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Mechanical characteristics, morphology and corrosion behavior of duplex stainless steel 2205

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Abstract:
Duplex stainless steel, also known as austenitic-ferritic stainless steel, is a high-performance material with superior mechanical and corrosion qualities that is commonly found in marine applications. Corrosion and mechanical performance degradation are common in the marine industry due to the demanding operating conditions at varying temperatures. The mechanical characteristics, morphology, and electrochemical behavior of 2205 duplex stainless steel at elevated processing temperatures in different cooling mediums are discussed in this paper. Optical and scanning electron microscopy (SEM) along with potentiodynamic tafel plots in water containing 3.5% NaCl solutions were used to examine the precipitation of distinct phases without and with heat treatment, as well as their impact on corrosion resistance. When comparing the mechanical properties of duplex stainless steels, air quenching was shown to produce the highest impact strength and average hardness values. Because of the greater volumetric precipitation of austenite after water cooling, the water-cooled sample performed better in corrosion resistance tests.

Keywords: DSS 2205, Toughness, Micro hardness, Morphology, corrosion, potentiodynamic Tafel

1. Introduction

The name duplex stainless steel comes from the fact that the duplex structure of austenitic ferritic stainless steels precipitates in nearly equal volume fractions, resulting in excellent mechanical and corrosion properties. Duplex stainless steel (DSS) is becoming more popular for the fabrication of stainless-steel parts used in the maritime, chemical, oil and gas production, and pipeline sectors [1, 2]. Due to its high corrosion resistance, austenitic stainless steel is the most often used steel [3]. The percentages of Cr and Ni in DSSs are 18-28 and 4.5-8, respectively, and these are the principal alloying elements of DSSs [2]. The stability of austenite is managed by varying the percentages of Nitrogen, Carbon, Manganese, and other alloying elements such that particle and grain boundaries change, resulting in improvements in material properties like as strength and elongation [4-6]. To increase mechanical qualities and corrosion resistance, main, intermetallic phases, and alloying elements must be developed and partitioned [7]. The morphology of DSS demonstrates that the growth of the ferrite structure, which aids in the material's transition from ductile to brittle and lowers impact resistance, is directly connected to the existence of a ferritic phase [8]. However, the austenitic phase's emergence in the morphology enhanced the impact characteristics of DSS, allowing for permanent deformation and stopping the ferritic phase's low-energy brittle fracture [5-7]. In order to understand their mechanical properties, the quantity of intermetallic phases is crucial [6, 8, 9].