable Alternative to Welding in Corrosive Environments
Topic: Anti-corrosion protection session – infrastructure & offshore structures
Author / Authors: Tom Marquardt[1], Linda Fröck[2]
[1]Muehlhan Holding GmbH
[2]Fraunhofer IGP
Abstract:
Welding remains the predominant method for mounting brackets onto coated steel structures, but it poses significant challenges to coating integrity. The high heat input often compromises both the substrate and its protective coating, causing localized damage or delamination and necessitating extensive coating removal around the weld zone. This not only increases corrosion risks but also requires substantial surface preparation and post-processing, making the process labor- and time-intensive.
Within a nationally funded German research project, an adhesive-based method for bracket fixation in maritime and offshore environments was developed and tested in both laboratory and field applications. This approach minimizes pre- and posttreatment by bonding brackets directly onto coated metal surfaces. In existing structures—such as a bridge, a lock gate, and an offshore transformer platform—the coating condition ranges from intact to severely deteriorated.
A potentially non-destructive adhesion test was devised to determine whether an existing coating can safely sustain bonding loads. When coatings are too compromised, a controlled, localized removal is performed before bracket application. Mechanical tests (tensile, shear, and mixed loading) on aged (temperature cycling, humidity, chloride exposure) and unaged samples of high-strength, low-alloy steel substrates confirmed the process's durability and reliability.
This presentation summarizes the experiences gained during process development and implementation, emphasizing how adhesive bonding preserves protective coatings and reduces corrosion risks. Overall, the results reveal reduced installation times, lower costs, and robust long-term performance compared to traditional welded solutions.

Session type: OS - oral session
Presentation language:
Title: Porównanie odporności korozyjnej lakierniczych systemów powłokowych do zastosowań w technice wojskowej
Topic: Military appliences session
Author / Authors: Marek Michalski[1], Norbert Radek[2]
[1]Barwa Kielce
[2]Politechnika Świętokrzyska
Abstract:
W pracy przedstawiono analizę funkcjonalnych właściwości eksploatacyjnych powłok wielowarstwowych do zastosowań w technice wojskowej w zakresie maskowania. Opracowane systemy powłokowe cechują się eksploatacyjną innowacyjnością ze względu na niewielkie grubości w porównaniu do obecnie stosowanych przez światowe koncerny zbrojeniowe przy zachowaniu współczynnika reemisji wymaganego dla skutecznego maskowania w zakresie optycznym. Ocenę właściwości przeprowadzono na podstawie przyspieszonych badań starzeniowych w komorze solnej, w komorze wilgotnościowej, w komorze z cyklicznie zmieniającymi się warunkami korozyjnymi oraz w badaniach odporności korozyjnej metodą potencjodynamiczną. Badania przeprowadzono dla maskujących systemów powłokowych dwuwarstwowych wykonanych w trzech wariantach: system powłokowy (SP1), system powłokowy modyfikowany nanorurkami węglowymi (SP2), system powłokowy modyfikowany mikrosferami szklanymi (SP3). Analiza uzyskanych wyników wykazała, że w/w systemy powłokowe charakteryzowały się zbliżoną odpornością korozyjną. System SP3 charakteryzował się najmniejszym odwarstwieniem i skorodowaniem wokół rysy oraz najmniejszą wielkością pęcherzy w badaniach korozyjnych. Ze względu na swoje właściwości użytkowe, opracowane systemy powłokowe mogą być stosowane na uzbrojeniu i sprzęcie wojskowym.

Session type: PS - poster session
Presentation language:
Title: Enhancing the corrosion resistance of organic polymers using nitrogen doped carbon dots from agricultural waste
Topic: Poster session
Author / Authors: Zahradeen Muhammad[1], Tawfik Saleh[1]
[1]King Fahd University of petroleum and minerals
Abstract:
To combat steel corrosion, a green and effective corrosion inhibitor, PAA/N-CQDs was synthesized via poly succinimide (PSI) ring opening reaction with a nitrogen-doped carbon quantum dot (N-CQDs) synthesized via one-step hydrothermal process from waste banana peels and ethelynediamine . Several analyses such UV-Vis, PL emission, XRD, TEM and TGA studies were applied for the evaluation of the chemical composition and surface characteristics of the synthesized N-CQDs, while FTIR and ^{1}H NMR were employed to characterize the poly-aspartic acid and the modified polymer. Electrochemical and traditional weight loss methods were employed to determine the inhibition efficacy of the inhibitor on C1018 steel in a 1M hydrochloric acid 3.5% sodium chloride corrosive medium. All analyses confirm the inhibitor's effective protective behavior. The findings indicated that the highest inhibitory efficacy of 94.4% was attained at 30 ppm. Furthermore, the inhibition mechanism was examined using the isothermal adsorption model, which revealed the inhibitor obeyed Langmuir isotherm with a physicochemical adsorption taking place. SEM confirmed the protective layer creation on the metal surface.

Session type: OS - oral session
Presentation language:
Title: Digital Radiography applied for corrosion on insulated pipes – practical approach
Topic: Corrosion problems in practice session
Author / Authors: Lauri Westling[1], Robert Wiśniewski[2]
[1]PexRayTech Oy, Finland
[2]Endo-Tech S.J.
Abstract:
Corrosion Under Insulation (CUI) is a persistent challenge in industrial maintenance, and Digital Radiography (DR) offers a fast and non-destructive solution for corrosion mapping. However, successful application requires careful control of technique parameters. This presentation explores the practical use of tangential and double-wall methods in compliance with ISO 20769-1 and 20769-2, focusing on radiation source selection, filtering, masking, geometry setup, and image quality optimization. Special emphasis is placed on wall thickness measurement using digital images, common exposure errors such as oversaturation and scatter, and strategies to avoid them. The lecture highlights practical field experiences and best practices, illustrating how DR can complement ultrasonic techniques by enabling effective corrosion localization before detailed thickness mapping. The goal is to provide a technical yet practical overview to help ensure reliable corrosion evaluation in insulated piping systems.

Session type: OS - oral session
Presentation language:
Title: Zinc Flakes – Versatile Solution for Galvanically Active Corrosion Protective Primers
Topic: Coatings session
Author / Authors: Peter Wissling[1]
[1]Eckart GmbH
Abstract:
When galvanically active corrosion protection is formulated, this has so far been done with zinc dust. In order to generate point to point contact, the spherical zinc dust particles must be added > 80 % into the binder system.
Zinc flake pigments are comprised out of the same metal composition as zinc dust, however have a flake shaped morphology. This flake form has a much greater surface and subsequently allows much lower loading of the flake pigment into binders. Typically loadings can be approx. 25 % by weight / 15 % Pigment Volume Concentration PVC.
This allows much more versatile formulation concepts; meaning, special parameters can be adjusted. Also, primers could e.g. be tinted, if required.
Since zinc flake primers are less brittle compared to traditional zinc rich primers, film flexibility is greater, allowing omission of an intermediate coat in a traditional three layer heavy duty protective coating.
On top, zinc flakes generate an additional barrier layer on top of galvanic principle, which further improves the corrosion protection mechanism.
Reference is made to ISO 12944 and also field exposure references are presented.

Session type: OS - oral session
Presentation language:
Title: Durability of Railway and Road Bridges from a Corrosion Perspective
Topic: Plenary lecture
Author / Authors: Adam Wysokowski[1]
[1]University of Zielona Góra, Head of Polish Society of Bridge Engineers
Abstract:
As part of the modernization of Poland's national transportation infrastructure, numerous spectacular steel bridge structures—both railway and road—are being renovated and rebuilt. These include record-breaking structures in terms of span length and overall dimensions, as well as historic bridges of great cultural significance.
An effective strategy for preventing corrosion in both railway and road infrastructure requires a thorough understanding of corrosion processes in the context of the specific operational conditions of bridges. While road bridges primarily rely on deck tightness to enhance corrosion resistance, railway bridges are exposed to different environmental influences. Therefore, a proper analysis of these factors plays a crucial role in ensuring the long-term durability of both railway and road structures and allows for the elimination of inappropriate material and structural solutions.
This approach aligns with the principles of sustainable development and offers significant ecological benefits. The presentation focuses on the challenges related to corrosion in railway and road infrastructure and explores methods for diagnosing, preventing, and repairing corrosion-induced damage in the context of the operational durability of engineering structures.

Session type: PS - poster session
Presentation language:
Title: Introduction to One Garnet Blast Abrasive
Topic: Surface preparation session, Anti-corrosion protection session in urban, road and railway infrastructure, Anti-corrosion protection session in the energy sector, Anti-corrosion protection session in the petrochemical industry, Anti-corrosion protection session for offshore structures, Anti-corrosion protection session in the automotive industry
Author / Authors: Nan Yang, Lily You
Abstract:
Garnet is a type of ruby, named as its crystals resemble pomegranate seeds. It has the characteristics of high hardness, good toughness, moderate specific gravity (4.0g/cm3), and acid & alkali resistance. It is the only abrasive available for ultra-high-pressure waterjet cutting machines and is also a high productivity blast abrasive.

One Garnet Group specializes in mining, processing and sales of garnet. It is currently the world's largest garnet factory with a production capacity of 1 million tons annually. One Garnet's entire production is fully automated, and quality is first-class.

The annual economic losses caused by material corrosion account for about 5~8% of GDP. Coating protection is to protect metal surfaces and isolate metal from corrosive media. Before painting, object surface needs abrasive blasting. It is recognized that 70% of the service life of coating depends on the quality of surface preparation, 30% depends on quality of paint.

One Garnet has high hardness (Knoop Hardness 1900~2360) and excellent toughness. It has been carefully crushed five times during the processing process to form rich cutting sharp edges, which can easily achieve the highest blasting grade Sa3. The surface area of blasting utensil is larger, and it is more suitable for blasting. The coating has stronger anchoring force, faster blasting and less material consumption. One Garnet is no free silica and heavy metals and implements strict production quality. It has extremely low salt content and conductivity, minimal blasting dust, good working environment, healthy and environmentally friendly. One Garnet is an upgraded product of traditional blast abrasives such as quartz sand, copper slag, staurolite, glass beads, steel grit and steel shot, and stainless-steel shot and etc.

Session type: OS - oral session
Presentation language:
Title: Controlling Corrosion from the Interface: Surface Preparation, Abrasive Choice, and Coating Reliability
Topic: Surface preparation session
Author / Authors: Alvin Yang[1]
[1]OneGarnet Group
Abstract:
Coating failures often begin not at the surface, but beneath the film, at the steel–coating interface. This presentation highlights the importance of surface preparation in preventing underfilm corrosion and improving long-term coating performance.

When water, oxygen, and salts reach the steel surface, they trigger localized corrosion reactions that remain hidden until blistering or delamination occurs. Residual chlorides or sulfates can accelerate this process, making coating adhesion unreliable regardless of paint quality or thickness.

To prevent this, four surface parameters must be controlled before coating begins: surface cleanliness, dust, roughness, and salt contamination. These are not visual standards, but measurable engineering conditions.

Abrasive blasting is the most practical way to prepare the interface, but abrasive choice has a direct impact on results. This talk compares several abrasives including slag, steel grit, and garnet. Garnet performs well in achieving high cleanliness levels, minimal dust, consistent anchor profile, and low salt residue, while also meeting environmental and safety requirements.

Surface preparation should be understood not as a procedure, but as a design decision. By managing interface quality through proper abrasive selection, engineers can improve coating reliability and extend asset lifespan.

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Session type: OS - oral session
Presentation language:
Title: Creep-Induced Fish-Mouth Rupture in T91 Superheater Tubes: Microstructural Degradation in HRSG Service
Topic: Corrosion problems in practice session
Author / Authors: Atef Zekri[1], Brahim Aissa[1]
[1]Material group, Qatar Energy and Environment Research Institute, Hamad Bin Khalifa University, Qatar Foundation, 34110 Doha, Qatar
Abstract:
This study investigates the high-temperature failure of a T91 steel superheater tube from a Heat Recovery Steam Generator (HRSG) after extended service. The tube suffered a fish-mouth rupture due to creep deformation caused by localized overheating. Microstructural characterization using metallography, microscopy, Phase analysis, and hardness testing revealed creep cavitation, carbide spheroidization, and a thick internal oxide scale. The oxide layer increased thermal resistance, creating local temperature gradients that raised hoop stress and accelerated creep damage. The results demonstrate the combined role of oxidation and creep in premature T91 failure and offer guidance for improving the reliability and life prediction of HRSG components.