Final Report

Project acronym: *NICRRE*

Project number*: M-ERA.NET2/2016/01/2017*

M-ERA.NET Call 2016

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Publishable project summary

In power generation plants, especially those co-fired with biomass, the operating temperature is often limited in order to reduce severe chlorine- or sulfur-induced corrosion, solid particle erosion and slagging, as these factors may cause unexpected plants shutdowns and high maintenance costs. Weld overlays are used to prevent corrosion of the boilers steel tubes but this can be a costly solution. One of the best possibilities to solve this problem is using specially developed innovative coatings, which also improve boilers performance extending their lifetime in highly corrosive combustion environments.

Therefore the main goal of the NICRRE project was to develop new coatings for combustion boilers in power generation plants and to identify suitable and cost effective techniques of their deposition. Two innovative material solutions were proposed and investigated: NiCrRe and NiCrRe/Al_2O_3 (both in different compositions), coatings have beeen deposited by three different techniques – air plasma spraying, high velocity oxygen fuel spraying, and direct laser deposition.
The project covered coatings development, characterization of microstructure and properties, fabrication and testing of demonstrators in conditions close to the real application environment. In parallel, the modelling works were carried out to support the experimental tasks.
Finally, after all structural investigations (LM, SEM/EDS, XRD, TEM), properties measurements (mechanical strength, hardness, thermal conductivity, wear resistance at room and high temperature, resistance to oxidation, thermal residual stresses, resistance to cyclic temperature changes, creep and corrosion resistance) and the demonstrators tests in near service conditions, the coatings composition of NiCrRe1vol.% and HVOF as the deposition technique - proved to be the best solution. The optimum spraying conditions of the HVOF process were as follows: spray distance of 380 mm, oxygen flow rate of 956 l/min, kerosene flow rate of 22 ml/min, and a carrier gas (N2) flow rate of 15 l/min. Estimated powder feed rate was 74.0 g/min and the combustion pressure 12.5 bar. During the deposition linear torch velocity was 220mm/s.
As a result of the works carried out in the project, the assumed level of technological readiness at the project end TRL 7 was met.
The most important innovation originating from this project is a new coating technology of about 0.5 mm thickness, which satisfies the requirements made in the project proposal regarding the coating thickness, adhesion to the steel substrate, and resistance to high temperature corrosion. The results of the NICRRE project will have a positive effect on the extension of boiler's inter-haul intervals, cost reduction of regular inspections, increase of electric energy and heat production.