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Investigation of SS 321 & Mechanical Properties

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Abstract- **This work aims at the analysis and optimization of joining similar grades of stainless steel by an arc welding. The parameters like current, filler materials, welding speed are the variables in this study. The mechanical properties and microstructure of 321 austenitic stainless steel welds are investigated, by using stainless steel filler material of different grades.**

Often in many product forms, the grain size and carbon content can meet both the 321S and 321H requirements.321 is often used at cryogenictemperatures, with excellent toughness to 450°F, and low magnetic permeability. 321 have a machinability rating of 42% relative to AISI B1112 steel. In this project the comparative study between normal welding and welding procedure specification is made for stainless steel grade 321 material by comparing its mechanical properties after welding.*Index Terms*— High Volume Air Sampler, National Ambient Air Quality Standards, Sound Meter, Suspended Particulate Matter (SPM),

I. INTRODUCTION

1.1 Stainless Steel

Stainless steel or corrosion resisting steels are a family of iron base alloys having excellent resistance to corrosion. Because of high corrosion resistance, stainless steel sheets are progressively used for kitchen, transportation, building constructions, etc.

II. STAINLESSSTEEL321

Austenitic steels are one of the best choices, as they combine good mechanical properties and corrosion performance. As they have low carbon percentage, intergranular corrosion can be prevented. Stainless steel sheets are the preferred material of use in many areas like automotive exhaust systems, steel pipes, chemical industrial equipments, etc. 321SS is selected for fabrication works mainly because the material contains low carbon and good weldability factor and also because it has high temperature service factor with good ductility.

2.1.1 Chromium

Chromium is by far the most important alloying element in stainless steel production. A minimum of 10.5% chromium is required for the formation of a protective layer of chromium oxide on the steel surface. The strength of this protective (passive) layer increases with increasing chromium content. Chromium prompts the formation of ferrite within the alloy structure and is described as ferrite stabiliser.

2.1.2 Nickel

Nickel improves general corrosion resistance and prompts the formation of austenite (i.e. it is an austenite stabiliser). Stainless steels with 8-9% nickel have a fully austenitic structure and exhibit superior welding and working characteristics to ferritic stainless steels. Increasing nickel content beyond 8-9% further improves both corrosion resistance (especially in acid environments) and workability.

2.1.3 Copper

Copper increases general corrosion resistance to acids and reduces the rate of workhardening (e.g. it is used in cold-headed products such as nails and screws). It is an austenite stabiliser.

2.1.4 Carbon

Carbon enhances strength (especially, in hardenable martensitic stainless steels), but may have an adverse affect on corrosion resistance by the formation of chromium carbides. It is an austenite stabiliser.

2.1.5 Sulphur

Sulphur is added to improve the machinability of stainless steels. As a consequence, sulphur-bearing stainless steels exhibit reduced corrosion resistance.

2.1.6 Manganese

Manganese is an austenite former, which increases the solubility of nitrogen in the steel and may be used to replace nickel in nitrogen-bearing grades.

2.1.7 Silicon

Silicon improves resistance to oxidation and is also used in special stainless steels exposed to highly concentrated sulphuric and nitric acids. Silicon is a ferrite stabiliser.

III. WELDING

3.1 Introduction to Welding Technology

Welding is a fabrication process used to join materials, usually metals or thermoplastics, together. During welding, the pieces to be joined (*the work pieces*) are melted at the joining interface

3.2 Welding Processes

The number of different welding processes has grown in recent years. These processes differ greatly in the manner in which heat and pressure (when used) are applied, and in the type of equipment used. There are currently over 50 different types of welding processes; we'll focus on 3 examples of ***electric arc welding***, which is the most common form of welding.

The most popular processes are shielded metal arc welding **(SMAW)**, gas metal arc welding **(GMAW)** and gas tungsten arc welding **(GTAW)**.

3.3 Types of Welding

There are many different types of welding processes and in general they can be categorized as:

3.3.1Arc Welding:

A welding power supply is used to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. In such welding processes the power supply could be AC or DC, the electrode could be consumable or non-consumable and a filler material may or may not be added.

The most common types of arc welding are:

3.3.2Shielded Metal Arc Welding (SMAW):

A process that uses a coated consumable electrode to lay the weld. As the electrode melts, the (flux) coating disintegrates, giving off shielding gases that protect the weld area from atmospheric gases and provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, the slag must be chipped away to reveal the finished weld.

3.4Selection of the welding process

The selection of the joining process for a particular job depends upon many factors. There is no one specific rule governing the type of welding process to be selected for a certain job

IV. TESTING

4.1 Hardness

Hardness is a commonly used property; it gives a general indication of the strength of the material and of its resistance to scratching and to wear. Hardness is usually defined as resistance to permanent indentation; thus, steel is harder than aluminum, and aluminum is harder than lead. Hardness, however, is not a fundamental property, because the resistance to indentation depends on the shape of the indenter and on the load applied.

4.2 Heat Treatment

Almost all the mechanical work in plastic deformation is converted into heat. This conversion is not complete, because a portion of this work is stored within the deformed material as elastic energy.

4.3 Tension Test

Mechanical testing plays an important role in evaluating fundamental properties of engineering materials as well as in developing new materials and in controlling the quality of materials for use in design and construction. The most common type of test used to measure the mechanical properties of a material is the Tension Test. Tension test is widely used to provide a basic design information on the strength of materials and is an acceptance test for the specification of materials.

V. WORKING OF EXPREMENT

Welding procedure specification

1. Safety first

Warning: Protect yourself & others. Read & understand this information.

Fumes & Gases can be hazardous to your health.

2. Select Joint Design

Start by determining the best manner in which to join your base metals. Be sure to consider strength required, welding position, metal thickness and joint accessibility

3. Choose the Welding Process

4. Select the Applicable Filler Metal

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5. Set the Parameters

SMAW - uses a direct current (DC) or an alternating current (AC).

DC uses either straight polarity, which is electrode negative or reverse polarity, which is electrode positive. Direct current flows in one direction continuously through the welding circuit. There are several advantages of DC. It works well at low currents

6. Clean The Base Metal

Cleaning should be done just prior to welding to prevent the formation of oxides. The base metal surface must be free of grease, oil, paint, dirt, etc. A clean surface will provide a smoother, stronger joint. Brush the plate surface and edges with a stainless steel wire brush to remove burrs & oxides.

7. Preheat If Applicable

Preheat is not required for most 300 austenitic grade stainless steels. The base metal should be brought to room temperature, 60 to 75 degrees. Preheat is necessary when welding ferritic or martensitic grades. It is also needed when joining metals that are thick or contain a high percentage of carbon.

VI. RESULT

Properties	**Before welding(MPa)**	**After welding(MPa)**
Yield strength	350	400
Hardness(Brinell)	172	205
Tensile strength	625	693

Table 6.1 Comparision of properties

VII. PHOTOGRAPHY

1. Tee Joint

FIG 8.1 Normal Welding Of Tee Joint
Fig 8.2 proper welding of tee joint

2. Lap joint

Fig 8.2normal Welding Of Lap Joint

Fig 8.4 Proper Welding Of Lap Joint

3. Butt Joint

Fig 8.5 Normal Welding Of Butt Joint

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Fig 8.6 Proper Welding Of Butt Joint

VIII. CONCLUSION

The stainless steel 321 grade shows improvement when welding procedure specification is followed.

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