SELECTION OF COMPATIBLE MATERIAL FOR SUPERCRITICAL POWER PLANTS

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Abstract

The article summarizes the results obtained within a project PRAMEK. The project is focused on corrosion behavior of structural materials for fossil – power – plant – steam - generator systems in water environment with supercritical parameters. Three types of steels were evaluated: ferritic - martensitic steels P91, P92 and VM12SHC; austenitic stainless steels 17 341, Super 304H and HR3C; and bainitic – martensitic steel T24. Materials were exposed in water environment under supercritical parameters (600°C, 25 MPa) for 1000 hours. For basic comparisons were steels tested in demineralized water without further chemical modifications. Then, selected steels were tested in alkaline demineralized water in oxygen and oxygen-free regime. The effect of the start-ups and shutdowns of the power plant is also studied. Furthermore, the effect of the chemical composition of the working fluid on steel resistance and service life was tested. Steel resistance is given mainly by the quality of the oxide layers which are formed on the surface in contact with the supercritical water environment. High quality oxide layer serves as a barrier against further oxidation of the steel. Evaluation of oxide layers and steel structural stability was performed by light and scanning electron microscopy equipped with wave and energy spectroscopy.

Multi – layered oxide was formed on ferritic-martensitic and bainitic – martensitic materials sample surface. Double layered oxide was formed on austenitic steels Super 304H and 17 341. Very thin oxide layer was created on HR3C surface, which means that steel exhibit very good corrosion resistance under the SCW conditions.

Keywords: Supercritical water, ferritic - martensitic steel, austenitic stainless steel, bainitic – martensitic steel, corrosion behavior under SCW

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