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MECHANICAL PROPERTIES AND MICROSTRUCTURAL ANALYSIS OF STAINLESS STEELS (304 & 310) THROUGH DISSIMILAR JOINING BY TIG & SMAW

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ABSTRACT

The dissimilar metal joints of have been emerged as a structural material for various industrial applications which provides good combination of mechanical properties like strength, corrosion resistance with lower cost. Selections of joining process for such a material are difficult because of their physical and chemical properties. The stainless steel 304 and 310 grades dissimilar material joints are very common structural applications. Joining of stainless steel 304 and 310 is very critical because of carbon precipitation and loss of chromium leads to increase in porosity affects the quality of joint leads deteriorate strength. In the present study, stainless steel of grades 304&310 were welded with mild steel by Tungsten Inert Gas (TIG) and Shielded Metal Arc Welding (SMAW) processes. The tensile strength of dissimilar metal joints was investigated. The results were compared for different joints made by TIG and SMAW welding processes and it was observed that SMAW welded dissimilar metal joints have better physical properties than TIG welded joints.NDT is carried out to check the weld quality. Heat Treatment for Stress Relieving and for increasing Strength. Micro-structural Analysis of welded area and HAZ.

Keywords: Welding, Dissimilar Metal, TIG, SMAW

1. Introduction

Welding is one of the most important and versatile means of fabrication available to the all kinds of manufacturing industries. A large number of arc welding techniques has been devised, however gas tungsten arc welding (GTAW) also called tungsten inert gas welding (TIG) is one of the most widely used welding technique in the fabrication as well as repairing of different components in various manufacturing, construction and other welding related industries. The major importance of such commonly used welding technique lies with its economy, easy in handling and its potential capability towards the joining of various metals and their alloys such as most of the steels including stainless steel, Aluminium, Magnesium, Copper, Carbon and sensitive materials like Titanium, Zirconium etc. The process produces qualitative welds with less distortion with the features of its intense heat source. TIG welding is mostly suitable for the high quality welding of thin sections of materials.

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2.Experimental Setup

2.1 Welding Setup for TIG & SMAW:

TIG Setup

Fig.1: TIG Welding Machine

SMAW Setup

Fig.2: SMAW Machine

Fig.3:Dye Penetration Test

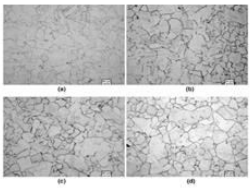

Fig.4: Etched specimen of Stainless steel

3.Result and Discussions

Testing

As we need to test 8 tensile specimens under UTM- 60 tonn:

4 with Heat Treatment (2 TIG & 2 SMAW), 4 without Heat Treatment (2 TIG & 2 SMAW

Table.1: With Heat Treatment

Specimen	Tensile Strength MPa	Elongation%
TIG1	519.861	15.64
TIG2	556.881	30.4
SMAW 'V'	562.943	23.14
SMAW '2V'	594.059	29

Table.2: Without Heat Treatment:

Specimen	Tensile Strength MPa	Elongation%
TIG1	542.373	28.92
TIG2	556.482	29.76
SMAW 'V'	391.14	6.02
SMAW '2V'	538.931	26.02

Discussions:

Comparision of TIG and SMAW Welding:

TIG	Sample 1 mm	Sample 2 mm
304	1.1mm	1.1mm
310	1mm	1mm
Weld Area	1.1mm	1.1mm

SMAW Welding	Single "V" mm	Double "V" mm
304	1.1mm	1.1mm
310	1mm	1mm
Weld Area	1mm	1mm

Metal	TIG(1)BHN	TIG(2)BHN	ARC(1)BHN	ARC(2)BHN
304(base)	187.33	187.33	187.33	187.33
310(base)	228.88	228.88	228.88	228.88
Weld area	187.33	187.33	228.88	228.88

3.1 Microstructure:

Fig 5 - TIG Sample-2

Fig 6 - TIG Sample – 1

Fig 7 - SMAW Sample – "2V"

Fig 8 - SMAW Sample – "V"

4. CONCLUSIONS

During the study, two different grades of stainless steel(304 & 310) were joined using TIG welding and SMAW. The tensile strength before and after heat treatment, weld quality and microstructure of weld area and HAZ were investigated. The Selection of different grades of stainless steel used for welding play an important role in deciding the properties of the weld. Shielded metal arc welding

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process is best for S.S 304 & 310. In the welding we can seen there is nothing defect found due to welding like porosity, cracks, etc. In case of SMAW double 'V'result was satisfied and clears an idea about welding under Tensile load. Flux consumption is more in single Vthan double V. Heat Treatment increases the Tensile strength. The strength of Heat Treated double 'V' dissimilar metal welded by Shielded metal arc welding is excellent as per report. Hardness value of 310 is more than 304that is only the result to make experiment successive. Hardness of SMAW welded joint is more than TIG. Including all the test reports we get best result with SMA welding on related metals plates. Micro Cracks are seen at TIG joint through NDT and metallography.

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