

The effect of Welding Parameters on Mild Steel by MMAW

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ABSTRACT

In this work, effect of welding parameters on the weld ability of mild steel which is welded by Metal arc welding, butt joint is investigated. The current and voltage are chosen as welding parameters. The effect of welding parameters is investigated on depth of penetration and Heat input which are measured as output parameters of welding.

Key words: Mild steel, Arc welding, Welding current, welding voltage, Welding speed

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1. INTRODUCTION

Today a wide variety of metal joining processes are used in fabrication industries. The welding is majorly used for metal joining. In this process arc i.e. electric discharge between electrode and parent metal is established. Due to high electrical resistance of welding arc high temperature is produced which is enough to melt the metal. MMAW - Manual Metal Arc welding is one of the oldest arc welding processes. Mild steel is widely applicable in fabrication of structure, process equipment, piping and ship building. The major factors affecting mechanical properties of weld joint are welding current, arc voltage, welding speed, polarity, edge preparation and welding technique. Out of these variables welding current, welding voltage and welding speed are primary variable which controls the fusion, depth of penetration, shape of weld puddle, reinforcement and heat input. Electrode polarity, inclination angle and welding technique are secondary variable which affect on energy absorbed, melting rate of base metal and weld metal. So in the present work. The effect welding current, are voltage on mechanical properties of mild steel elements have been investigated.

2. LITERATURE REVIEW

Manual metal arc welding was first invented in Russia in 1888. It involved a bare metal rod with no flux coating to give a protective gas shield. The development of coated electrodes did not occur until the early 1900s when the Kjellberg process was invented in Sweden and the Quasi-arc method was introduced in the UK [1]. It is worth noting that coated electrodes were slow to be adopted because of their high cost. Welding is a wide process used for fabrication to join two materials. The authors considered welding parameters such as voltage, current and welding speed on depth of penetration. The material was carbon alloy steel(0.14%C) of dimension 75 x 50 x6mm, voltage 18v and current was 250amps. The maximum penetration takes place with minimum speed even by maintain constant voltage and current[2]. Welding is more economical, convenient and less susceptible to failure or corrosion as compared to other joining processes. Owing to the advantages of welding over other joining process, numerous welding processes have been Developed [3]. For manual welding methods, labor costs generally make up the vast



majority of the total cost. As a result; many cost-saving measures are focused on minimizing operation time. To do this, welding procedures with high deposition rates can be selected, and weld parameters can be fine-tuned to increase welding speed. Mechanization and automation are often implemented to reduce labor costs, but this frequently increases the cost of equipment and creates additional setup time. Material costs tend to increase when special properties are necessary, and energy costs normally do not amount to more than several percent of the total welding cost [4]. The primary investigation was done to know effect of welding parameters such as current, arc voltage, welding speed, heat input rate on Heat affected zone. It was observed that there is change in structure of material from austenite into bainite which could improve strength and impact toughness. It was known that by increasing speed the width of HAZ decreases and it is necessary to control welding parameters to get better weld quality bead [5]. The author investigated multiple weld qualities of welding input process parameters for obtaining greater weld strength with optimum metal deposition rate in welding of dissimilar metals like stainless steel and Mild steel. The process used for welding is Manual Metal Arc welding and dissimilar metals used are low carbon steel and Stainless steel. Welding speed, voltage, current, electrode angle are taken as controlling variables [6].

From the literature survey it is concluded that the most commonly primary variables in are welding arc welding current, voltage & speed, which would change characteristics of joint

2.1 Welding current: Welding current is an influential variable that control melting rate of electrode, there by the deposition of electrode rate on joint. It also controls the depth of fusion, and penetration

2.2 Welding Arc Voltage: Welding arc voltage is also called are arc voltage, is the electrical potential difference between tip of electrode and the surface of molten weld pool. It effects on shape of fusion zone, welding reinforcement electrode melting rate etc.

2.3 Welding Speed: Welding speed is the linear speed at which are moves with respect to plate, along with the weld joint. If speed get increases the heat input to the joint decreases and if speed get decreases, heat input increases.

2.4 Heat Input: Heat input rate or energy of arc was an important parameter in welding which can be calculated

Heat input rate = $V \times I \times 60 / v$ J/mm

Where V= Arc voltage in volts

I= Welding current in ampere

v= welding speed or arc travel speed (mm/min)

3. EXPERIMENTAL METHODOLOGY

3.1 EXPERIMENT PROCEDURE

Following steps are followed for experiment

1. First 36 specimens of dimension 70mm x40mm x5mm from mild steel flat.
2. 45° single V edge preparation was made on these specimens.
3. Before welding the specimens are cleaned from dust, oil to avoid impurity in molten metal pool.
4. Welding was made by closed butt joint thus edges of the work piece are suitably prepared.
5. Work pieces are kept in position with respect to each other and welding was performed.



Fig-1 EXPERIMENTAL SETUP

3.2 PARENT METAL USED & ITS CHEMICAL ANALYSIS

Mild steel flat pieces of 70 mm x 40mm x 5 mm thickness. The chemical analysis of mild steel is as shown in Table -1.

Table -1 Chemical Composition of Base Metal Element

| ELEMENT | Cr | Ni | C | Mn | S | P | Si | N |
|---------|------|------|------|-----|------|-------|-----|---|
| % of Wt | 0.69 | 0.01 | 0.19 | 0.8 | 0.04 | 0.017 | 0.4 | - |

3.3 Electrode used & its Chemical Analysis

3.15 mm diameter and 350 mm long electrode was used for welding. Chemical composition of electrode is shown in Table – 2.



Fig-2 WELDING ELECTRODE

Table -2 Chemical Composition of Electrode

| ELEMENT | C | Mn | Si | S | P |
|---------|------|------|------|------|------|
| %of Wt | 0.07 | 0.44 | 0.22 | 0.02 | 0.02 |

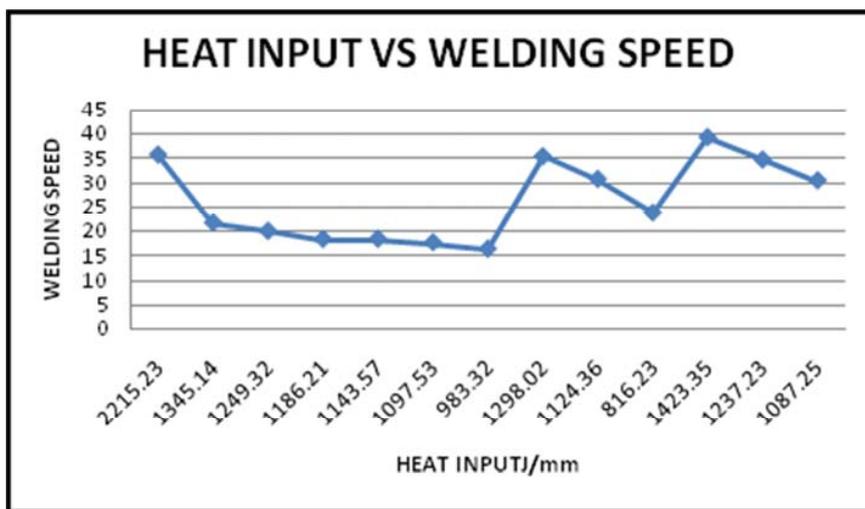
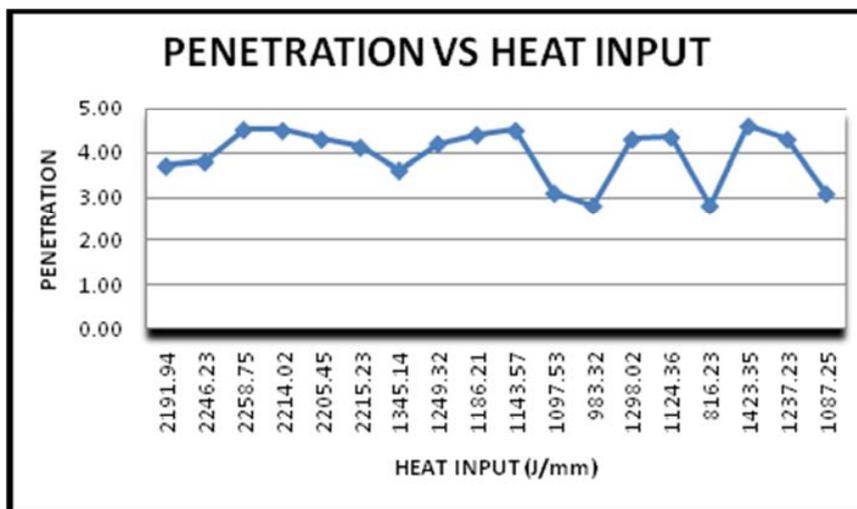
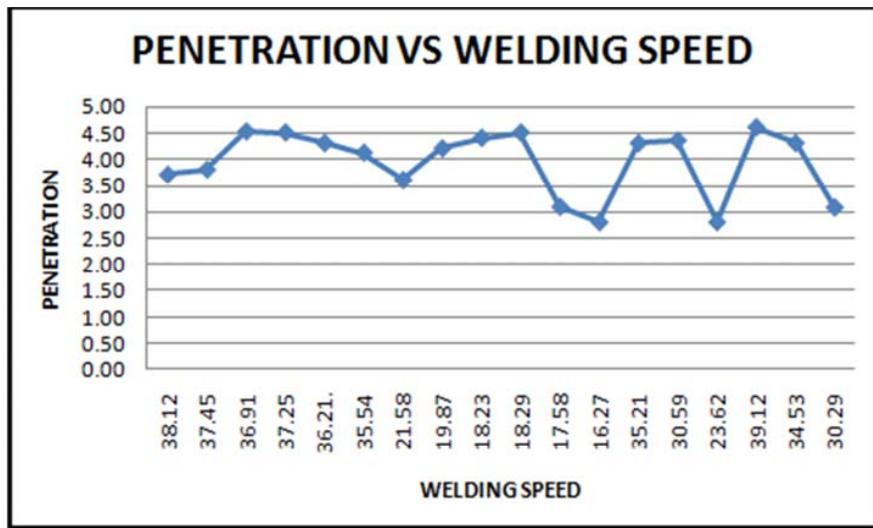


Fig-3 WELDING MACHINE

In this work metal arc welding is used. Arc welding is a welding process, where Coalescence is produced by heating with an electric arc or arcs, mostly without the application of pressure and with or without the filler metal. The safety precautions & corrective measures taken to avoid accidents and to get good quality weld beds. In welding process speed of welding was varied along with the arc voltage and current. The voltage and current is varied in three steps as shown in following table3.

TABLE 3. VARIOUS PARAMETERS OF WELDING

| SLNO | Welding Voltage | Welding Current (Amp) | Welding Speed (mm/min) | Heat Input (J/mm) | Penetration In mm |
|------|-----------------|-----------------------|------------------------|-------------------|-------------------|
| 1 | 15 | 205 | 38.12 | 2191.94 | 3.70 |
| 2 | 15 | 205 | 37.45 | 2246.23 | 3.80 |
| 3 | 15 | 205 | 36.91 | 2258.75 | 4.52 |
| 4 | 15 | 205 | 37.25 | 2214.02 | 4.50 |
| 5 | 15 | 205 | 36.21 | 2205.45 | 4.30 |
| 6 | 15 | 205 | 35.54 | 2215.23 | 4.12 |
| 7 | 20 | 91 | 21.58 | 1345.14 | 3.60 |
| 8 | 20 | 91 | 19.87 | 1249.32 | 4.20 |
| 9 | 20 | 91 | 18.23 | 1186.21 | 4.40 |
| 10 | 20 | 91 | 18.29 | 1143.57 | 4.50 |
| 11 | 20 | 91 | 17.58 | 1097.53 | 3.09 |
| 12 | 20 | 91 | 16.27 | 983.32 | 2.80 |
| 13 | 25 | 122 | 35.21 | 1298.02 | 4.30 |
| 14 | 25 | 122 | 30.59 | 1124.36 | 4.35 |
| 15 | 25 | 122 | 23.62 | 816.23 | 2.80 |
| 16 | 25 | 122 | 39.12 | 1423.35 | 4.60 |
| 17 | 25 | 122 | 34.53 | 1237.23 | 4.30 |
| 18 | 25 | 122 | 30.29 | 1087.25 | 3.08 |



4. RESULTS AND DISCUSSION

The speed of the welding was calculated for each welded specimen and the depth of penetration was measured by cutting cross section perpendicular to direction of welding. The variation of depth of penetration, welding speed and heat input is analyzed from graph 1, 2 and 3. From graph it was observed that depth of penetration linearly increases by decreasing the speed and reaches maximum depth and later it gets decreases, even though by maintaining constant voltage and current. The depth of penetration increases at each case of voltages and current with the increased heat input up to maximum and gets decreases gradually as heat input decreases. And least depth of penetration 2.8mm was observed at lowest heat input 816.23J/mm value even by maintaining constant voltage and current. And maximum depth of penetration is at heat input value 2258.02 J/mm. The graph welding speed Vs Heat input shows that by maintaining constant welding speed a heat input remains constant with small variation. So it can be stated that at different voltage, current and welding speed effects on depth of penetration and heat input.

5. CONCLUSIONS

- Even by maintain constant voltage and current, depth of penetration varies with welding speed and maximum depth was observed at speed of 39.12mm/min for voltage 25V and current 122amps.
- So it can be concluded that increase in speed and by maintaining constant voltage and current depth of penetration increase up to maximum value and if speed increases beyond the optimum value results to decrease in depth of penetration.

6. REFERENCES

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