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An Extensive Study of TIG welding

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INTRODUCTION

Tungsten Inert gas Welding is an arc welding process in which the arc is produced by a non-consumable tungsten electrode. An inert shielding gas (He or argon) shields the welded area from air contamination, and filler is typically employed when welding thick plate. Since the electrode has a melting point of roughly 3400^{o}C, it is not consumable. To increase electron emission, arc stability, and current carrying capacity, thorium and zirconium are added to tungsten electrodes at concentrations of 1 to 2%. Energy from a welding power supply with a steady current is conducted across the arc by a plasma column, which is made up of highly ionized gas and metal vapors.The filler material rate has no bearing on the amount of heat input in GTAW.

PRINCIPLE OF TIG WELDING

The electrode in a TIG welding method is non-consumable and serves only to form an arc.The tungsten electrode, molten metal, and heat-affected zone are all protected from ambient contamination by an inert gas blanket that is supplied through the GTAW torch. The TIG welding process's schematic diagram is displayed in Fig. 1. A lightweight handle with a space to hold a stationary tungsten electrode makes up a welding torch. The shielding gas in the welding torch enters the arc zone by a nozzle and passes by or along the electrode. Using a continuous current welding power source, an electric arc is formed between the electrode and the workpiece material. Energy is then transported across the arc by a column of highly ionized gas and metal vapors.

AREAS OF APPLICATION OF TIG WELDING

TIG welding is often used for jobs that demand high quality welding such as for instance.

- The offshore industry
- The petrochemical industry
- Power plants
- The chemical industry
- The food industry
- The nuclear industry
- Automobile

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- Aerospace

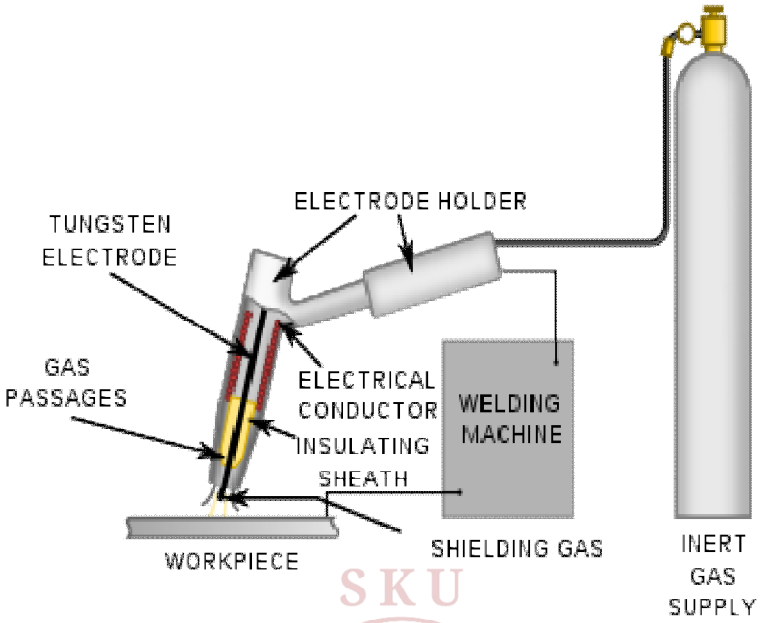

Fig. 1 Schematic diagram of Autogenous TIG welding

EXPERIMENTAL SETUP

Before you begin welding, ensure your workspace is clean, well-ventilated, and free from flammable materials. Secure the workpiece in a stable position, and ensure proper grounding of the welding machine to prevent electrical hazards.

WELDING TORCH

The TIG welding torch can be used manually or automatically. The structure of the manual and automatic torches is comparable. While the automatic torch often comes with a mounting rack, the manual torch features a handle. Hard copper or brass alloys are used to make a torch's interior metal components in order to efficiently transfer heat and electricity.

ELECTRODE

In TIG welding, a non-consumable tungsten electrode is employed. The tungsten electrode was securely held in the middle of the torch, and shielding gas was continuously flowing around it. Because tungsten has the highest melting temperature of all pure metals, it is employed as the electrode in GTAW. The tungsten electrode has a gas nozzle all around it. The material used to make this gas nozzle is typically ceramic. A tungsten electrode with a diameter of 2.4 mm has been employed for this experiment.

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POWER SOURCE

The TIG welding procedure requires a power supply with a steady current. Welding mild steel plate requires direct current with straight polarity. Direct Current with straight polarity welding is achieved by connecting the work material to the positive terminal of the DC welding equipment and the negative terminal to an electrode holder. TIG can use a pulsed or continuous DC power source. In order to maintain a consistent arc, a DC power source in steady state has been employed for the current work, where voltage can fluctuate but current remains constant.

INERT GAS SUPPLY

The welding torch relies on a gas cylinder to provide Argon gas. The gas flow rate is regulated by a suitable regulator and valve. The purpose of this inert gas is to protect the weld zone from atmospheric contamination, thereby preventing welding defects. In the current experiment, the gas flow has been maintained in the range of 12-15 l/min.

MOVABLE VEHICLE

The TIG welding operation utilizes a movable setup to ensure a consistent welding speed. This portable tractor securely holds the welding torch and plays a crucial role in maintaining the appropriate gap between the tungsten electrode tip and the workpiece being welded. It can be challenging to sustain a uniform weld speed and electrode-to-workpiece gap manually.

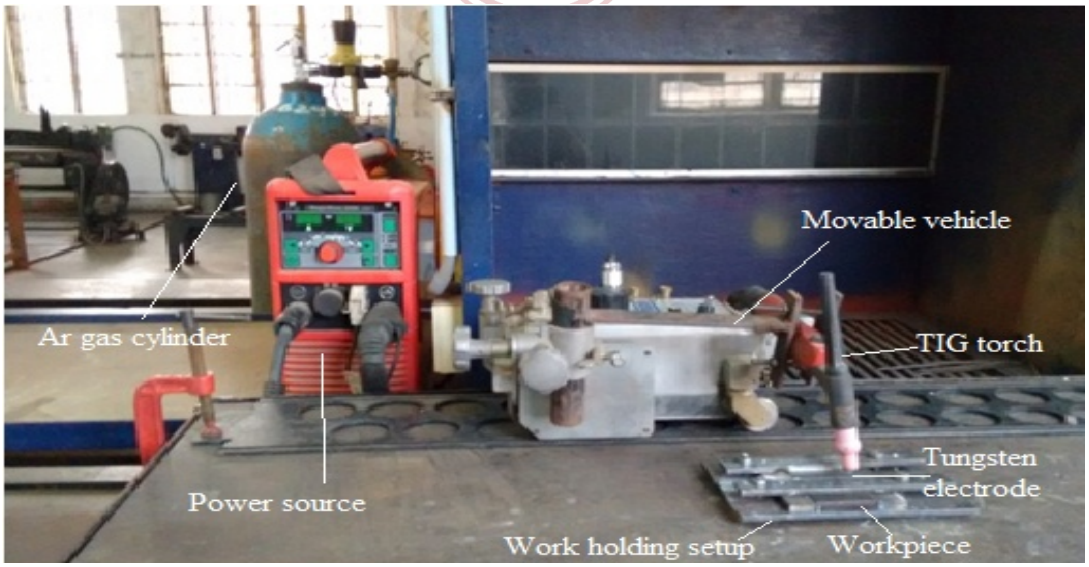

Fig.2 Experimental setup of TIG Welding

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BASIC WELDING TECHNIQUES

ARC STARTING

To start the arc, gently tap the tungsten electrode against the workpiece while also pressing the foot pedal or activating the torch switch. Once the arc is formed, gradually pull back the electrode to establish a steady welding arc. If you need any more details or assistance, feel free to ask.

TORCH CONTROL

Remember to focus on controlling the torch angle and travel speed to ensure a consistent weld bead formation. It's essential to maintain a slight angle of about 10-15 degrees while keeping a steady forward motion to prevent excessive heat buildup.

FILLER METAL ADDITION

When working with thicker materials or forming fillet welds, it's important to incorporate filler metal into the weld pool. Keep the filler rod dipped into the front part of the weld pool while sustaining the arc to guarantee correct fusion.

SHIELDING GAS COVERAGE

Filler metal must be added to the weld pool when working with thicker materials or creating fillet welds. To ensure proper fusion, keep the filler rod dipped into the front portion of the weld pool while maintaining the arc.

SAFETY PRECAUTIONS

- Wear the right personal protection equipment at all times, such as flame-resistant clothes, welding gloves, and a helmet with a suitable shade lens.
- To avoid being exposed to potentially dangerous gases and fumes, avoid welding in small areas without adequate ventilation.
- Regularly check your equipment and replace any worn or damaged parts to guarantee dependable and safe performance.

PRACTICE MAKES PERFECT

Learning to TIG weld takes time and experience. Ascend to more complicated welds improvement.Work your way up to more complicated welds by starting with spinout progress.It takes time and practice to become proficient at TIG welding. Ascend to more complicated welds by starting with easier jobs. Initial setbacks shouldn't deter you; effort and dedication will eventually result in improvement.

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CONCLUSION

- It conclude that the conventional TIG welding process performed show that, maximum depth of penetration was obtained with parametric combination of minimum welding speed and maximum current.
- When the same procedure is repeated with additional utilization of flux powder, depth of penetration increases in comparison to the conventional welding along with change in the tensile strength of weld.
- When maintain a constant welding speed, another set of experiments are done by maintaining a gap between workpiece. It is observed that, with a gap of 1 mm, defect-free welding with proper material flow obtained throughout the joint.
- Comparing the three methods of TIG welding, depth of penetration and tensile strength of weld joint is maximum when adequate gap is maintained between the components to be welded.

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