Effect of gas management on the corrosion control of austenitic steels in Solar Salt at 620°C up to 5.000h

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Molten Salts play a crucial role in transformation processes from heat to electricity in existing Concentrating Solar Power plants and will become vital for the energy transition of sectors relying on high temperature process heat. Mixtures of $NaNO_3$ and KNO_3, such as so-called Solar Salt, serve as heat transfer fluids and thermal energy storage (TES) media and currently offer an operating temperature range between 290 °C and 565 °C. Only recently the authors of this abstract demonstrated that the high temperature limit of nitrate salts can be enhanced to temperatures of 620 °C from a molten salts-perspective, thereby opening new fields of applications (e.g. flexibilization of modern coal-fired power plants with TES technology). Yet, the higher operating temperatures come with an increasing risk of salt decomposition and thereby impurity-induced salt corrosion. In Solar Salt it is believed that, amongst other factors, increasing concentrations of oxy-anions (e.g. O^{2-}), formed during thermal decomposition, exacerbate corrosion of structural materials.

The work to be presented at the EFC workshop comprises a corrosion study of prominent austenitic steels (*300-types*) in Solar Salt 620 °C using sophisticated gas management techniques. Under a stabilizing gas atmosphere, corrosion tests were performed for up to 5.000h. The corrosion mechanisms were analyzed by employing descaling (corrosion rate) analysis. as well as classical cross-sectional analysis, complemented by investigations on the salt chemistry. The findings after 5.000h indicate, that acceptable corrosion rates of below 15µm/year can be achieved by controlling the gas phase. The interplay between the salt chemistry and the corrosion performance will be presented and extends the understanding of the role of corrosive impurities in nitrate salts at previously unexplored temperatures. Our study demonstrates that the stabilizing (reactive) gas atmosphere has a tremendous impact on the corrosion of structural materials, mainly by lowering the corrosive impurity level in the molten salt. Our work directly contributes to the use of molten nitrate salts as next-generation heat transfer fluids and thermal storage media.