Understanding the mechanism of fast corrosion initiation caused by KCl on waterwalls and superheated materials in waste and bio-fired power plants

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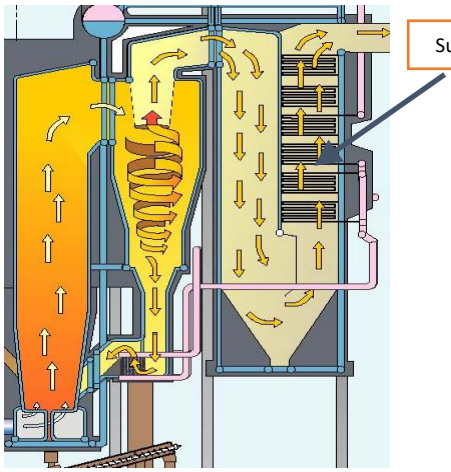
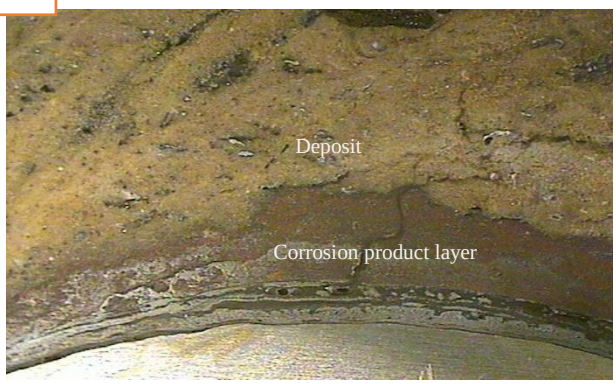
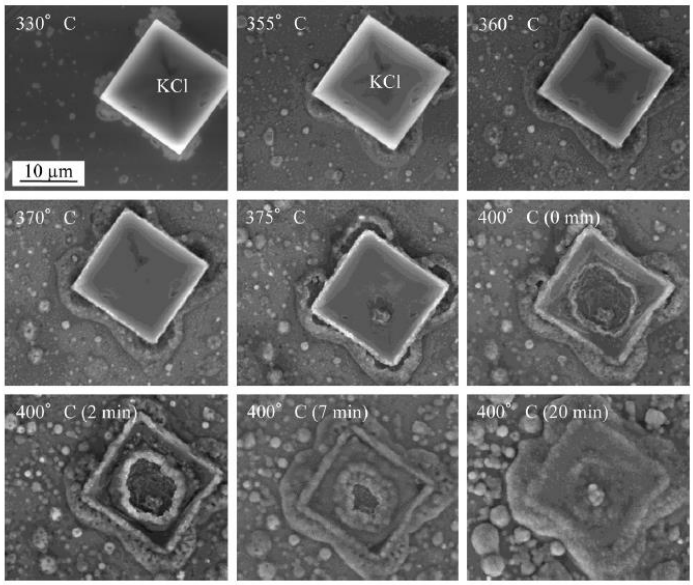
In this work we investigated the initial oxidation of a low-alloyed steel (Fe–2.25Cr–1Mo) in the presence of small amounts of KCl(s) using ESEM in-situ exposure and analysis at 400 °C[1]. We used XRD, SEM/EDX and FIB for characterizing the corrosion products and microstructure. The results show the role of KCl in general corrosion of the low alloyed steels even in small amounts. We concluded that the KCl's initial distribution has an important effect on the corrosion behavior of the alloy. Equilibrium calculations using Factsage software show formation of a KCl/$FeCl_2$ liquid phase film on large parts of the oxide surface in the presence of KCl. We propose that Cl increases the oxidation rate by affecting the grain boundaries in oxide phase and decreases the oxide scale adhesion.



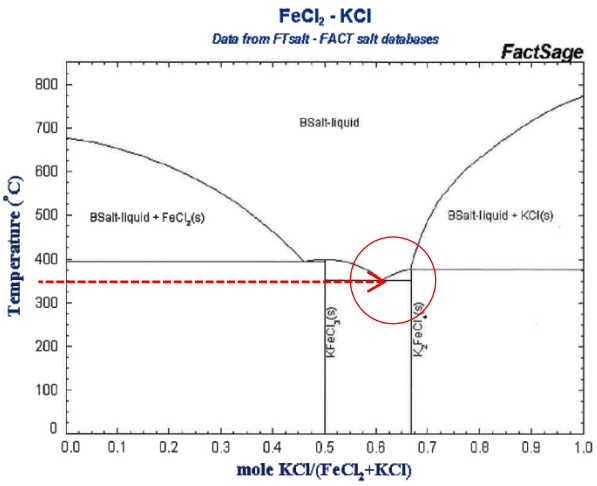
Combustion of biomass (CFB) boiler



Cross section of superheater tubes after use in CFB boiler



ESEM in-situ image during 20 min of exposure at 400 ºC of a KCl particle. The whole KCl particle is consumed and overgrown with oxide after 20 min of exposure.



The sudden onset of rapid hematite growth at 355°C caused by FeCl /KCl eutectic melt on the surface.

[1] Jonsson et al.," Corrosion Science", 2011, Vol. 53, pp. 2233.