CHAPTER 1

INTRODUCTION

In the recent years, the need for corrosive resistive high strength materials with less cost has become a mandatory requirement for several applications. Even though many new materials and technologies have been developed, proportionately opposite response also is normal. In this aspect every material has some merits and demerits but stainless steel possesses sufficient mechanical property along with corrosion resistance it needs to be slightly modified in terms of its composition and microstructure to enhance its mechanical properties and corrosion resistance. Generally Ni is use to add on stainless steels to improve toughness and corrosion resistance. Nickel has the strongest austenite stabilizer but N is measured to be as much as thirty times as powerful than nickel as an austenite former (Reed 1989 and Zackay et al 1956). In addition to the fact that the consumption of an expensive strategic metal like Ni is reduced to 6-20 kg by one kg of nitrogen.

It has been shown that small amount of nitrogen in alloy steels has a beneficial or a deleterious influence on the properties of the materials, depending on its concentration, the thermal processing of the alloy, and the presence of alloying elements. Nitrogen also imparts a number of other beneficial properties to austenitic and austenitic-ferritic duplex stainless steels. It is an excellent solid solution-strengthening element in stainless steel, increasing the yield strength at room temperature and at sub zero temperature, with no significant decrease in toughness or ductility (Zackay 1956, Okagawa 1983). As a result, Nitrogen Allooyed Martensitic Stainless Steel (NAMSS)
offers a unique combination of strength and toughness. Nitrogen is also reported to improve the passivation characteristics of stainless steels. It increases resistance to localized corrosion (Janik-Czachor 1982), and reduces sensitization effects.

In order to realize the advantages associated with nitrogen alloying, the nitrogen has to be in solution in the metal matrix. Excess nitrogen tends to cause porosity or form brittle nitrides. Iron, mild steel and low alloy steel have low solubility limits for nitrogen (the equilibrium solubility of nitrogen in iron at its melting point is only approximately 0.044% (by mass) at 1 atmospheric pressure). It is therefore important to limit nitrogen absorption in these steels. Austenitic stainless steels can accommodate significantly higher levels of nitrogen in solid solution as against 0.4 wt%, and 0.08 wt% in ferritic and 0.02 wt% in martensitic stainless steels (Speidel 1988).

However, production of NAMSS using (conventional) regular acid lined high frequency induction furnace under normal atmospheric temperature and pressure becomes necessary to meet commercial requirement. Moreover, the improvement of mechanical properties by various thermo mechanical treatments like hot rolling, extrusion, hot forging etc is the need of the present day materials requirement.

In order to fulfill this serious lacuna the present investigation was taken up for detailed study carried out in a detailed manner.

In this investigation a detailed analysis was carried out on the nitrogen solubility at atmospheric pressure at the melting point of martensitic stainless steel. Various quality tools like QFD and FMEA were used to optimize the production. During this research NAMSS produced with eleven different nitrogen contents and six melts were heat treated and characterized.
To find out the effect of heat treatment temperature, heat treatment was carried out at various temperatures starting from 900°C to 1000°C and characterized.

To find out the effect of thermo mechanical treatment, size reductions were carried out for 10%, 30%, 52%. The hot forged specimens were further heat treated and characterized.