Characterization of chloride-induced high temperature corrosion in wet condition of austenitic stainless steel

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ABSTRACT: High temperature corrosion of austenitic stainless steel in wet hydrogen chloride environment was characterized and investigated by optical microscopy and X-Ray microanalysis. The hydrogen chloride was diluted in water and boiled to generate stream feeding into ceramic tube furnace which set up at 900 degree Celsius. Optical microscopy and X-Ray Microanalysis are primarily selected for characterization techniques. The corrosion product generated on surface mostly composed of ferrous oxides. There is not found any Ni on the surface so it still promoted austenitic matrix of stainless steel in corrosive environment.

1 INTRODUCTION

[1]High temperature corrosion is a form of corrosion that does not require any liquid-formed electrolyte reacts with corrosive material. There are many researches devotes to investigation high temperature corrosion because it is widespread in various application for example power generation, heat treating industry, automotive, aerospace, defense etc.

There are some researchers devotes to concentrate in high temperature corrosion field. Sorell studied the role of chlorine in high temperature corrosion of austenitic stainless steel for waste-to-energy plants application and found that 300 Series stainless steels is susceptible to chloride-induced pitting and stress corrosion cracking during operation and moisture plays an important role for corrosion. Chang and Wei reviews the high temperature chlorine corrosion of metals and alloys at temperature more than 200 degree Celsius and concludes that high temperature corrosion consists mainly of the diffusion of ions in the scale and the volatilization of the scale. The effect of water vapor on the corrosion resistance of most metals is beneficial due to the formation of a protective oxide in contrast with Cr-containing steel because hydrogen produced from the reaction of H/O with Cr at the alloy/oxide interface. It is detrimental to corrosion resistance of Cr-containing steel. Goutier et al studied oxidation behavior of 304 austenitic stainless steel between 1193 and 1293 K in CO_2 environment and found that the corrosion products were chromia at grain boundary, wustite on the surface, and chromite. Shariff et al comparatively studied between dry and wet high temperature corrosion of 304 stainless steel in CO_2 and found that oxidation occurred instead of carburization due to decomposition of CO_2. Wet condition was more deteriorate than dry condition because of porous oxide scale.

In this study, the corrosion products after exposed to HCl/H_2O environment were characterized and concluded the effect of effect of wet HCl corrosion.

2 MATERIAL AND EXPERIMENT

2.1 *Material*

The selected austenitic stainless steel was SUS 310S grade containing high chromium and nickel contents. The material had been chemically analyzed by XRF technique and result was shown on table 1. The size of specimen was 15x15 millimeters and the thickness was 4 millimeters.

Table 1. Chemical composition of SUS310S

Element	C	Cr	Ni	Si	Mn
Quantity (%)	0.08	24.58	19.13	0.59	1.85

2.2 *Experiment*

The specimen was heated inside tube ceramic furnace. The temperature was gradually increased from ambient temperature to 900 degree Celsius with heating rate 6ºC/min and, then, held 13 hours before shut off furnace heater to decrease temperature to ambient again. The heating cycle was seen on Fig.1.