CHAPTER 1

INTRODUCTION

Quest for an economical material with superior corrosion resistance in chloride environments and excellent mechanical properties has gained momentum in recent years. One of the viable materials satisfying the above stipulation is nitrogen alloyed Super Austenitic Stainless Steels (SASS) as they possess high Pitting Resistance Equivalent Number (PREN), it is often defined as PREN = % Cr + 3.3 (% Mo) + 30 (% N), when compared to conventional 300 series austenitic stainless steels (304, 316, etc.) and duplex stainless steels. The PREN is a characteristic value that decides the pitting resistance of an iron base alloy. Generally, the PREN value for SASS is ranging from 45 to 60, while the austenitic stainless steels (300 series) has less than 30 and the duplex stainless steel has between 30 and 40. Cost of the SASS is intermediate to the austenitic stainless steel grades and the nickel based alloys, while corrosion resistance, in some cases, challenges that of higher nickel alloys.

Due to higher pitting resistance and retention of strength with high toughness at elevated temperatures, SASS have been extensively used in pulp mill bleach washers, flat plate heat exchangers for high temperature seawater and chemical processing equipment where a nickel-based alloy would normally be required. Long time exposure of austenitic stainless steels to elevated temperature is known to cause decomposition of the austenitic matrix resulting in the formation of various types of precipitate phase such as sigma (σ), chi (χ), Lave (η), carbides and nitrides. The formation of precipitate phases in SASS depends on temperature as well as the amounts of Cr, Mo and Si content. The consequence of these precipitate phases is known to cause detrimental to both mechanical and corrosion properties. Although these previous works talk about the formation of precipitation phases and give their effects on mechanical properties of SASS contain low Mo (< 6.5 wt %), a correlation between the precipitate phases and properties of a higher molybdenum containing SASS is not reported. Thermodynamic aspects of the precipitate formations in SASS are not thoroughly established yet. Limited amount of literature is available for cast SASS. In order to bridge the gaps in the literature, this research work was carried out.

1.1 OUTLINE OF THE THESIS

The present thesis consists of seven chapters. The first chapter gives an introduction to SASS on the global scenario, its importance, advantages and limitations. The second chapter gives an extensive literature review of the current innovation being carried out on the production and characterization of SASS. The scope of the present investigation is given in chapter 3 and it focuses to bridge the gaps in literature. The fourth chapter includes the materials used and methods adopted for the production and characterization of solution-annealed and isothermally aged cast SASS. In chapter 5, production, the results of optical microscopy, SEM with EDS, XRD, hardness testing, impact testing, tensile testing and potentiodynamic polarization testing carried out on the solution-annealed as well as isothermally aged SASS are discussed. The prominent findings of the present investigation are given in chapter 6 as conclusions. From the conclusions of the present research, the new ideas or the work to be left out are given in chapter 7 as scope for future work.