International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 8 Aug 2021, pp: 1639-1642 www.ijaem.net ISSN: 2395-5252

Analysis of Surface Coating of High Temperature Oxidation Behaviour of Power Plant Materials- Ss316

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Submitted: 10-08-2021 Revised: 25-08-2021 Accepted: 28-08-2021

ABSTRACT: The main objective of this work is to evaluate the high oxidation behaviour of super heater material which is used in the High temperature application such as super critical boiler. High temperature application operates at elevated temperature range above 900˚c. At elevated temperature, there occurs corrosion of metal which leads to failure of material. Since the corrosion causes the metal to form rust on metal. This turns the metal to corrode which interrupts and decrease its functionality of plant. Hence, the selective super heater material (SS316) is selected for this work. High temperature oxidation behavior is analyzed by testing the material in tubular furnace in steam at 900˚c. The material is tested in the furnace by three methods. First one is without coating of metal surface of specimen and second one is with $Al2O3$ coating of metal surface of specimen and third one is $Cr2O3$ coating of metal surface of specimen. After that the tested specimens are analyzed by SEM. From that results suitability of the metal for high temperature application in power plant is discussed.

Keywords: Oxidation behaviour of power plant materials ss316

I. INTRODUCTION

A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. The purpose of applying the coating may be decorative, functional, or both. The coating itself may be an all-over coating, completely covering the substrate, or it may only cover parts of the substrate. Functional coatings may be applied to change the surface properties of the substrate, such as adhesion, wettability, corrosion resistance, or wear resistance. In other cases, e.g. semiconductor device fabrication (where the substrate is a wafer), the coating adds a completely new property, such as a magnetic response or electrical conductivity, and forms an essential part of the finished product. Increasing the efficiency of energy production is one of method to reduce the carbon dioxide emission generated, and thus contains global climatic change. Increased level of steam in atmosphere derives mostly from combustion of fossil fuels. Since fossil fuels will most probably remain as an important source of energy in the coming decades, increasing the efficiency of energy production will have direct and crucial impact to the green gas emission generated. Another method to reduce greenhouse gas emission generated in combustion of fossil fuel is carbon capture and storage (CCS), which involves capturing the carbon dioxide from the fuel and pumping it to storage where it is not released to the atmosphere. Steam power plants equipped with CCS requires considerably more auxiliary power than conventional Boilers, so increasing the efficiency is the important step in making CCS economically feasible technology. Two crucial factors affecting on the efficiency of condensing power plant are the temperature and pressure level of live steam. With improved steam parameters, higher efficiency is achieved. The maximum operating temperatures of structural alloy limit the achievable steam temperature. The final super heaters are exposed to highest temperatures, so proper material selection of these components is crucial in order to achieve high plant efficiency and availability. The materials must have sufficient mechanical high temperature strength and adequate resistance against corrosion in both inner and outer tube surface.

II. 2. MATERIALS AND EXPERIMENTAL PROCEDURE:

For the last two decades the power industry standard material for high temperature applications is the SS316 grade material. The steam

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leaving the super heater of a modern large capacity boiler is in the order or 870 to 925 °C and at pressures ranging from 170 bar to 230 bar. This means the last stages of the super heater and the pipes carrying the steam to the turbine should withstand these extreme conditions. This
requires this material should have very high strength properties, which do not deteriorate with time, and should be creep resistant.

Table 1. Chemical Composition of SS316

Elements	**Al**	**Ni**	**Si**	**Cr**	**C**	**P**	**Mn**	**Mo**	**N**
weight%	0.04	14.0	1.0	18.0	0.08	0.045	2.0	2.0	0.10

Table 2. Mechanical Properties of SS316

Ultimate tensile strength	**515Mpa**
Tensile yield strength	205Mpa
Modulus of elasticity	200Gpa
Density	8.027g/cm3
Hardness	95 BHN

III. RESULTS AND DISCUSSIONS

3.1 SEM Test

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning it with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that can be detected and that contain information about the sample's surface topography and composition. The electron beam is generally scanned in a raster scan pattern, and the beam's position is combined with the detected signal to produce an image. SEM can achieve resolution better than 1 nanometer. Specimens can be observed in high vacuum, in low vacuum, in wet conditions (in environmental SEM), and at a wide range of cryogenic or elevated temperatures. The most common mode of detection is by secondary electrons emitted by atoms excited by the electron beam. On a flat surface, the plume of secondary electrons is mostly contained by the sample, but on a tilted surface, the plume is partially exposed and more electrons are emitted. By scanning the sample and detecting the secondary electrons, an image displaying the topography of the surface is created.

Table 3.UNCOATED MATERIAL (SS316)

S.No	**Initial Wt**	**Finial Wt**	**mg**	**g**	**hrs**	**g/mm2**	**S.No**
1	4.721	4.721	0	0	0	0	**1**
2	4.721	4.723	0.002	2	10	0.00568828	**2**
3	4.721	4.725	0.004	4	20	0.01137656	**3**
4	**4.721**	**4.727**	**0.006**	**6**	**30**	**0.0170648**	**4**

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Figure 1. Graph for Uncoated SS316 Material

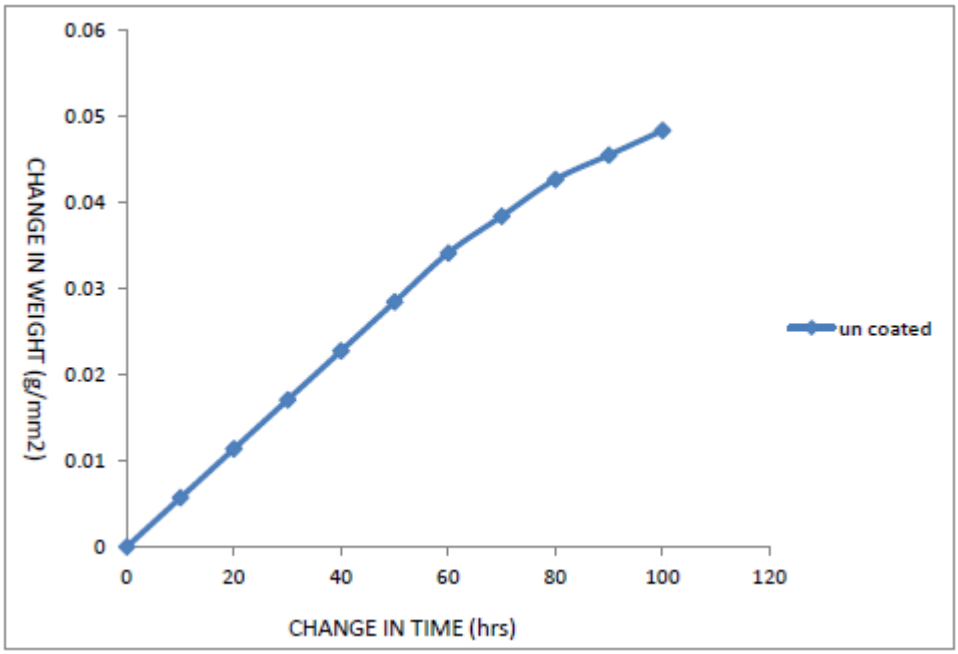
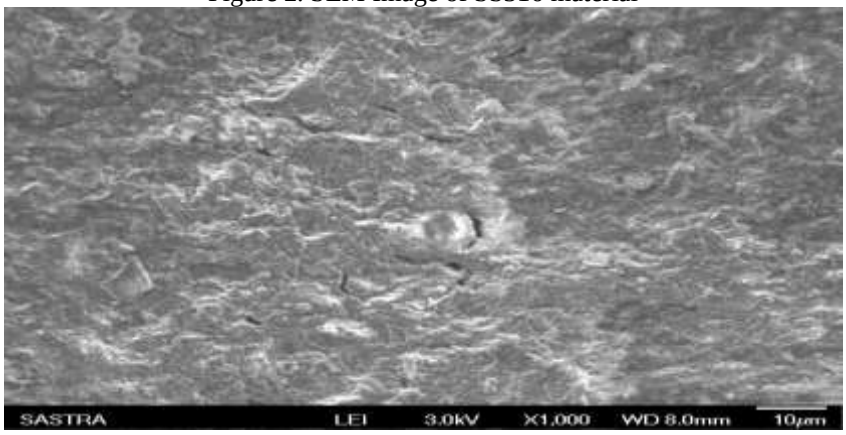


Figure 2. SEM Image of SS316 material



IV. CONCLUSION

In this study, high temperature oxidation behavior of super heater materials SS316 are investigated at temperature 900℃ through journals. Based on the various journals I choosed SS316 is suitable for power plant materials to improve the corrosion resistance. The microstructure specimen (uncoated SS316 material) was carried out SEM (scanning electron microscope).

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