Corrosion of austenitic steels for molten salt storage at elevated temperatures of 620 °C

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Molten Salts play a crucial role in transformation processes from heat to electricity in existing Concentrating Solar Power plants. 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, 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 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 EuroCorr comprises a corrosion study of prominent austenitic steels (*inter alia* 316, 321, 304) in three different corrosion environments: 1. state-of-the-art conditions (560 °C under air), 2. elevated temperatures of 620 °C in air and 3. at 620 °C under a stabilizing gas atmosphere. Corrosion experiments are performed in specialized autoclave test rigs and allow for precise molten salt chemistry control over time. Metal specimens are analyzed in terms of descaling (corrosion rate) as well as classical cross-sectional analysis for an in-depth analysis of the corrosion mechanisms. 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. The corrosion rate significantly decreases when switching the gas phase between an air blanket and a reactive gas phase. Our work directly contributes to the use of molten nitrate salts as next-generation heat transfer fluids and thermal storage media.