High-temperature corrosion of superheater tubes in oil shale boilers

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Abstract

The oil shale is the most important local fuel in Estonia. About 95% of electricity consumed in Estonia is produced at two power plants (Balti and Eesti) utilizing oil shale. Estonian oil shale is one of the most complicated fossil fuels that causes an intensive fouling and corrosion of heating surfaces tubes. In order to investigate the phenomena of high-temperature corrosion of the boiler steels in the oil shale boilers the number of laboratory and industrial corrosion experiments has been conducted in Thermal Engineering Department (TED) of Tallinn University of Technology (TUT).

The main mechanisms of corrosion and corrosion rate of steel 12Ch1MF most commonly used in superheaters and reheaters and some Russian martensitic and austenitic steels has been investigated in the last four decades. Recently some steels grades manufactured according to EN were examined as well. The experiments have shown that presence of chlorine in oil shale ash deposits drastically intensify high-temperature corrosion. The empirical kinetic equations for calculation of corrosion depth depending on operation time and temperature have been established, Fig. 1. Among other results, the dependence of corrosion resistance of the pearlitic steels on chlorine content and austenitic steels on alloying elements contents ratio Ni/Cr has been revealed and analyzed (see Fig. 2, 3). At present time the industrial corrosion tests are being conducted in the oil shale circulated fluidized bed boilers, which were erected in 2004.

In order to avoid unscheduled outages of boilers and to reduce the amount and cost of the repair of the heating surfaces due to corrosion the method of assessment of remaining life of the superheater tubes has been developed, Fig. 4.

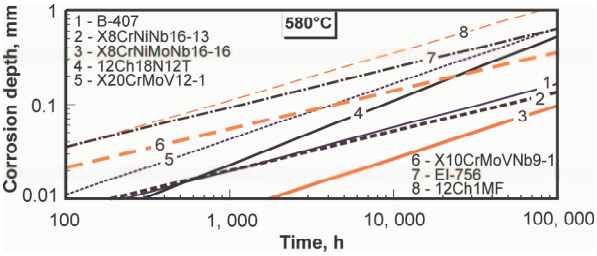

Figure 1. Corrosion of boiler steels in the presence of oil shale ash

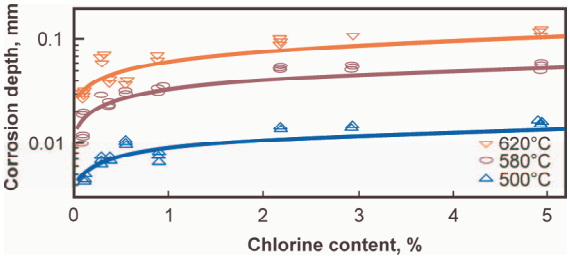

Figure 2. Corrosion depth of the steel 12Ch1MF as a function of the chlorine content in the ash deposits

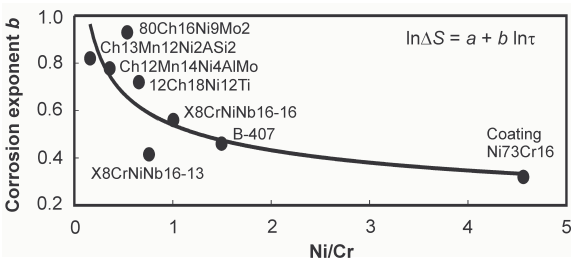

Figure 3. Austenitic steels corrosion intensity in presence of chlorine

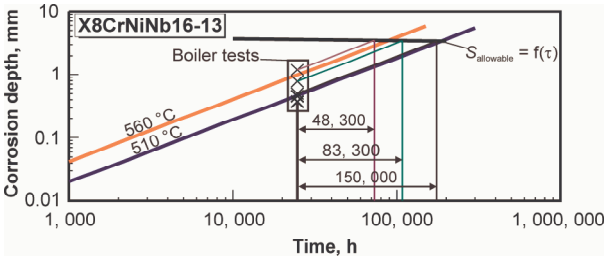

Figure 4. Diagram of remaining life assessment of superheater austenitic steel tubes