

Study on residual mechanical properties of EAF marine steel under corrosion for circular economy in offshore structures

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ABSTRACT

Driven by the global need to achieve net-zero by 2050 and by facilitating circular economy approaches, steelmaking has recently shifted towards using scrap-based electric arc furnace (EAF) utilising scrap materials instead of iron ore. This process produces steel with CO₂ emissions reduced by 80 - 90% compared to the conventional basic oxygen furnace (BOF) process (Kieush et al. , 2023). However, the mechanical properties of those two are different in strength and ductility (Shima and Nakagomi , 2005), with EAF-manufactured steel alloys consisting of higher nitrogen, carbon, and copper content. Although DH36 steel has already demonstrated good mechanical performance under lower temperatures (Zhao et al. , 2022), the material content of recycled alloys has raised concerns with regards to their use for offshore applications. This paper presents an experimental investigation on the residual mechanical properties of DH36 marine steel grade. The tested specimens were manufactured from both EAF and BOF routes, obtained from suppliers included in the Lloyd's Register. Four different corrosion levels were applied to the specimens, ranging from 5% to 20%, with their results compared against the virgin material properties. The influence of manufacturing methods and corrosion levels on the residual mechanical properties

were evaluated. Although the yield stress and ultimate strength of EAF marine steel were reduced with the loss of material due to corrosion, BOF specimens observed even higher mechanical properties' degradation. Overall, EAF steel demonstrates comparable or superior performance to BOF steel under corrosion, suggesting its potential to be used in offshore structures.

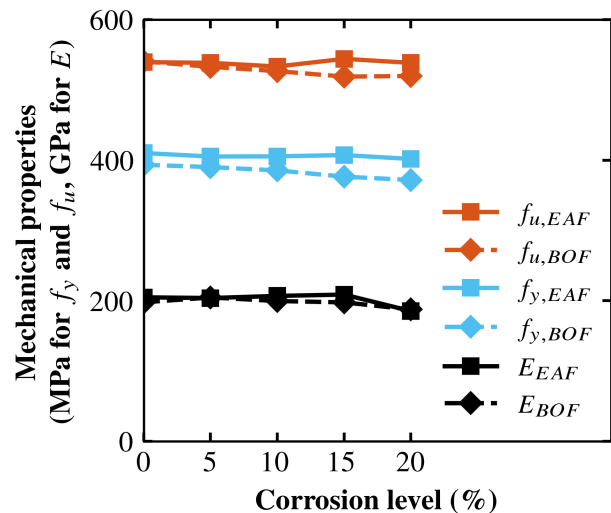


Figure 1: Mechanical properties for DH36 steel through EAF and BOF routes

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