Abstract

In the face of challenges related to climate change, the limited availability of fossil fuels, and the dynamic development of energy production based on alternative fuels, it has become essential to adapt the existing power infrastructure to new operating conditions. Power plants originally designed for the combustion of conventional fuels are not fully suited to the environments generated during the combustion of biomass and waste, leading to significant corrosion-related issues. This dissertation analyzes the influence of the chemical composition of alternative fuels and combustion temperature on corrosion processes. The investigations were carried out at three different temperatures - 480 °C, 520 °C, and 580 °C - using samples made from three steel grades commonly used in the power industry (P235GH, 16Mo3 and 13CrMo4-5), both in the uncoated condition and coated with two protective layers: Inconel625 and Alloy310. The samples were exposed to corrosive environments during the combustion of three types of alternative fuels (P1, P2, P3), including biomass-based fuels and a waste-derived fuel.

The results clearly show that the intensity of corrosion phenomena increases with rising operating temperature. Among the analyzed fuels, the most severe corrosive impact was observed for P2 - the fuel-derived fuel - indicating its particularly aggressive nature under high-temperature conditions. Applying protective overlay coatings significantly reduced corrosion progression, improving the resistance of all tested steel grades. Inconel625 provided slightly better protection against degradation; however, Alloy310, although marginally less effective, exhibited very good protective properties. Given its considerably lower cost, Alloy310 may be considered a valuable alternative to Inconel625 for high-temperature corrosion protection.

The findings of this study make a meaningful contribution to the understanding of material behavior in environments resulting from the combustion of alternative fuels and may support the development of more efficient and cost-effective designs for next-generation power installations.