International Journal of Advanced Mechanical Engineering.
ISSN 2250-3234 Volume 4, Number 6 (2014), pp. 695-700

http://www.ripublication.com

Weldability Issue of AISI 202 SS (Stainless Steel) Grade with GTAW Process Compared to AISI 304 SS Grade

Sahil Bharwal[1] and Charit Vyas[2]

[1, 2]Department of Mechanical Engineering,
Sant Longowal institute of engineering and technology, Sangrur, Punjab

Abstract

AISI 202 SS (stainless steel) has similar mechanical property as compare to AISI 304 SS grade, but its ability to resist corrosion is somewhat less as compare to AISI 304 SS grade in chloride environment. But it is very inexpensive so we can use it in indoor applications like indoor fabrication, automobile trim and application where atmosphere is not a considerable factor. But there is very less research reported on welding of AISI 202 SS grade

In present work we use gas tungsten arc welding (GTAW) process to weld AISI 202 SS grade. GTAW process benefits the welded joint with maximum strength and better deposition rate. The results obtained after welding of AISI 202 are comparable to AISI 304 type satisfying the requirement of prescribed properties of welded joints. Hence 202 type SS can be used instead of 304 type SS for the above mentioned applications.

Keywords: AISI 202 SS, AISI 304 SS, GTAW, Strength, Chloride Environment.

1. Introduction

Austenitic stainless steel is most commonly used in petrochemical, chemical and power engineering, also in vehicle and aviation industries. [1] Stainless steel is used when both the properties of steel and resistant to corrosion are required. The welding of automotive exhaust gas systems, stainless steel pipes, repairing of chemical industries equipments, etc. are done with the help of gas tungsten inert gas welding (GTAW or commonly known as TIG) [2]. Chrome-manganese austenitic stainless steel grades (“standard 200-series”) with well-defined and well-documented technical properties have proved acceptable materials for specific applications for many years. There has recently been a significant increase in the use of new and economical

chrome manganese grades (which can be referred to as “new 200-series” grades). These 200-series grade use different chemistries, characterised by reduced chromium and extra low nickel content. As well as currently being significantly cheaper, from a material cost point of view, 200-series stainless steels can offer good strength, depending on their chemistry. Certain grades (equivalent to 201-, 202- and 205-series) even offer about 30% higher “mechanical properties” (yield strength) than the classic 304-series chrome nickel grade – allowing designers to cut weight.

Almost the complete replacement of Nickel is possible by combined Mn. and Nitrogen addition with Carbon. Lower nickel addition requires more manganese and nitrogen to stabilize the austenitic phase. Higher draw ability properties may be obtained with lower nitrogen additions but then chromium content must be reduced down to 14-15% in order to provide the stability to the austenitic phase. AISI 304 stainless steel is widely used in forming applications because of its superior formability. The high nickel price in recent years prompted an investigation into the feasibility of replacing AISI 304 with AISI 202 in applications requiring comparable mechanical properties. The aim of this investigation was therefore to study the weldability of AISI 202 stainless steel using uniaxial tensile tests and observing the chemistry to clear the way to use

Yan (2009) investigated the mechanical properties and microstructure of stainless steel and results showed that the microstructure consists of delta ferrite and gamma ferrite phase. [3]. Morisada (2012) showed the effect and use of high frequency tungsten inert gas welding method in order to decrease the blow holes in a weld [4]. The hardness of the weld metal was lower than that of the heat affected zone (HAZ) metal area and heat affected zone was lower than that of base metal concluded by Durgutlu (2003) in the research where he observed that increasing hydrogen content in the shielding gas reduced the mechanical properties [5]. Kang (2008) analyzed the effect of alternate supply of method of shielding gases in austenitic stainless steel using Gas tungsten arc welding and concluded that welding speed of Ar+67 % He was more than that of supplying alone argon (Ar) but less than Ar ::He ratio [6].

2. Experimental procedure

Grade 202 stainless steel plate was selected for the study cut in the dimension of 100 × 50 × 6 mm for conduct the experiments. The chemical composition by weight percentage of Stainless Steel 202 sheet of 6 mm thickness is shown in Table 1.

Table 1 Chemical composition of stainless steel grade 202.

Element	%C	%Mn	%Si	%Cr	%Ni	%P	%S	%N
%wt	0.15	7.5-10	1	16-18	4-6	0.06	0.03	0.25

GTAW process is used for welding using a power source as shown in Figure 1. The main experimental setup used consisted of a travelling carriage with a table for supporting the specimens as shown in Figure 2.

Figure 1

Figure 2

Three parameters are selected such as gas flow rate, current and welding speed for weld the samples. Argon gas is used as a shielding gas in order to protect the welded area from the atmospheric gases. The value of welding current, gas flow rate and welding speed is 160 A, 6 l/min and 2.5 mm/sec. TIG welding has been performed on SS 202 grade steel for the completion of experiment. In welding process, the cut and v-grooved samples were welded at above mentioned value of current, gas flow rate and welding speed. After welding a tensile specimen is cut and a small sample was prepared for microstructural analysis.

3. Result and discussion

3.1 Tensile test

The tensile test is performed on the sample and the ultimate tensile strength found out is 610 Mpa. The result of tensile test is regarded as satisfactory value that will report that the weldability of AISI 202 is fair enough that produces the comparable results with AISI 304.

Figure 3

3.2 Microstructural analysis

Austenitic stainless steel is widely in a variety of industries. In order to check out the structure of the material microstructure is considered to be one of the most important mechanical properties. Microstructure of parent material before welding is shown in Figure 4 and microstructure of weld metal is shown in Figure 5.

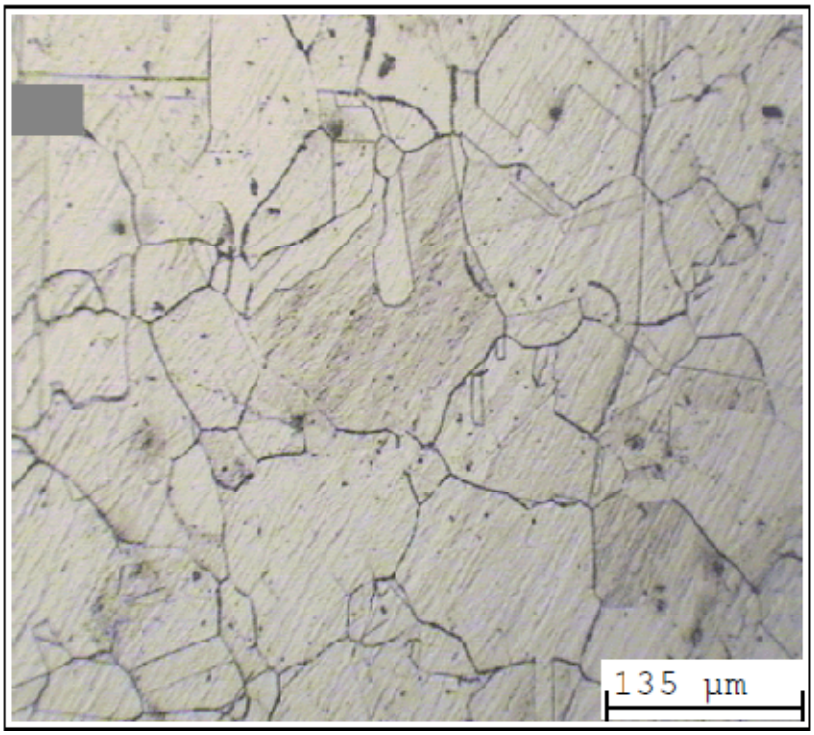

Figure 4

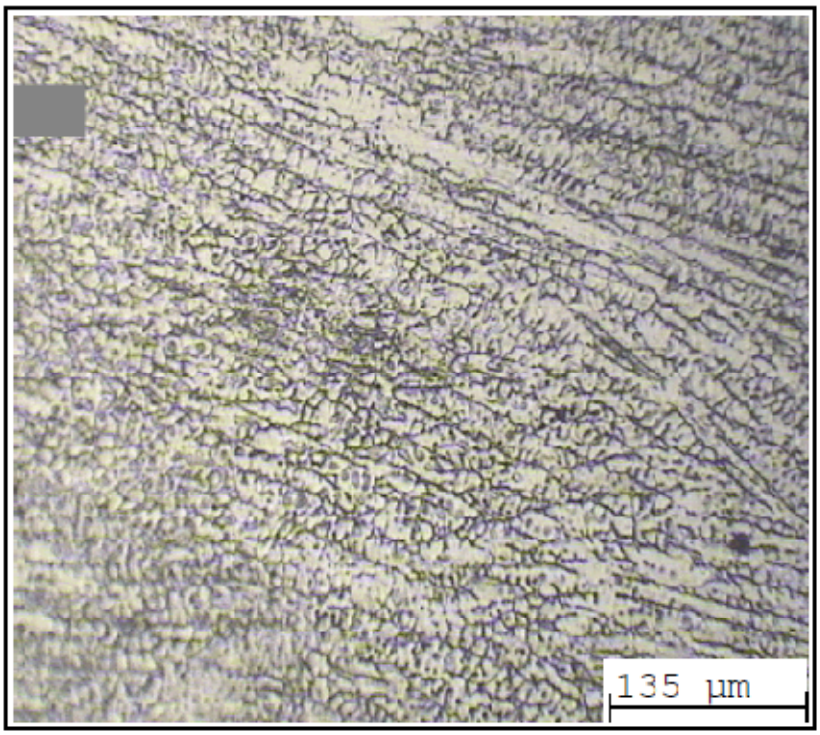

Figure 5

The results for the microstructure of weld metal stainless steel 202 represents a delta ferrite structure in matrix of austenite in weld metal

4. Conclusion

The stainless steel grade 202 was used for the present study to explore the strength using input process parameters selected from the trial runs for welding. The tensile strength obtained is fair enough to deal with the serviceability of AISI 202 in the prescribed applications. It can be stated that 202 SS can be utilized instead of 304 SS. The results obtained from the microstructure shows that structure consists of austenite grains in heat affected zone as well as in parent metal. The microstructure has a delta ferrite structure in matrix of austenite in weld metal. This result confirms previous research of several authors.

5. References

[1] Raafal M. Molak, Krystian Paradowski, Measurement of mechanical properties in 316L stainless steel welded joint, Int. J. Pressure vessels an piping, 86 (2009) 43-47.

[2] Lothongkum G, Viyanit E, Bhandhubanyong P. Study on the effects of pulsed TIG welding parameters on delta-ferrite content, shape factor and bead quality in orbital welding

[3] Yan Jun, Gao Ming, Zeng Xiaoyan, Study microstructure and mechanical properties of 304 stainless steel joints by TIG, laser and laser-TIG hybrid welding, J Optics and Lasers in Eng 48 (2010) 512-517.

[4] Morisada Yoshiska, Fujii Hidetoshi, Inagaki Fuminori, Kamai Masayoshi, Development of high frequency tungsten inert gas welding method, J Materials and Design, 44 (2013) 12-16.

[5] Durgutlu Ahmet, Experimental investigation of the effect of hydrogen in agron as a shielding gas on TIG welding of austenitic stainless steel, Turk J Materials and Design 25 (2004) 19-23.

[6] Kang B.Y, Prasad Yarlagadda K.D.V, Kang M. J, Kim H.J, Kim I.S, The effect of alternate supply of shielding gases in austenitic stainless steel GTA welding, J Mat Process Techn 10 (2009) 4722-4727.