Mechanism of coupling corrosion caused by flue gas and deposits in municipal solid waste incinerator: Resistance of HVOF-NiCr coating

Xiuju Zhang[1], Huan Liu[2], Hong Yao[2]

[1] *School of Mechanical and Power Engineering, Nanjing Tech University, Nanjing, 211816, China*

[2] *State Key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology, Wuhan, 430074, China*

Presenter's e-mail address: zhangxiuju@njtech.edu.cn

Abstract Municipal solid waste (MSW) incineration technology have developed rapidly for the achievement of waste disposal and energy conversion. However, the contents of alkali salts especially chlorides are much higher than traditional solid fuels such as coal and biomass, resulting in severe high-temperature corrosion[1]. High-velocity oxy-fuel spray (HVOF) coating is a promising method, while the complex corrosion process involving flue gas and deposits was still unclear[2]. In this study, the in-service performance and coupling corrosion mechanism was investigated. After the 2700 hours of in-situ experiments in a 400 t/d MSW incinerator, thickness loss of bare high temperature superheater was 1.9 times that of bare low temperature superheater. For coated superheater by HVOF-NiCr coating, the layered Cr, Mo and Ni oxides was successively formed during the corrosion process, contributing to an 80% reduction in the thinning rate. In order to further investigate the corrosion mechanism induced by deposits and flue gas, the decoupling analysis of corrosion kinetics and in-stage characterization was conducted based on the lab-scale experiments. Results showed that a two-stage linear fitting was appropriate, theoretically confirming that the coupling corrosion reaction is dominated by deposits. HCl and SO_2 can significantly accelerate the deposits-induced corrosion by about 10 times, through promoting the inward penetration of chlorine and oxidation. The resistance of HVOF-NiCr coating against corrosion can be divided into two stages. In the first 10 hours, the growth of spherical nickel oxide with continuous oxygen intake resulted in a quick mass gain rate of 1.18 $mg \cdot cm^{-2} \cdot h^{-1}$. Subsequently, the corrosion rate significantly decreased to 0.086 $mg \cdot cm^{-2} \cdot h^{-1}$ due to the formed oxide layer. This study provided a new insight into the coupling corrosion caused by flue gas and deposits through kinetic analysis, and the resistance of HVOF-NiCr coating was clarified through the staged characterization.

Keywords MSW incineration; High-temperature corrosion; Flue gas; Deposits; Coating

Reference

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