

Comparison of Hardness and Tensile Strength of TIG and MIG Welding Using Stainless Steel-202

Saurabh Kumar Khotiyan

Assistant professor, Department of Mechanical Engineering, School of Technology, Quantum University, Roorkee,
Uttarakhand

Abstract: TIG (Tungsten Inert Gas) welding and MIG (Metal Inert Gas) welding are most important welding techniques in industry point of view. Stainless steel is a common material used in all industries. In this paper the study is done on welding technique (TIG or MIG) to find which welding technique is the best for stainless steel-202. The comparison is done on the basis of mechanical properties of the welded joint of TIG and MIG welding on stainless steel-202. It was observed that TIG welding has better in Tensile strength and hardness.

Keywords: TIG, MIG, Stainless Steel-202

1. INTRODUCTION

The stainless steel is a very useful material in structural engineering due to its high quality of physical property. With its better weld quality and joining efficiency stainless steel is one of the most popular material in current metal industries. From small houses to big buildings, stainless steel has its own importance. Welding is a process where joining is done by application of heat. There are many types of welding existing to weld different metals. So here arises a very interesting question that which welding technique is best to weld it, which is the aim of this paper.

2. TUNGSTEN INERT GAS (TIG) WELDING

In the tungsten inert gas welding process, the arc is maintained between a non-consumable tungsten electrode and a work piece in a protective inert gas atmosphere. Figure 1 shows the real processes.

Filler material is used externally for the joining of the work pieces. Normally, a DC arc is used with tungsten as the negative pole (DCEN). This is not possible for soft metals, where the oxide layer persists if the work piece is used as the anode. This layer prevents the formation of the weld pool. The mobile cathode spot can disperse the oxide layer but excessive heat is generated at the tungsten electrode if this is used as the anode.

Hence, AC arc is used for such materials. To avoid the melting of the electrode, thorium or zirconium is added to the tungsten (to increase the melting point). Argon is most commonly used to provide the inert atmosphere. Nitrogen is sometimes used for welding copper. To prevent the possible little contamination, an argon deoxidant is added to the filler (Ghosh and Mallik, 2005).

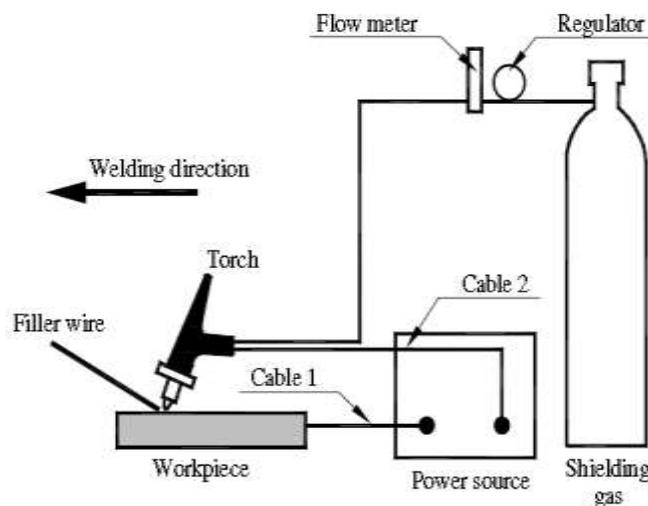


Fig. 1 TIG welding process

Direct polarity is the most commonly employed in GTAW. This effect produces a high heat in the work piece and therefore gives a good penetration and a relatively narrow weld shape. When alternating current is used, is possible to obtain a good combination of oxides elimination (cleanliness) and penetration (Ambriz and Mayagoitia, 2011). The polarity system used in the TIG welding process is shown in Fig. 2.

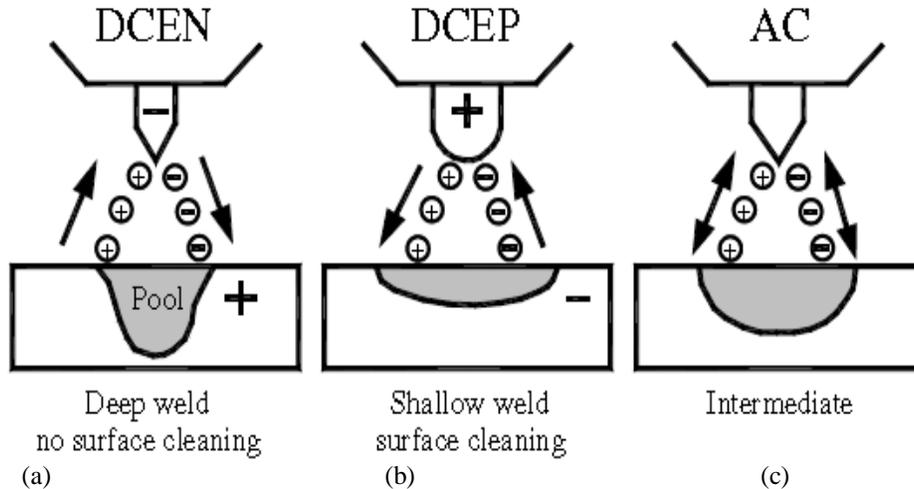


Fig. 2 Polarity in TIG welding process

3. METAL INERT GAS (MIG) WELDING

In MIG welding process the arc is maintained between a consumable electrode and the work piece in an inert gas atmosphere. The coiled electrode wire is fed by drive rolls as it melts away at the tip. Generally a DC source is used with the consumable electrode as the positive terminal. For welding steel, a shielding is provided by CO₂ for lowest cost. Normally, a high current density in the electrode (of the order of 10,000 amp/cm²) is used so that projected types of metal transfer results. The welding current is in the range 100-300 amp. The process is primarily meant for thick plates and fillet welds. Fig.3 shows the main process (Ghosh and Malik, 2005).

There are three basics metal transfer in MIG welding process: Globular transfer, Spray transfer and Short-circuiting transfer. In the *globular transfer*, metal drops are larger than the diameter of the electrode, they travel through the plasma gas and are highly influenced by the gravity force.

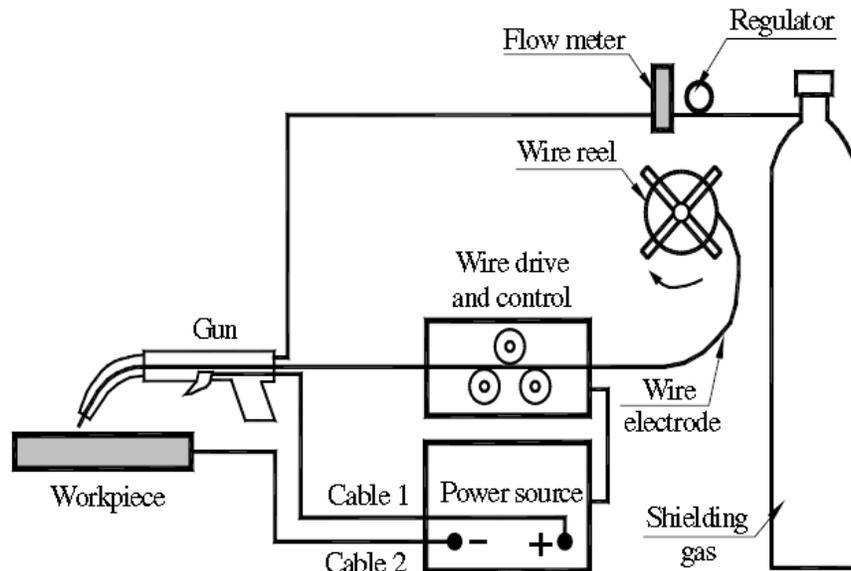


Fig. 3 MIG welding process

On the other hand, *spray transfer* occurs at higher current levels, the metal droplets travel through the arc under the influence of an electromagnetic force at a higher frequency than in the globular transfer mode.

In *short-circuiting transfer*, the molten metal at the electrode tip is transferred from the electrode to the weld pool when it touches the pool surface, that is, when short-circuiting occurs. Figure 4, shows the typical range of current for some wire diameters (Ambriz and Mayagoitia, 2011).

4. MATERIALS AND EXPERIMENTAL METHOD

This section mainly deals with experimental details and material used in this investigation work, like welding technique, specimen size and testing conditions etc. A stainless steel-202 having dimension of 100 x 50 x 6 mm plate is taken for this experiment. The chemical composition by weight percentage of stainless steel-202 sheet of 6 mm thickness (Bharwal Sahil, Vyas Charit-2014) is shown in table 1 given below:

Table 1 Chemical composition of Stainless Steel-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

5. RESULT AND CONCLUSION

In this investigation tensile testing has been done on UTM, hardness testing has been done on Brinell hardness tester, has been done on impact testing machine.

The hardness of the weld metal is measured with the help of the Rockwell hardness testing machine at B grade (HRB) and the values of the hardness in the weld region is shown in the Table 2:

Table 2 Hardness of the weld region

Type of Welding	Hardness of weld region (HRB)
TIG	102
MIG	96

Different types of tensile properties of welded SS-202 were evaluated such as yield strength, ultimate tensile strength, percentage elongation and joint efficiency. For each condition three specimens were tested and the average properties of the welded joints are taken, these properties are shown in the following Table 3.

Table 3 Tensile properties of welded joints

Type of Joint	Yield Strength (MPa)	Ultimate Tensile Strength (MPa)	Elongation (%)
TIG	279.2	430	5.3
MIG	263.6	412	4.8

6. CONCLUSION

After the welding by TIG and MIG mechanical properties of welds have been tested and following conclusions can be drawn:

1. It is found that the maximum hardness is found in TIG and the minimum hardness is found in MIG welded joint. The hardness pattern in the weld region in two welding processes is like, TIG > MIG.
2. Secondly we found that the yield strength, ultimate tensile strength, and percentage elongation is also maximum in case of TIG.

On the basis of the above discussion it can be elaborate that the TIG is the best suitable welding process to join Stainless Steel grade-202 as compared to MIG welding processes.

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