Evaluation of Mechanical Properties of Metals by Using Different Metal Joining Process

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ABSTRACT: This paper titled "Evaluation of Mechanical Properties of Metals by Using Different Metal Joining Process." Describes the mechanical properties of material before and after the welding. The material chosen for study is Mild Steel Flat and Mild Steel rod this studies were conducted based on the experimental values taken on and by comparing them by using graphs. Mechanical properties can be finding by finding tensile strength on the UTM machine. We also studied the weld zone mechanical properties under various welding operations like TIG, MIG and Gas welding on MS. flat and MS. Rod . Also compared the all values.

Keywords - Joining Process, Metal.

1. INTRODUCTION

The evaluation of mechanical and metallurgical properties has become the essential step to check the material defects and its strengths before and after welding for the application of different loads. Various conventional techniques are utilized for finding the above result by using the desired material.

This is an attempt has been made to find the material defects and also its strength to bare different loads before and after welding. The history of joining metals goes back several millennia. Called forge welding, the earliest examples taken from the Bronze and Iron Ages in Europe and the Middle East The ancient Greek historian . Herodotus states in The Histories of the 5th century BC that "Glaucus of Chios " was the man who single-handedly invented iron welding". Welding was used in the construction of the Iron pillar of Delhi, erected in Delhi, India about 310 AD and weighing 5.4 metric tons.

The middle Ages brought advances in forge welding, in which blacksmiths pounded heated metal repeatedly until bonding occurred. In 1540, Vannoccio Biringuccio published De la pirotechnia, which includes descriptions of the forging operation. Renaissance craftsmen were skilled in the process, and the industry continued to grow during the following centuries.

In 1800, Sir Humphry Davy discovered the short pulse electrical arc and presented his results in 1801. In 1802, Russian scientistVasily Petrov also discovered the electric arc, and subsequently published "News of Galvanic-Voltaic Experiments" in 1803, in which he described experiments carried out in 1802. Of great importance in this work was the description of a stable arc discharge and the indication of its possible use for many applications, one being melting metals.

In 1808, Davy, who was unaware of Petrov's work, rediscovered the continuous electric arc. In 1881–82 inventors Nikolai Benardos (Russian) and Stanislaw Olszewski (Polish) created the first electric arc welding method known as carbon arc welding using carbon electrodes. The advances in arc welding continued with the invention of metal electrodes in the late 1800s by a Russian, Nikolai Slavyanov (1888), and an American, C. L. Coffin (1890). Around 1900, A. P. Strohmenger released a coated metal electrode in Britain, which gave a more stable arc. In 1905, Russian scientist Vladimir Mitkevich proposed using a three-phase electric arc for welding. In1919, alternating current welding was invented by C. J. Holslag but did not become popular for another decade.

2. NEED FOR PRESENT WORK

The present work aims to find the mechanical and metallurgical properties of metals before and after welding of mild steel flat and rod. This process assesses the material mechanical strength for the application of different loads on it before and after welding. By the use of these properties we can find the weld strength and also the material defects caused during welding by metallurgical properties.

3. DIMENSION OF CHOSEN METAL

3.1 MS bright rod: Length-300mm, Diameter-12.7mm
3.2 MS flat: Length-300mm, Width-40mm, Thick-3mm
Material used:

Mild steel rod (bright) was used as the substrate material. The sample of 12.7 diameters, 300mm length was used.

4. WORK PIECES AFTER BREAKAGE ON UTM

Fig01: Arc welded piece after breakage

Fig02: Gas welded piece after breakage

Fig03: MIG welded piece after breakage

By using the below values, we can find the % elongation in length and % of reduction in area of all specimens

1 Tabulated values for MS.Rod

M.S. Rod							
S.NO	Type of work piece	Original length of rod(mm)	Final length of specimen(mm^2)	Original cross sectional area(mm^2)	Final cross sectional area(mm^2)	% of elongation in length	% of reduction in area
1	Normal specimen	200	244	12.7	7.3	22	66.95
2	Arc welded specimen	200	224	12.7	8	12	60.31
3	Gas welded specimen	200	218	12.7	10	9	37.93
4	MIG welded specimen	200	232	12.7	7.5	16	65.1

7.2 Tabulated values for MS.Flat Table

M.S.Flat							
S.NO	Type of work piece	Original length of rod (mm)	Final length of specimen (mm)	Original cross sectional area (mm^2)	Final cross sectional area (mm^2)	% of elongation in length	% of reduction in area
1	Normal specimen	200	250	40	23	3	2.4
2	Arc welded specimen	200	226	40	26	3	2.8
3	Gas welded specimen	200	212	40	27	3	2.9
4	MIG welded specimen	200	228	40	24	3	2.6

7.1 calculations for M.S rod:

7.4.1 Normal piece calculation

Length of the rod =200mm ,

Diameter of the rod =12.7mm

Area of the rod (A_0) =$\pi/4(d)^2$

=$\pi/4(12.7)^2$=126.6mm

^{2}Deflection length of the rod = 44mm

Diameter of the deflection = 7.3 mm

Area of the rod after deflection=$\pi/4(d)^2$

=$\pi/4(7.3)^2$=41.83mm^{2}Stress (σ)=F/A=5400/126.6=42.6N/mm^2

% of elongation in length = (L^*_0- L_0/ L_0)*100= ((244 – 200) /200)*100 = 44/2 =22%

% reduction in area = (A_0- A^*_0/ A_0)*100= ((126.6-41.83) /126.6)*100 = 66.95%

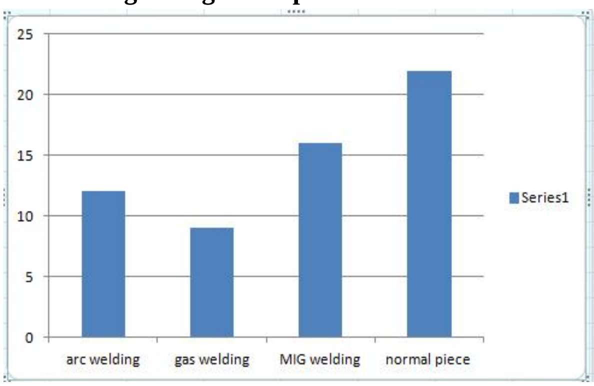
The remaining calculations for MIG and TIG welding as like arc welding

8.1 Comparison of welding strength by using graphs

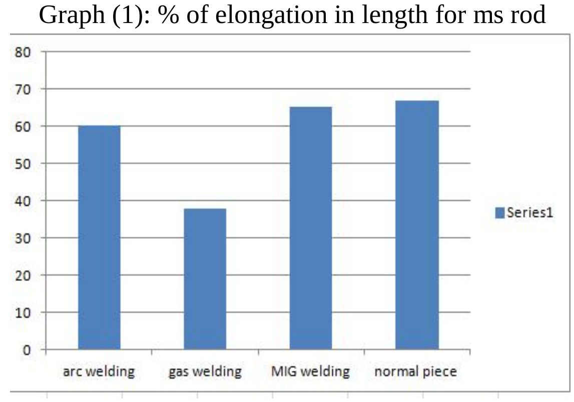
Factors: 1.% of elongation in length

2. % of reduction in area

8.1.1 Welding strength comparison of MS.Rod



Graph (1): % of elongation in length for ms rod



Graph (2): % of reduction in area for ms rod

8.3 Comparison of Ultimate tensile Strength of M.S Flat

7.4.2 Arc welded piece calculation:

Length of the rod =200mm

Diameter of the rod =12.7mm

Area of the rod (A_0) =$\pi/4(d)^2$ =$\pi/4(12.7)^2$=126.6mm^2

Deflection length of the rod = 24mm

Diameter of the deflection = 8 mm

Area of the rod after deflection=$\pi/4(d)^2$

=$\pi/4(8)^2$=50.24mm^2

Stress (σ)=F/A=7000/126.6=55.2 N/mm^2

% of elongation in length = (L^*_0- L_0/ L_0)*100

= ((224– 200) /200)*100 = 24/2 =12%

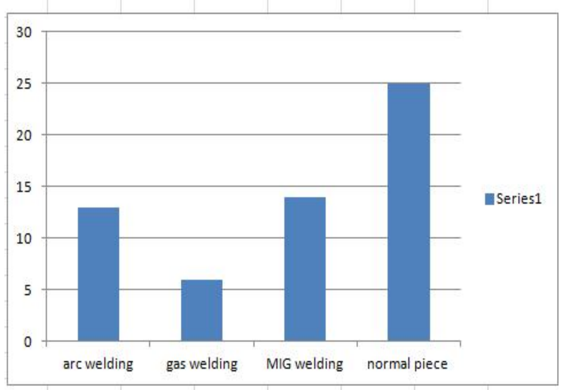
% reduction in area = (A_0- A^*_0/ A_0)*100

= ((126.6-50.24) /126.6)*100 = 60.31%

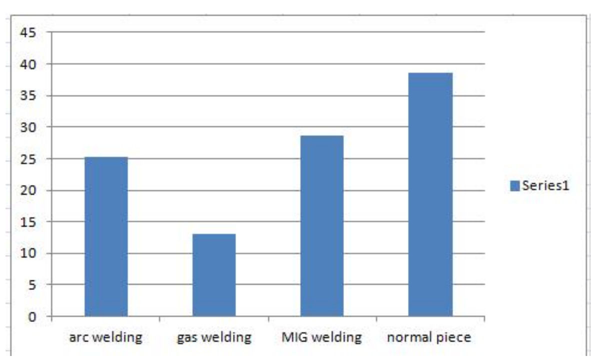
= ((126.6-78.5) /126.6)*100 = 37.93%

Factors: 1.% of elongation in length

2. % of reduction in area



Graph (3): % of elongation in length for m.s flat



Graph(4): % of reduction in area

By using the above mechanical and metallurgical properties we conclude that MIG welding as high tensile strength and having less material defects while welding. We can tell that which welding is better for joining. Graph (2,4): % of reduction in area. These properties are also useful to known which Welding is better o joining and fabrication process.

We came to know that MIG welding is the best among all welding under mechanical testing.

9.1 Future scope

The properties we had evaluated in this project is in single metal (Mild steel).so it is possible to evaluate these properties on different metals like Aluminum, Iron bars etc.

In this project we used only three welding methods to compare their strength by using the above mechanical and metallurgical properties. In future we can compare the strength of different welding methods by using the same method which we had done. Example: Seam welding, Friction stir welding.

We had tested only Liquid Penetrating test (LPT) to know metallurgical properties such as heat affected zone (HAZ), material defects. But other NDT methods also can used to test the metallurgical properties. Example: Ultrasonic test, Radio graphic test, etc.

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SHAIK HIMAM SAHEB has received Bachelor of Engineering degree in Mechanical Engineering from, VIST, Kakatiya University Telangana, India, in the year 2007, and Motet. With the specialization of Machine Design. Area of interest Mechanisms and Machines & Fracture analysis

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