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COMPARATIVE STUDY OF MIG and TIG WELDING JOINT: A REVIEW

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Abstract

Welding is one of the most common process for joining of two similar or dissimilar metals permanently. There are various welding process like: Arc welding, gas welding, resistance welding etc. In this paper study carried out to review the impact of two important arc welding process i.e. MIG and TIG welding on AA-6061, AA-6062, mild steel and stainless steel. The mechanical properties of these joints are examined by performing test such as ultimate tensile stress, yield strength, percentage elongation, impact strength, hardness test, etc. It was observed that, for AA-6061 TIG welding is better than MIG welding whereas for AA-6062 MIG welding is good. However, for dissimilar metals joints TIG welding is more suitable than MIG welding.

Keywords: TIG, MIG, Aluminum Alloy, Mild steel, Yield Strength, Ultimate Tensile Strength, Hardness.

Introduction

Welding is the most common manufacturing process used to permanently join two similar or dissimilar metals and alloys with or without the application of heat and pressure. The heat required to weld the workpieces is obtained from different sources such as electric current, gas flame, etc. TIG and MIG welding processes are one of the most versatile welding process having vast applications in automobile, aerospace etc. The physical dissimilarity amongst the two processes is that TIG welding usages a non-consumable tungsten electrode whereas MIG welding usages a consumable electrode in wire form.

In **Metal Inert Gas welding (MIG)**, arc is developed between an electrode and workpiece in an inert gas atmosphere. The electrode used in the process is continuously fed through feed motor. There are three modes of metal transfer used in MIG. In **Spray transfer,** droplet size is much smaller than wire diameter and it travels through the gap under the influence of electromagnetic field. It has good deposition rate of metal and is more stable as compared to other modes of metal of transfer. In **Globular transfer,** droplet sizes are bigger than wire diameter and

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travels through the plasma gap under the influence of gravity. In **Short-circuit transfer,** droplet are transmitted from the electrode tip to the weld pool as it touches the pool surface (short-circuit) [1].

In **Tungsten Inert Gas welding (TIG)**, arc produced is formed between the workpiece and the electrode in an inert gas atmosphere using non-consumable tungsten electrode. In this, filler electrode is used externally. Usually, DC arc is used, with tungsten as negative polarity however while using aluminum and magnesium workpiece is taken as cathode because of the formation of oxide layer on using workpiece as anode. It produces good quality weld. Its welding can be performed with or without the use of filler metal. Direct polarity is usually used in GTAW because it produces high heat in the workpiece which gives good penetration and narrow weld shape. Argon is most common shielding gas used [1].

Literature review

Comparison of TIG and MIG welding for different material:

1. Mild Steel component

R. Sudarshan et al., [2] welded mild steel specimen by TIG and MIG welding. They performed tensile test on mild steel specimen to find ultimate tensile load (UTL), ultimate tensile stress (UTS), breaking load (B.L.) and breaking stress (B.S.), they conclude the following results:

Figure 2: Comparison of mechanical properties of TIG & MIG welded mild steel component [2].

From the above results, author concluded that:

- TIG welding has higher ultimate tensile load as compared to MIG welding.
- Breaking load for MIG welding is much smaller as compared to TIG welding.

2. Alunimum Alloy AA-6061

H.R. Ghazvinho et al. [3], had performed welding of AA-6061. They studied the effects of welding voltage, welding current and welding speed on mechanical properties of AA-6061 by performing impact strength test and hardness test.

After conducting experiment, it was found that impact strength of TIG welding is more as compared to MIG welding and hardness is more for TIG as compared to MIG.

Saurabh Kumar Khotiyan et al. [3], also had performed the welding of AA-6061 and compared the mechanical and microstructural properties of AA-6061 and found that TIG welding is better for AA-6061 as compared to MIG welding. The results obtained are given below:

From the above figure we concluded that MIG has better yield strength, joint efficiency and %elongation as compared to TIG welding joint of AA-6062. The microstructure examination reveals that MIG welded joint has very fine and equiaxed uniformly distributed grains as compared to TIG welded joint. Due to fine grains MIG welded joint has higher strength, %elongation and joint efficiency.

Mild Steel and Stainless SteelRadha Raman Mishra et al. [5] performed the experiments by taking dissimilar metals of

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Stainless steel and Mild Steel, and performed the tensile test. Results obtained are following:

CONCLUSION

Following conclusion can be derived from the above study:

For AA-6061, TIG weldment is preferable as compared to MIG welding due to higher yield strength, %elongation and joint efficiency whereas for AA-6062 MIG welding is preferable due to fine grain structure.

For mild steel, TIG welding is more suitable as compared to MIG welding as joint produced by TIG welding has higher Ultimate Tensile Strength, Breaking Load, etc.

For AA-6061 joint efficiency of TIG welding is more than MIG welding.

For dissimilar welding of mild steel and stainless steel, TIG welding is more suitable as compred to MIG welding because it gives weld strength, has less porosity, corrosion resistance and ductility.

References

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[2] Sudarshan, R., and M. Devaiah. "Effect of Process Parameters in MIG Welding on Mild Steel IS 2062." International Journal of Applied Engineering Research 13.4 (2018): 2046-2054.

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[5] Mishra, Radha Raman, Visnu Kumar Tiwari, and S. Rajesha. "A study of tensile strength of MIG and TIG welded dissimilar joints of mild steel and stainless steel." International Journal of Advances in Materials Science and Engineering 3.2 (2014): 23-32.

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***Figure 1**. TIG and MIG welding processes*

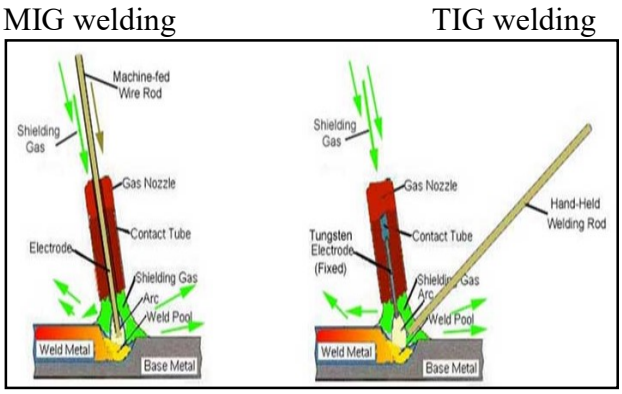
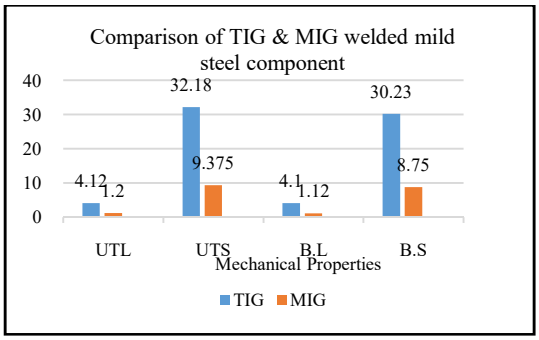


***Figure 2**: Comparison of mechanical properties of TIG & MIG welded mild steel component [2].*



From the above results, author concluded that:
TIG welding has higher ultimate tensile load as compared to MIG welding.
Breaking load for MIG welding is much smaller as compared to TIG welding

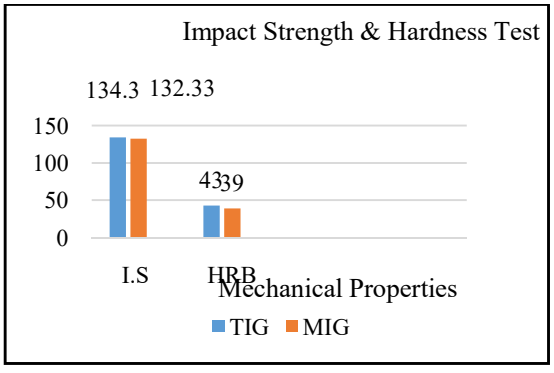


***Figure 3**: Comparison of hardness and impact strength of TIG & MIG welded Aluminum alloy [3]*

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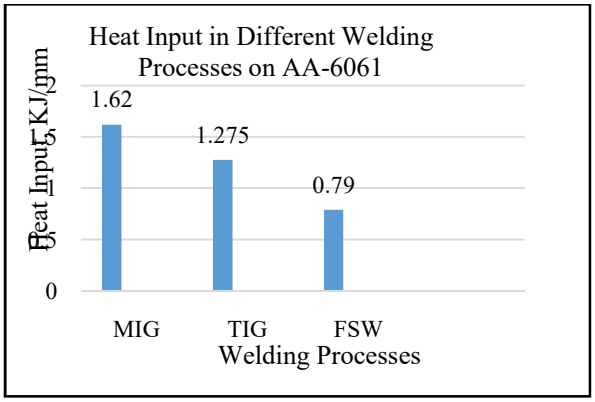

On the basis of Heat input

Figure 4: *Heat Input in Welding Processes TIG, MIG and FSW [1]*

On the basis of Joint Efficiency

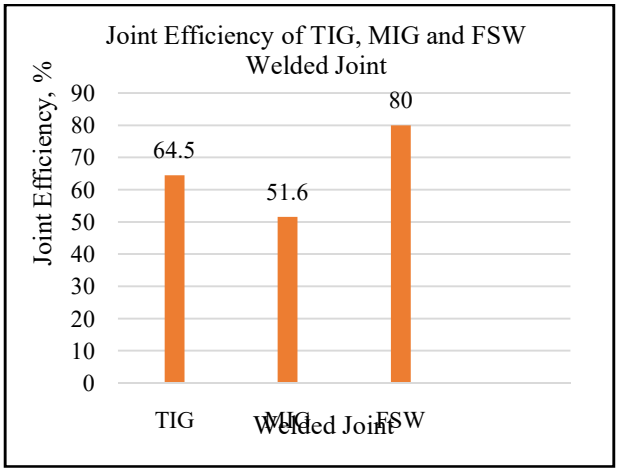

Figure 5*: Tensile Properties of BM and Different Welded Joints [1]*

[1] Aluminium Alloy A-6062

Yatender Gupta et al. [4] (2016) performed the welding on AA-6062 on TIG and MIG welding and compare the mechanical and microstructural properties and they conclude the following results:

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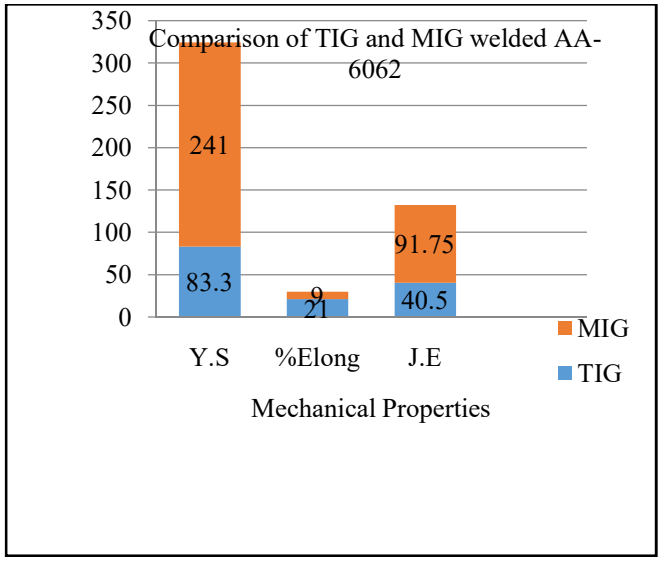

***Figure 6**: Comparison of mechanical properties of TIG & MIG welded AA-6062[4]*

Test sample	Material 1	Material 2
TS1	SS202	MS
TS2	SS304	MS
TS3	SS310	MS
TS4	SS316	MS

(a) Tensile Test

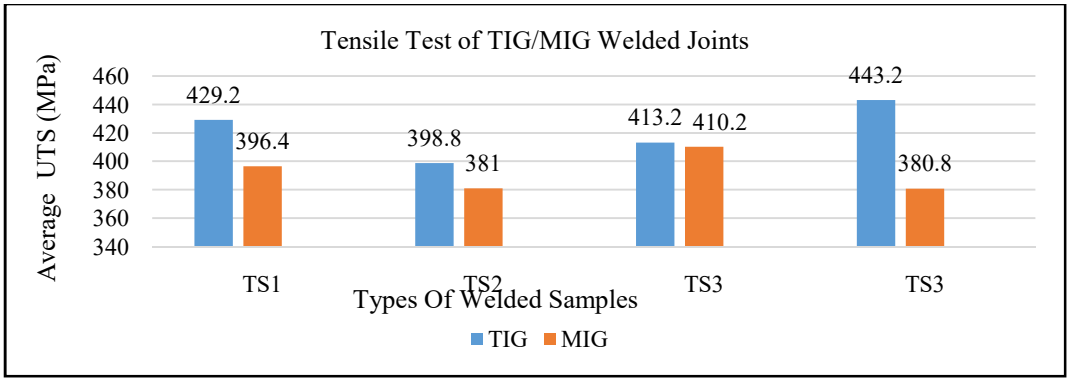

Figure 8: Comparative study of TIG and MIG welded joint for Tensile Test [5]

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(b) Yield Strength

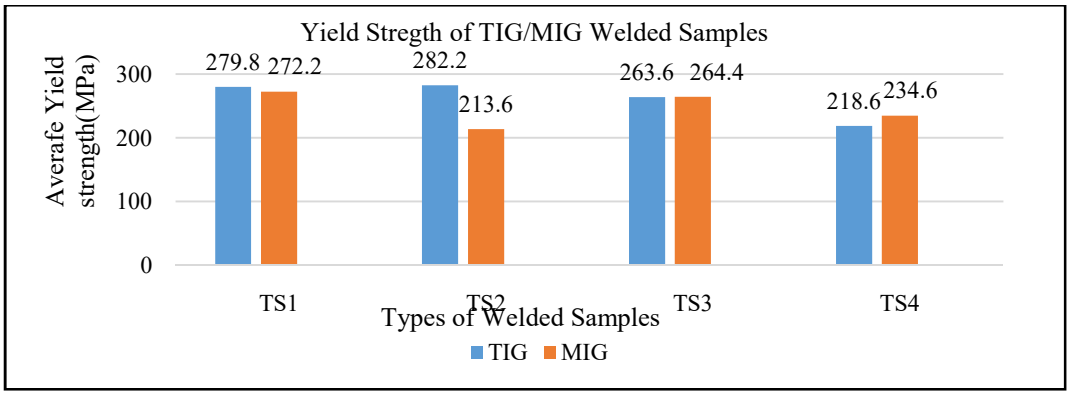

Figure 9: Comparative study of TIG and MIG welded joint for Yield Stregth [5]

(c) Average Percentage Elongation

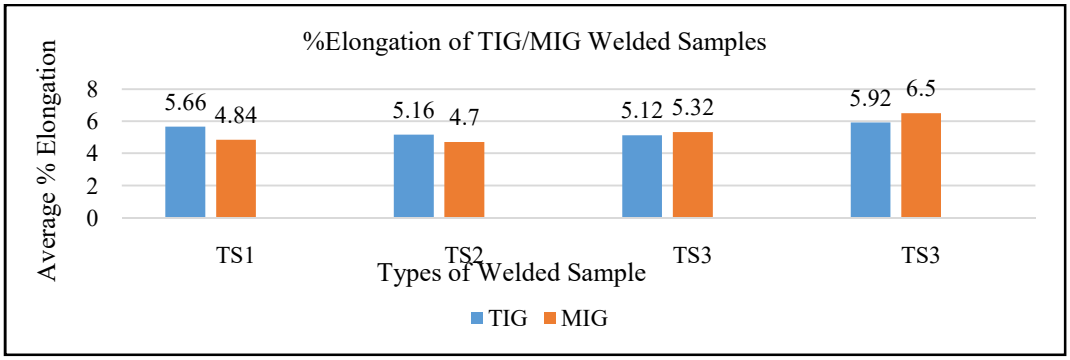

Figure 10: Comparative study of TIG and MIG welded joint for Average % Elongation [5]