

High temperature corrosion of 310S austenitic stainless steel in CO₂/HCl environment

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Abstract– High temperature corrosion of SUS 310S austenitic stainless steel was investigated comparatively in CO₂ and HCl/H₂O environment at 900°C. The thickness of corrosion layer in case of CO₂ surrounding was thinner than HCl/H₂O environment because of protective chromium oxide layer formation. The corrosion layer of HCl/H₂O environment was porous and weak caused by water vapor leading to intergranular corrosion and intermetallic compounds (oxide, chloride, carbide)

Index Terms – High temperature corrosion, austenitic stainless steel

I. 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.

^[2]Goutier et al studied oxidation behavior of 304 austenitic stainless steel between 1193 K and 1293 K in CO₂ environment and found that the corrosion products were chromia at grain boundary, wustite on the surface, and chromite. ^[3]Shariff et al comparatively studied between dry and wet high temperature corrosion of 304 stainless steel in CO₂ and found that oxidation occurred instead of carburization due to decomposition of CO₂. Wet condition was more deteriorate than dry condition because of porous oxide scale.

In this study, the corrosion products after exposed to CO₂ and HCl/H₂O environment were comparatively characterized and approximately identified thickness of corrosion products as well.

II. EXPERIMENTAL SET UP

A. Materials

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 material

Element	C	Cr	Ni	Si	Mn	Fe
Quantity (%)	0.08	24.58	19.13	0.59	1.85	53.93

B. High temperature corrosive environment

The specimen was heated inside ceramic tube furnace. The temperature was gradually increased from ambient temperature to 900 degree Celsius with heating rate 6°C/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.

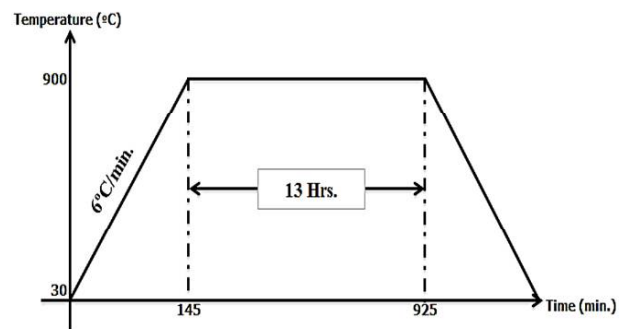


Fig.1 heating cycle

The atmosphere was prepared thermally into 2 cases. For the first case, CO₂ gas directly fed into heated furnace with 5 liter per minute feeding rate. The feeding time was 1 minute. The second case, HCl acid solution was prepared by mixing 12 moles concentrated HCl 200 mL with 800 mL of distilled water, boiled such solution, and fed the stream into furnace. The schematic of test apparatus was shown on Fig.2.

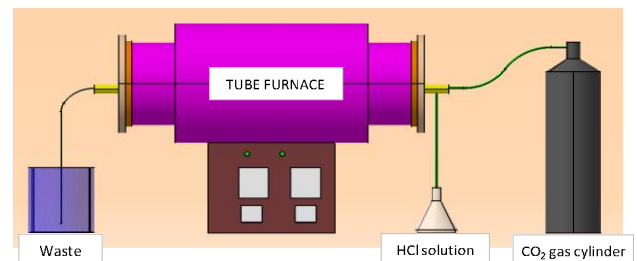


Fig.2 Schematic diagram of test apparatus