Nitridation of grate in a biomass-fired boiler - DTU Orbit (27/10/2019)

Nitridation of grate in a biomass-fired boiler

After a straw-fired power plant in Denmark had been in operation for 16 years with 93,815 hr operation, there was a need for overlay welding repair of the grate due to a decrease in wall thickness from erosion/corrosion. The grate consisted of 15Mo3 (Werkstoff nr. 1.5415) tubes where water/steam flows through, which were welded together with fins, and where one side faced the combustion zone coming into contact with the fuel (the side that required weld overlay). The water/steam temperature was 320°C and the surface metal temperature was estimated to be 350°C. However, there were difficulties when trying to overlay weld the grate as the weld pool was unstable. The microhardness measurements on cross-sections of the tubes revealed a higher hardness of the tube facing the combustion zone compared to opposite the combustion zone. In addition, there was higher hardness adjacent to the combustion side than the steam/water side. Analysis of etched cross-sections with light optical and scanning electron microscopy revealed the presence of acicular structures at the convex surface. Further analysis has been conducted with X-ray diffraction and a LECO nitrogen analyser indicating the presence of iron nitrides. Reasons for their evolution and implications for the repair welding are discussed.