To Study the Effect of Wind Velocity on Weldablility of ASTM A36 Grade Steel using MMAW

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Abstract: - Welding is a process in which localized coalescence (permanent joint) is produced by heating the material up to suitable temperature with or without application of filler material. Normal arc welding is performed in an open atmosphere and effect of the wind velocity, on the weld is neglected. So in this study, experiment is conducted to find the effect on weld strength, using arc welding with varying wind velocity. Welding was performed at wind velocity, varying from (0-20) kmph and welding parameters are kept constant. To find out the Weld strength, tensile test and Impact loading test is performed and Dye penetration test is performed to find out the surface defects.

Key- Words: - Metal arc welding, Electrode, Wind velocity, Die penetrant test, Tensile testing

1 Introduction

In Welding process two pieces of metal are joined together so that bonding takes place at their original boundary surfaces". When two parts to be joined are melted together, heat or pressure or both is applied and with or without added metal for formation of metallic bond.

The electrodes are used in shielded metal arc welding process are known as stick electrode, which are covered electrode or coated electrode.

The primary effect of a strong cross wind is to displace (or blow away) the shielding gas used to protect the weld metal during metal transfer and solidification. In absence of shielding gas can result in gross of nitrogen into the weld metal.

To provide protective environment to the arc zone and weld pool with the help of inert gases (like carbon dioxide) generated by thermal decomposition of constituents present in coatings such as hydrocarbon, cellulose, charcoal, cotton, starch, wood flour

SMAW electrodes have been used for field welding since their development, and are widely accepted. Cellulosic and retile electrodes generate a CO/CO_2 shielding gas with a high proportion of hydrogen during welding, while limestone ($CaCO_3$) is used in basic electrodes to effectively generate a CO/CO_2 shielding gas during welding.

2 Literature review

Welding can have traced its historic development back to ancient times. In welding major development happened in 19th century.

Oscar Kjellberg of Sweden invented a covered or coated electrode. The stick electrodes were produced by dipping short lengths of bare iron wire in thick mixtures of carbonates and silicates. Then coated electrodes dry Arc welding is most commonly and widely used welding technique for variety of purposes. Weld joint may not be very reliable unless the weld is of reasonably good quality. Improving the weld quality is of prime concern. Arc welding is commonly used for welding of mild steel, cast-iron, stainless steel [1]. Arc welding is performed in an open atmosphere having no surface wetness. Wind Welding is not allowed during the period of high winds unless the welder and the weld are shed adequatel [2].

2.1 Impact Load Testing

Historically, the impact-pendulum test method and associated apparatus were suggested (in nearly their current forms) by S. B. Russell in 1898 (Russell, 1898) and G. Charpy in 1901 (Charpy, 1901a, b). A. G. A. Charpy presented his fundamental idea in France in the June issue of the Journal of the Soc. Ing. Civ. de Francais and in the Proceedings of the

Congress of the International Association for Testing of Materials, which was held in Budapest in September 1901. The impact-test procedure seems to have become known as the Charpy test in the first half of the 1900's, through the combination of Charpy's technical contributions in developing the procedures which became a robust, engineering tool. Considering the material behavior in the design of different types of construction operations at different conditions because the science and technology of failure prevention is intimately associated with failures and accidents. From this, it follows that the development of new material-testing procedures occurred in close connection with the history of engineering science [3].

2.2 Historical background of tensile testing

The importance of tensile testing of metallic materials should be recognized by the fact that one of the earliest British Standards, BS18 covering this subject, was published in 1904. The first British Standard, published in 1903, set down the required shapes (sections) of rolled metallic products; this was issued by the British Engineering Standards Association (BESA), which included leading engineers and scientists, and which was first constituted on 26th April 1901. This organization was supported by The Institution of Civil Engineers, The Institution of Mechanical Engineers, the Institution of Naval Architects, The Iron and Steel Institute and the Institution of Electrical Engineers. By 1920 there were over 300 committees in the UK focused on the specification, production and testing of engineering products. In April 1929, the Association was granted a Royal Charter [4].

2.3 Penetrant Testing

Penetrant testing, also called dye penetrant or liquid penetrant testing, is the use of specifically designed liquid penetrating dye to detect discontinuities at the surface of a weld or base metal. The penetrant is applied to the surface, and left on the surface for a specified time to penetrate cracks, pores, or other surface-breaking discontinuities, and is carefully removed Then .developer is applied to the surface, which takes out the penetrant from the discontinuities. This result in visible contrasting indication in the developer, which may be removed for closer visual examination of the area providing indications.

Dye penetrant inspection finds hairline cracks the visible dye penetrant inspection process detects surface cracks and other flaws, such as laps and pores in all metals and non metals also. It is used for determining the integrity of a weld. Flaws appear as red marks on a white background during dye penetrant inspection. The cracks are also seen as thin red lines on a white background [5] &[6].

3 Experimental setup

The manual metal arc welding machine is used to conduct the welding operation the test rod used are 3.2mm diameter, length 120mm ,at 100volts current impulses. Welding transformers is a transformer having thin primary windings with large number of turns is shown in figure 1.

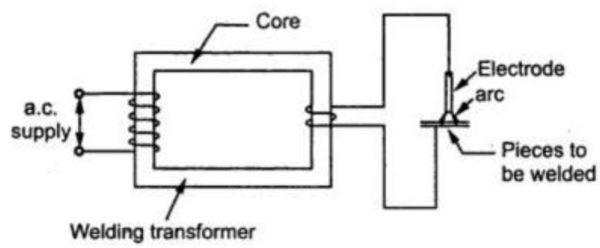

Figure 1: Welding transformer

While the secondary is having one more area of cross-section and with less number of turns. This ensures very high current and less voltage in the secondary. One end of the secondary is connected to welding electrode and the other end is connecting to the pieces to be welded. Due to the gap resistance between the electrode and pieces to be welded, when a very high current flows and heat is produced. This heat is very large. Due to this heat, a tip of electrode melts and fills the gap between the two pieces.

The main elements in the experiment welding transformer in SMAW process, varying the wind the artificially by fan, it's measured by Anemometer.

Anemometer

Anemometer measures the speed or (velocity) of the moving air. Mini LCD Digital Anemometer measures the wind speed and the temperature. The wind speed measuring range is from 0 m/s to 40m/s. It measures the maximum and the minimum wind speeds in beau fort wind scale. Anemometer can be divided into two classes; one that measures the wind's speed, and second that measure the wind's pressure; but as there is a close connection between the pressure and the speed, an anemometer will give information about the both.

Test procedure:

Many computer based testing systems have automatic range selection and will capture data even if the range selected is initially too small. The identity of each specimen should be verified, and identification should be accurately recorded for the test records. The dimension needed to calculate the cross sectional area of the reduced section should be measured and recorded. These measurements should be repeated for every specimen; it should not be assumed that the sample preparation is perfectly consistent. The load indicator zero and the plot load axis zero, if applicable, should be set before the specimen is held in the grips. Zeroes should never be reset after the specimen is in position. The specimen is placed in the grips and is secured by closing the grips. Then the extensometer if applicable is installed, but one should be sure to set the mechanical zero correctly. The strain readout zero should be set after the extensometer is in place on the specimen.

Tensile Test setup:

The basic test for the determination of material behavior is tensile test. Generally, it is carried out using a round specimen. When determining the strength of a welded joint, also standardized flat specimens are used. A specimen is ruptured by the test machine the actual force and the elongation of specimen is measured. With these measurements values, tension σ and strain ε are calculated. If σ is plotted over ε, the drawn diagram is typical for test. The most important characteristic values which are determined by this test are: Yield stress, Tensile strength, and elongation. It consists of Gripping Device, Extensometers, Temperature control. Setup of the tensile test consists test piece in a loaded frame of suitable testing machine. Tensile load is the most important factor of testing machine; other factors include proper gripping and the alignment of the test piece and installation of the extensometers, strain sensors and plastic deformation (yield formation).

Impact Load Test

Toughness is a measure of the amount of energy a material can absorb before fracturing. It becomes of engineering importance when the ability of the material to withstand an impact load without fracturing is considered. Impact test conditions were more as severe as comparatively more potential for fracture i.e.

- Deformation at a relatively low temperature
- A high strain rate (i.e. rate of deformation) and
- A tri-axle stress test (which may be introduced by the presence of a notch)

Dye penetrant test

Dye penetrant inspection process detects open cracks and other flaws, such as laps and pores in all metals, non metals. It is widely used for determining the quality of a weld. Flaws appear as red marks on a white background with dye penetrant inspection, cracks appear as vivid red lines on a white background. The process consists of:

- Applying a liquid, red dye penetrant which in enters surface flaws,
- Removing the red dye penetrant that did not enter a defect, and
- Spraying on a white developer.

Tensile Test

TABLE 1
TENSILE TEST

Wind speed (kmph)	Values (in mpa)
0	414
10	400
15	390
20	378

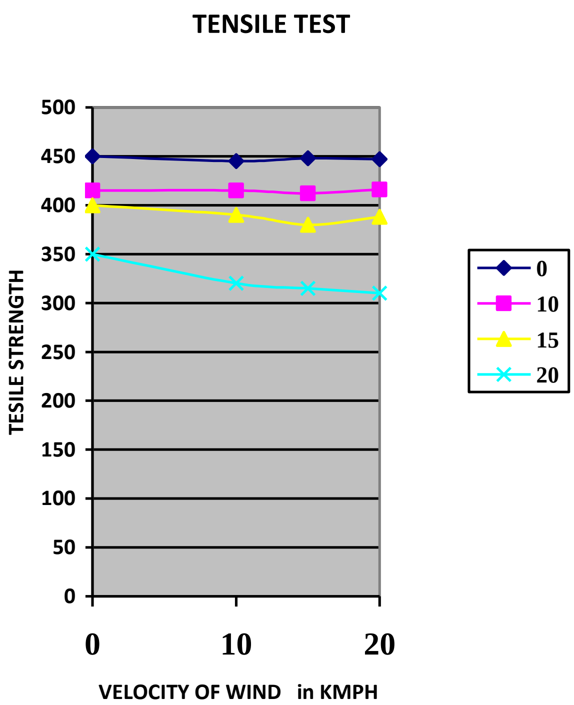

Figure 2: Tensile Test

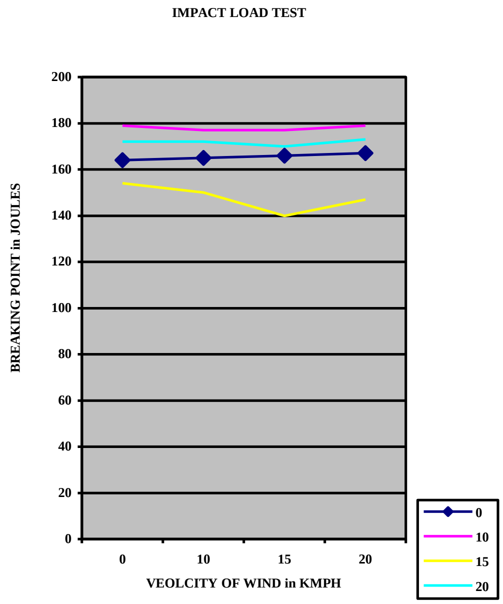

Figure 3: Impact Load Test

Impact Test:

TABLE 2
CHARPY TEST

Wind speed (kmph)	Values (in joules)
0	164
10	179
15	154
20	172

Dye Penetration Test

We could only find out the cracks happened at 20kmph the images are mentioned below stepwise.

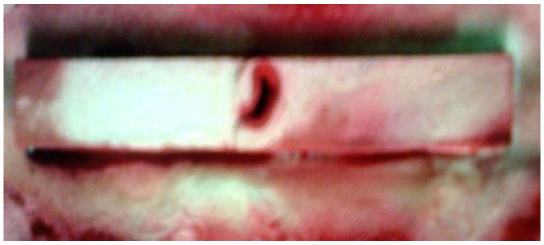

Figure 4: Dye Penetration Test

4 Conclusion

Increasing the speed of wind the desired weld strength consistently decreases as wind not allows the arc to set between the two weld specimens. At speed 15-20 kmph, cracks and lack of fusion were seen. As mild steel is welded at various wind velocities, from the tests we have found out that, at 10 kmph we obtained the best result.

Further study can be done to investigate the microstructures. Non destructive tests can be performed for further studies of the weld. Similar studies can be done for TIG and MIG welding.

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