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*Publication date:*  
2024

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

*Citation (APA):*

Belesakos, C., Bi, H., & Dam-Johansen, K. (2024). *Environmental factors impact investigation on corrosion protection of steel monopiles by organic coatings under cathodic protection*. Abstract from EUROCORR 2024: European Corrosion Congress, Paris, France.

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# Environmental factors impact investigation on corrosion protection of steel monopiles by organic coatings under cathodic protection

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## **Abstract**

Offshore wind power is under strategic growth, with fast expanding larger wind turbine deployments, in shallow to deep waters, due to better wind conditions and environmental concerns. Steel monopiles, the primary choice for fixed bottom foundations, face severe corrosion issues, due to the harsh corrosive offshore conditions, demanding effective corrosion mitigation strategies. Understanding the complex interplay between cathodic protection and coatings performance, will facilitate the optimization of corrosion mitigation strategies for offshore monopiles, ensuring their structural integrity and enhanced service life.

This work focuses on the systematic investigation of the environmental factors affecting Impressed Current Cathodic Protection (ICCP) effectiveness, the coatings performance and degradation, as well as the understanding of the interactions between the ICCP and the coating system, for enhanced corrosion mitigation of steel monopiles. A lab pilot scale experimental setup is utilized, simulating real field conditions of a conventional monopile, for a more comprehensive perception of the interactions between ICCP potential levels and coating systems, allowing for an optimized corrosion mitigation strategy for steel monopiles.

Potentiostatic measurements were performed to control and assess the ICCP parameters and monitor the cathodic protection behavior. The corrosion rate, the coatings protective properties and the ICCP efficiency were evaluated with Electrochemical Impedance Spectroscopy (EIS) and Linear Polarization Resistance (LPR). The coatings surface morphology and degradation extent were characterized by Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDX). The chemical changes in coatings were identified with Fourier-Transform Infrared Spectroscopy (FT-IR). Continuous environmental conditions monitoring was implemented for understanding ICCP and coating system's performance, thereby providing guidance for refining monopile corrosion protection strategies.