In biomass fired power plants, the fast corrosion of superheaters is facilitated by the presence of corrosive flue gas species, for example, SO$_2$, which are released during combustion. To understand the role of the gas species on the corrosion process, comparative laboratory exposures of deposit (KCl)-coated and deposit-free austenitic stainless steel (TP 347H FG) samples to gas mixtures containing SO$_2$ was carried out, under conditions relevant to biomass-firing. Exposures were conducted isothermally at 560°C for 72 h, in oxidizing-sulphidizing, and oxidizing-sulphidizing-chlorinating gas mixtures containing 60 ppmv SO$_2$. Scanning electron microscopy (SEM), energy dispersive X-rayspectroscopy (EDS) and X-ray diffraction (XRD) techniques werecomplimentarily applied to characterize the resulting corrosion products. A partially molten K$_2$SO$_4$-layer formed on KCl coated specimens, and corrosion resulted in localized broad pits containing sulphides and oxides. The severe pitting attack was decreased by the presence of HCl in the gas mixture.