Seminar

Institute for Plasma Research

Title : Oxidation and Hot Corrosion Behavior of 904L Super Austenitic Stainless Steel

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Venue : Online - Join the talk:
https://meet.ipr.res.in/Dr.ManishkumarKSingh_PDFTalk

Abstract :

Super austenitic stainless steel (SASS) grades possess outstanding mechanical properties, oxidation as well as corrosion resistance over a wide range of temperature. These highly alloyed grades are also known as Fe-Ni-Cr alloy, which are specifically alloyed with additional stabilizing elements like Mn, Si, Cu, Mo, N and to some extent with Boron, to enhance their working under service conditions.

Numerous studies have been carried out on oxidation behavior of such SASS grades at nominal service temperature from 500-900 ˚C. It was found that under flowing air condition the attack was not severe, whereas, under stagnant air condition the attack was severe due to which catastrophic attack could not be prevented. Volatile species in Fe-Ni-Cr alloys, such as Cr2O3 and Fe2O3, become highly unstable above 600 ˚C. In contrast, Ni hinders the formation of oxidizing species namely Fe, due to which outward depletion of the base metal is obstructed and the oxidation resistance is improved. However, no systematic study has been reported on 904L for its oxidation resistance.

Biomass fired plants are more environment friendly than fossil fuels fired ones and cause almost zero CO2 emission. Biomass and waste are renewable fuels and good substitutes of fossil fuels for power generation, for a sustainable society. However, burning of biomass fuel results in deposition of ash, which contains inorganic alkali chlorides and sulfates and reduce thermal efficiency of the heat exchangers and cause severe corrosion at working temperature. The usage of waste products in energy production is known as WTE (Waste to Energy). The presence of both alkali chlorides and sulfates results in lowering of melting temperature of the deposits and accelerates the rate of corrosion. The main problematic element in biomass ash environment is Invitation talk for PDF Position potassium which combines with passivation layer of Cr2O3 and forms K2CrO4 rather than sodium, at lower temperatures up to 400 ˚C. Although, protective oxides are stable in air, they become less stable in contact of KCl at high temperature.

Our investigation dealt with systematic study of oxidation behavior of the 904L steel by cyclic and isothermal exposures at 500-650 ˚C for 100 h. During cyclic exposures, 15 cycles were carried out, for maximum up to by 100 h whereas, during Isothermal exposure, the samples were subjected to 25, 50, 75 and up to 100 h at 500, 550, 600 and at 650 ˚C in stagnant air atmosphere. The isothermal and cyclic hot corrosion behavior of the 904L steel was carried out in synthetic biomass ash environment, using two

different mixtures of NaCl+KCl+Na2SO4+K2SO4 salts, SM1 and SM2, with Cl:S ratio of 40:60 and 60:40 respectively, at 500-650 ˚C up to 100 h.

It was observed that cyclic exposure of the SASS 904L at elevated temperature is more detrimental than isothermal exposure. The severity of damage was highest from hot corrosion due to SM2 salt mixtures having more Cl ions. The oxide scale and corrosion products were characterized using XRD, SEM (EDS) and EPMA techniques.