INVESTIGATION OF DEVELOPED DISSIMILAR METAL MIG WELDED JOINT THROUGH STATISTICAL TOOL.

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ABSTRACT – An attempt is made to develop the dissimilar metal plate welded joints by MIG welding process using Cu coated mild steel Filler wire. Dissimilar metal welding is used in various fields like chemical, petrochemical, nuclear, thermal power plant industries, automobile industries also in aeronautical engineering and marine industries. This paper deals with the analysis of mechanical properties at different parameters like welding current, voltage, and welding speed. In this trial, two metals Ms and stainless stee304 are used. So the main focus will be to improve the mechanical properties like hardness and tensile strength by UTM machine and Rockwell hardness testing machine. In this paper optimum value of current, voltage speed of weld speed is identified for the highest value of weld strength and BHN value which helps to predicts the strength of the proposed welded joint under the consideration of the applied field.

KEYWORDS: Tensile strength, and hardness, UTM Machine, Rockwell Hardness Testing, Mini Tab software, MIG welding.

INTRODUCTION: Dissimilar welding is a welding method that is used to fabricate two different metals having different chemical compositions and different mechanical properties.[1]` In this study MIG welding, a method is used to join the metals using Cu coated Ms. Filler wire of 0.8 mm diameter & two different metals MS and SS304 are used.

Dissimilar metal welding is widely used in aeronautical, automobile, and chemical industries also in nuclear and thermal power plants.

These days generally laser welding is used for dissimilar metal joining because of its quick operation and it creates strong weld joint but the installation cost is high and skilled operators are required.

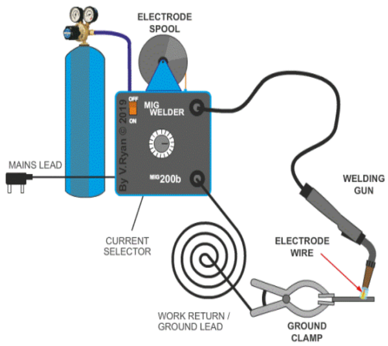
SELECTION OF WELDING PROCESSES:

1. Availability of equipment. 2. Repetitiveness of the operation. 3. Quality requirement. 4. Location of work. 5. Material to be joined. 6. The appearance of the finished product. 6. Worker skills. 7. Cost. 8. Specification required.

Reason to adopt MIG welding: 1. Adopt any condition. 2. Less skilled operators are required. 3. Low installation cost. 4. Productivity can be increased.

5. Improved weld joint can be created.

MIG - MIG welding is also known as gas metal arc welding, it is a welding process in which an electric arc forms between the consumable MIG wire electrode and the specimen, and heat is generated between them due to which the metal gets soft so they can fuse along.



PROBLEMS ACCOUNTING – In this study main focus will be on the improvement of the mechanical properties like hardness and tensile strength and the mixing of metals is the most important portion to create a strong weld joint.

PROBLEMS - Structural problems for the welding of dissimilar materials are: 1. Materials are different. 2. Crystal structure. 3. Melting point. 4. Specific heat. 5. Thermal conductivity. 6. Poor fracture toughness leads to weak joints.

The factors have to be taken out into account – 1.To create the required joint. 2. To obtain a fit joint for the motive. 3. Speed of the process. 4. Cost of the manufactured individual joint. 5. Required equipment size & weight. 6. The process should have NDT.

OBJECTIVES–1. Examine the effect of joining dissimilar materials at different parameters like welding voltage, current, and welding speed. 2. Investigate the weld joint quality by mechanical testing machines like UTM and hardness testing machines.

SCOPES – 1. With the accomplishment of this study, we can reduce the cost so productivity can be improved. 2. To create a strong weld joint. 3. To improve the mechanical properties.

LITERATURE REVIEW:

Seiji Sasabe, Tsuyoshi Matsumoto, Tadaaki Miono (2014): This study was performed to create the brittle intermetallic free joint by MIG braze welding. In this study aluminum alloy and steel were two metals used. In this study, the main focus was to reduce the thickness of the brittle IMC.

Taichi Murakami, Kazuhiro Nakata, Hongiun Tong (2003): In this study dissimilar welding of metal was done by MIG & TIG welding Using EN19 & SS304 metals, and a comparison of microstructure was done near the weld area. The mechanism of suppressed growth of the intermetallic compound layer during this process has been discussed.

GT Gopalakrishna, BS Ajay Kumar, KR Vishnuc, SD Sundarneshan, KG Satyanarayana (2018): In this study EN19 & SS304L were two dissimilar metals used to join by MIG welding and the comparison of microstructure was done near the weld pool. This study is undertaken to find out the strength of the weld created by EN19 & SS304

Lufeng Zhang, Zhi Cheng, Zheng Ye, Hai chi (2018): In this study welding of dissimilar metals was done by the MIG welding method. Aluminum and steel were two metals used and an Al-Si filler of 1.2 mm diameter was used. The bonding quality of the weld joint was examined during this study.

MM Hatifi, MH Firdaus, AY Razlan (2014): In this experiment two dissimilar metals Aluminium alloy & stainless steel were joined by the MIG welding method. In this study, the effect of different parameters on welding joints was examined and an impact test was performed also accelerometer response measuring technique was applied.

Yugang Miao, Yang Zeng, Teng Wang, Bintao WU, Xiaosong Feng (2015): In this study, two dissimilar metals Q235 galvanized steel and 1.2 mm diameter aluminum filler was used. During this experiment, T shaped structure with a uniform appearance and excellent performance was obtained.

LH Shah, M Ishak (2014): In this study progress of dissimilar welding of metals aluminum and steel by MIG welding is reviewed. In this experiment, an effort was made to improve the weld strength.

Hyoung Jin Park, Shehun Rhee, Mun Jin Kang, Dong Cheol Kim (2009): In this study dissimilar metals aluminum alloy & steel joined by Ac pulse MIG welding. This attempt was made to increase productivity.

Taguchi design: This is a method used to design off-line quality control, it is a method used to ensure good performance in the design stage of the process.

In this experiment, two different metals Ms and SS304 were joined together by the MIG welding method using Cu coated Ms. Filler wire of 0.8 mm of diameter. In this study, an experiment was performed using different parameters like welding current, voltage, and welding speed.

Experimental Setup:

Elements	C	Mn	P	S	Si	Cr	Ni	N	Cu	Zn	Al	Sn	Fe
SS304	0.08	2.0	0.045	0.03	1.0	18-20	8-12	...	0.34	0.0048	0.0028	0.0377	Bal
Ms	0.21	0.546	<0.01	<0.01	0.223	0..406	0.0853	0.1	0.21	...	0.008	...	Bal

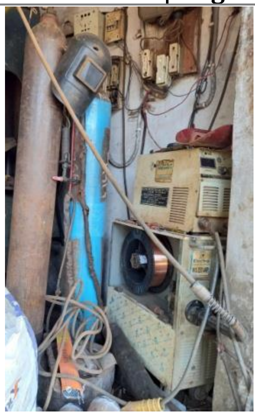
Chemical composition of Ms & SS304

Elements	C	Mn	Si	P	S	Cu
Cu coated **Ms** Filler	0.06-0.15	1.40-1.85	1.80-1.15	<0.025	<0.035	<0.50

Chemical composition of Cu coated Ms. Filler wire

Variable Parameters

S.NO	Sample	Current(amp)	Voltage(v)	Welding speed Mm/sec
1	1	76	24	200
2	2	76	21	195
3	3	76	18.9	160
4	1	68	24	200
5	2	68	21	195
6	3	68	18.9	160
7	1	65	24	200
8	2	65	21	195
9	3	65	18.9	160



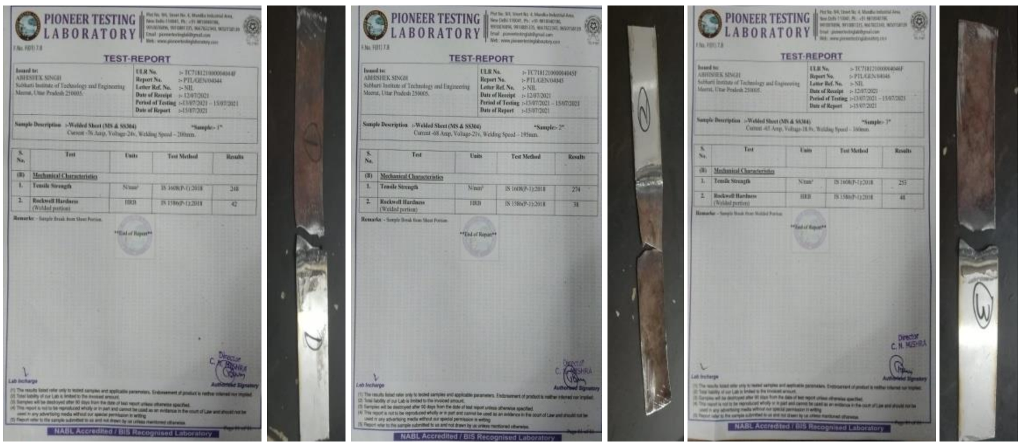

Sample.1 Sample.2 Sample.3

Obtained Values of Tensile strength and Hardness.

S.No	Sample	Current Amp	Voltage Volt	Welding speed M m/sec	Hardness HRB	Tensile strength N/mm^2
1	1	76	24	200	42	248
2	2	76	21	195	43.57	250
3	3	76	18.9	160	42.17	244
4	1	68	24	200	38	274
5	2	68	21	195	37.78	280.21
6	3	68	18.9	160	39	284
7	1	65	24	200	48	253
8	2	65	21	195	48.87	260
9	3	65	18.9	160	49	251.50

Hardness and tensile strength at different parameters

Sample reports and sample images after the Rockwell Hardness & Tensile Test.



Experimental Result :

Table at different parameters:

S.No	Sample	Curre nt Amp	Voltage Volt	Welding speed M m/sec	Hardness HRB	Tensile strength N/mm^2
1	1	76	24	200	42	248
2	2	76	21	195	43.57	250
3	3	76	18.9	160	42.17	244
4	1	68	24	200	38	274
5	2	68	21	195	37.78	280.21
6	3	68	18.9	160	39	284
7	1	65	24	200	48	253
8	2	65	21	195	48.87	260
9	3	65	18.9	160	49	251.50

METHODOLOGY:

Taguchi design: In this study, Taguchi Method is used for the analysis, in which L9 orthogonal Array & Three factors Taguchi design is used.

Taguchi analysis:

Taguchi method is used to design a robust design during the design stage.

In this step values of Signal to Noise Ratios and Means are calculated.

SN Ratio: It is used to choose quality characteristics.

In this study, "Larger **is better"** characteristics is used to find out the **SN ratio.**

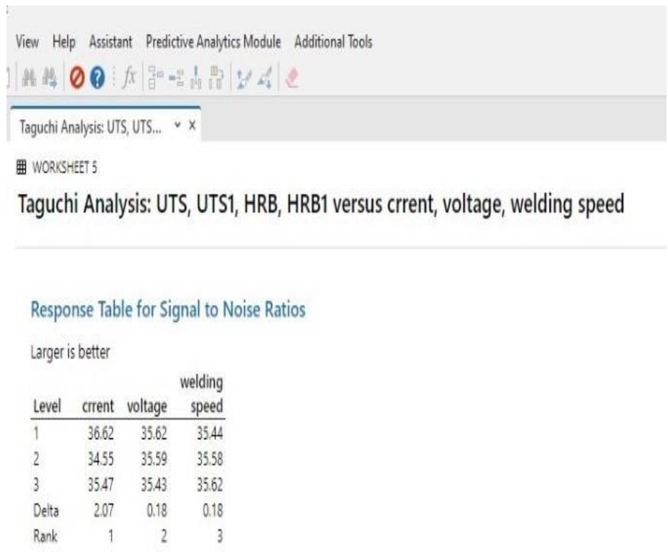
Larger is better.

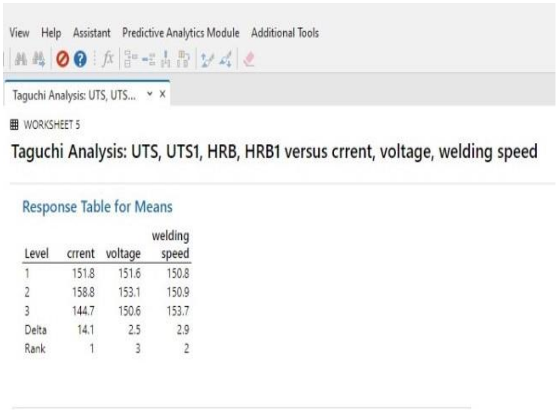
$$S/N = -10*\log(\sum(Y^2)/n)$$

n - Number of measurements in trail.

Y – Measured value in a run.

Values of SN ratio and Means calculated with the help of the **Minitab20 software**



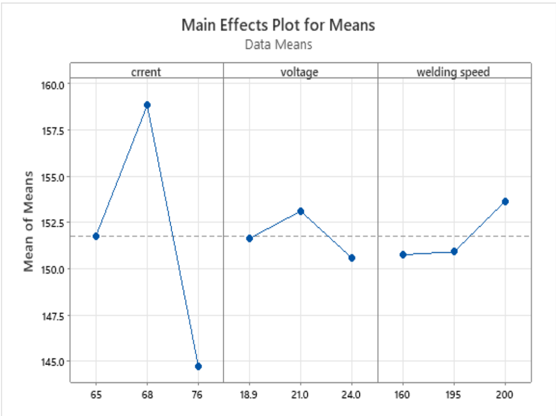


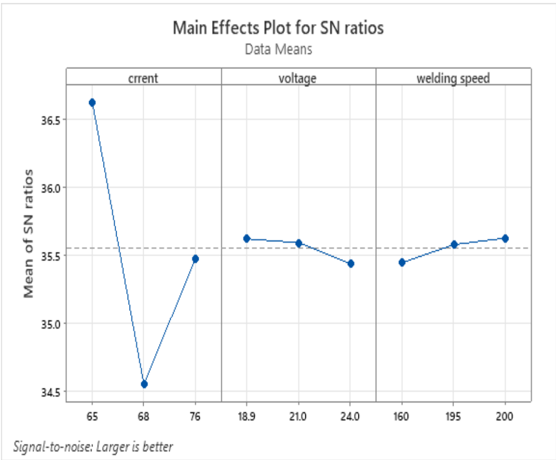
Taguchi Analysis: UTS, UTS1, HRB, HRB1 versus crrent, voltage, welding speed

Response Table for Means

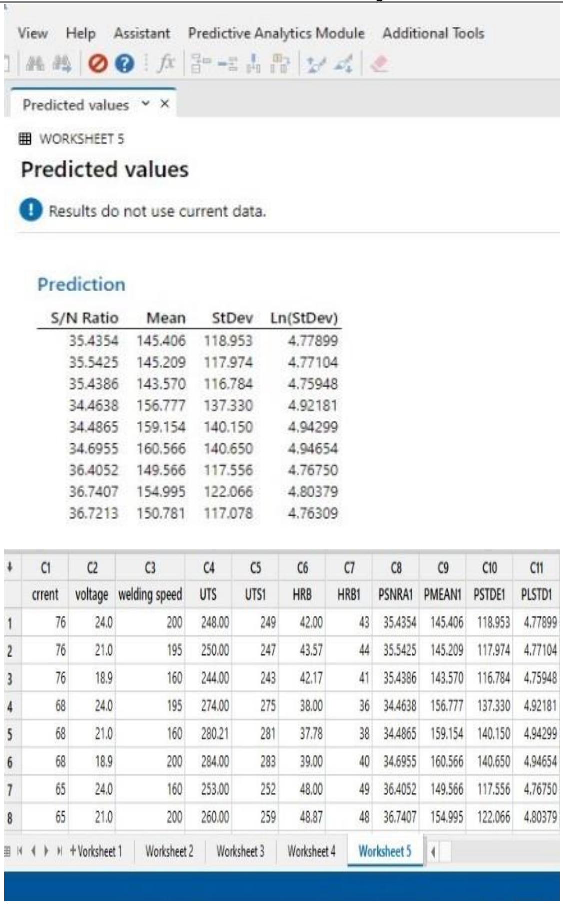
Level	crrent	voltage	welding speed
1	151.8	151.6	150.8
2	158.8	153.1	150.9
3	144.7	150.6	153.7
Delta	14.1	2.5	2.9
Rank	1	3	2

Main effect Plot: Main effect plot is a way to show how each factor like SN ratio, Means slope, and Standard deviation affects the response characteristics.





Predicted Values: It is a method to show the fitted values of the selected characteristics at the specified factor setting.



Predicted values

Results do not use current data.

Prediction

S/N Ratio	Mean	StDev	Ln(StDev)
35.4354	145.406	118.953	4.77899
35.5425	145.209	117.974	4.77104
35.4386	143.570	116.784	4.75948
34.4638	156.777	137.330	4.92181
34.4865	159.154	140.150	4.94299
34.6955	160.566	140.650	4.94654
36.4052	149.566	117.556	4.76750
36.7407	154.995	122.066	4.80379
36.7213	150.781	117.078	4.76309

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
	crrent	voltage	welding speed	UTS	UTS1	HRB	HRB1	PSNRA1	PMEAN1	PSTDE1	PLSTD1
1	76	24.0	200	248.00	249	42.00	43	35.4354	145.406	118.953	4.77899
2	76	21.0	195	250.00	247	43.57	44	35.5425	145.209	117.974	4.77104
3	76	18.9	160	244.00	243	42.17	41	35.4386	143.570	116.784	4.75948
4	68	24.0	195	274.00	275	38.00	36	34.4638	156.777	137.330	4.92181
5	68	21.0	160	280.21	281	37.78	38	34.4865	159.154	140.150	4.94299
6	68	18.9	200	284.00	283	39.00	40	34.6955	160.566	140.650	4.94654
7	65	24.0	160	253.00	252	48.00	49	36.4052	149.566	117.556	4.76750
8	65	21.0	200	260.00	259	48.87	48	36.7407	154.995	122.066	4.80379

RESULT & DISCUSSION: During the present study, it was observed that the mixing of metals is very important because each metal has its different chemical composition, mechanical properties, melting point, conductivity, and heat transfer rate. In this experiment when current and voltage were increased metal started melting due to the high heat generation due to which proper joint could not be created. Based on the experimental result it is found that sample 1 achieved higher strength 253 N/mm^2 at 65 amp 24 volts, sample 2 achieved higher strength 280.21 N/mm^2 at 68 amp 21 volts, sample 3 achieved higher strength 284 N/mm^2 at 68 amp 18.9 volts, it shows that sample 3 is approx 84% more strengthen the sample 1 and 98 % strengthen then sample-2. As trends are shown above in plot 1 and plot 2, also result available in table 1. Both experimental and statistical plots validate the optimum solution as sample 3 at 68amp & 18.9 volt.

CONCLUSIONS:

The proposed experiment design by the Taguchi method fulfills the desired objective. Universal Testing Machine & Rockwell hardness testing machine is used to find out the tensile strength & hardness of weld joint. All the possible values have been calculated by using MINITAB 20 software. The optimum values were predicted using MINITAB 20 software.

The experimental results confirmed the validity of the used Taguchi method for enhancing the welding performance and optimizing the welding parameters in MIG welding at welding speed 200 mm/s, welding voltage 18.9 volts & welding current 68 amp.

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