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Alleviation of thermal corrosion caused by molten ash on heat-exchange tubes in MSW incinerators: Effects of Ni-, Co-, Fe-based HVOF coatings

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Abstract

Thermal corrosion on heat-exchange tubes had an adverse effect on the economical and safe operation of municipal solid waste (MSW) incinerators. In order to alleviate the corrosion caused by molten ash, high velocity oxygen fuel (HVOF) thermal spraying technology was considered for its ability of enhancing corrosion resistance. In this study, 10 typical Ni-, Co-, Fe-based coatings were employed to find the relationship between material composition and high temperature corrosion resistance. The MSW incineration ash adhesion tests at 873 K were performed to specially simulate the corrosion caused by molten ash on tubes. Besides, mass gain measurements under the exposure of Na/K chlorides and sulfates were also performed to assess the failure of tubes. From experimental results, the strong positive correlation between MSW incineration ash adhesion force and mass gain rate proved the feasibility of using the former as an in-furnace corrosion indicator. Fe-based coatings with Fe accounting for up to 80 wt.%, rather than common coatings with Fe content of ca.50 wt.%, had better performance against thermal corrosion. For Ni/Co-based coatings, the optimal content of ternary components, including body metal (Ni/Co), eutectic metal (Cr) and the other strengthening elements (Mo+*W*+Si+*B*, et al.), seemed to be 60–20–20 wt.%. The mutual allocation of three kinds of elements, rather than the content of one specific element, affected its MSW incineration ash adhesion tendency. The microstructure characterization indicated the prevented permeation of corrosive species containing Na, K, S, Cl by the presence of strengthening elements such as Mo. Further comparison of NiCr

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