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A Study of Mechanical Properties of MIG Welding and TIG Welding Welded Dissimilar Joint of Mild Steel and 304 Austenitic Stainless Steel

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Abstract: Mild steel (MS) and 304 austenitic stainless steel (ASS) plates were successfully welded in butt joint position by TIG and MIG welding using argon as a shielding gas. Multiple trails were performed to optimise the process parameters to obtain a good welded joint. To assess the quality of the prepared weldments their mechanical properties were investigated. Transverse and longitudinal tensile strength of the weldments were measured and compared with the base metal. During transverse tensile test all the specimens were broken in the mild steel portion. Tensile strength of the weldments was found greater than the mild steel base metal and less than 304 ASS base metal. Longitudinal tensile strength of weldments welded by MIG welding was found higher than the longitudinal tensile strength of weldments welded by TIG welding. Transverse percentage elongation and longitudinal percentage elongation was found lower than the base metal. Percentage elongation of weldments welded by MIG welding was found higher than the weldments welded by TIG welding. Impact strength of welded joint welded by MIG welding was found higher than the TIG welding welded joint. Microstructure of the welment at both the fusion zones (towards MS side and ASS side) and at weld metal zone of weldment was also investigated. The investigation showed the defect free microstructure in all zones.

Key words: Dissimilar joint, Mild steel, Austenitic stainless steel, TIG welding, MIG welding, Mechanical property, Microstructure.

1. Introduction

The stainless steel is one of the most popular materials for structural applications; due to their excellent physical properties. The additional benefits and the design codes of stainless steels have focused their industrial use for conventional structural engineering applications such as civil construction, nuclear reactors, thermal power plants, pressure vessels and heat exchangers for several industrial applications. The better joint efficiency, simple process, low fabrication cost, welding reliability and efficient metal joining process are essential for production of many engineering and structural components. The metallurgical changes such as micro-segregation, precipitation of secondary phases are the major problems which produces poor mechanical properties in stainless steel welds. Therefore, for structural applications, the stainless steels are utilized efficiently by dissimilar steel welds between stainless steels and carbon steels with effective and economical utilization of the special properties of each steel present in the same structure. The coarse grains and inter granular chromium rich carbides along the grain boundaries in heat affected zone is observed during conventional arc welding which deteriorates the mechanical properties of the joints. The joining of stainless steels with plain carbon steels is a common application in thermal power industries. Stainless steel plays an important role in the modern world owing to its excellent corrosion resistance. Austenitic stainless steel represents more than 70% of the total stainless steel production in the world. Austenitic stainless steel is preferred more than other stainless steel types due to its good weldability.

1.1 Austenitic stainless steel

Austenitic stainless steels have "face centred cubic" (FCC) crystal structure. These are the most common and familiar type of stainless steel. They are most easily recognized as nonmagnetic material. They have good weldability and forming capability and also it can be successfully used for cryogenic temperatures to the red-hot temperatures of furnaces and jet engines. They contain about 16 to 25% chromium, and can also contain nitrogen in solution, both of which contribute to their high corrosion resistance. They also do not lose their strength at elevated temperatures as rapidly as ferritic (body centred cubic) iron base alloys. Table 1.1 shows the chemical composition of different grades of ASS. The stainless steel AISI 304 is the most preferred stainless steel because of its good mechanical properties, weldability, formability and very good corrosion-oxidation resistance.

Table 1.1: Compositions of different grades of austenitic stainless steel [1].

Designation	C	Mn	P	S	Si	Cr	Ni	Mo	N
201	0.15	5.50-7.50	0.060	0.03	1.00	16.00-18.00	3.50-5.50	-	0.25
301	0.15	2.00	0.045	0.03	0.75	16.00-18.	6.00-8.0	-	-

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302	0.15	2.00	0.045	0.03	0.75	17.00-19.00	8.00-10.00	-	0.10
304	0.08	2.00	0.045	0.03	0.75	18.00-20.00	8.00-10.50	-	0.10
304L	0.03	2.00	0.045	0.03	0.75	18.00-20.00	8.00-12.00	-	0.10
305	0.12	2.00	0.045	0.03	0.75	17.00-19.00	10.50-13.00	-	-
316	0.08	2.00	0.045	0.03	0.75	16.00-18.00	10.00-14.00	0.1	0.10

Austenitic stainless steel is readily joined by arc, resistance, friction, electron beam and laser beam welding processes. However, SMAW, GMAW, GTAW and FCAW processes are commonly used. Plasma arc and SAW are also suitable joining processes for austenitic stainless steels. Oxyacetylene welding is however not recommended except for emergency repairs.

The austenitic SS have about 45% higher thermal coefficient of expansion, higher electrical resistance and lower thermal conductivity than mild steels. High welding speed is recommended which will reduce heat input, reduce carbide precipitation and minimize distortion. The melting point of austenitic stainless steels is slightly lower than mild steel. Because of lower melting point and lower thermal conductivity, welding current required is lower. The higher thermal expansion necessitates the need to take special precautions with regard to warpage and distortion. Tack welds should be twice as many as normal. Any of the distortion reducing techniques such as back step welding, skip welding, etc. should be used.

2. Literature review

Many researchers have investigated the properties of dissimilar metal welded joints. Some researchers have investigated the weldments of dissimilar metal stainless steel and mild steel. Here works of some of the researchers have been presented as literature review.

Radha Raman Mishra et al. have studied the tensile strength of MIG welding and TIG welding welded joints of dissimilar metal using mild steel and stainless steel. They found that tungsten inert gas welding was more suitable than metal inert gas welding for dissimilar metal welding of mild steel and stainless steel. They found that the main problem which occurred in welding dissimilar material by MIG is the development of cracks during the welding [2]. Keyur Panchal has done experimental investigation of TIG welding of stainless steel and mild steel plates. He studied the results like hardness, tensile strength, bend test and dilution. In TIG welding defects like porosity, cracks, etc. was not found.The hardness of weld metal was found maximum [3]. Bahadır Işcan et al. investigated the mechanical properties of AISI 304 austenitic stainless steel joints welded by TIG and MIG welding methods using 308L filler wire. The tensile tests of weldments were done to determine the tensile properties. Experimental results showed that, except for the samples welded by 110A welding current, the fracture did not occur in the weld zone. They also found that as the welding current value was decreased, there was improvement in the mechanical properties [4]. A. Joseph et al. have studied the residual stresses in dissimilar metal pipe joints. Dissimilar pipe weld joints of ferritic stainless steel and austenitic stainless steel were produced to evaluate the residual stresses. Maximum tensile residual stress with or without buttering layer are almost the same however, the residual stress at the HAZ of ferritic stainless steel were found less with buttering layer [5]. Brijesh Kumar Maurya et al. welded the 304 stainless steel to 1020 mild steel using gas metal arc welding (MIG). These samples were welded using stainless steel wire electrode under different process parameters. It was concluded that on increasing the gas pressure beyond a required value the strength of weldments decreased and it was good for the average gas pressure [6]. Wichan Chuaipan et al. have studied dissimilar welding joints between AISI 304 stainless steel and AISI 1020 carbon steel plates. The welding processes applied for this work were gas tungsten arc welding (GTAW) and shielded metal arc welding (SMAW). The weldments produced by these two processes were tested under tension and bending. The impact testing conducted on weldments showed higher toughness for GTAW than that produced by SMAW. In case of mechanical and corrosion properties of weldments, GTAW was considered as a more promising process that could be used for dissimilar welding joints between these two metals [7]. Jing Wang et al. studied the effect of welding process on the microstructure and properties of dissimilar welded joints between low alloy steel and duplex stainless steel. They observed that the impact toughness of weld metals by MIG welding was higher than that of TIG welding. The austenitic content in the weld metal was increased in case of MIG welding that increased the strength of the joint [8].

3. Problem to be investigated

The dissimilar welded joint between AISI 304 and mild steel has not been investigated thoroughly. Hence, it was decided to investigate the mechanical properties of welded joint of AISI 304 and mild steel by performing tensile test and impact test. It was also planned to investigate the microstructure of the weldment. A standard tensile specimen was shown in Fig. 3.1 and its parameters were recorded in table 3.1.

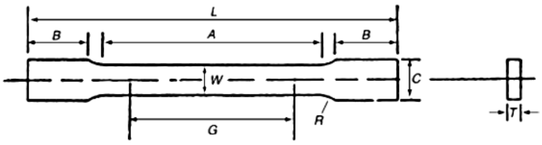
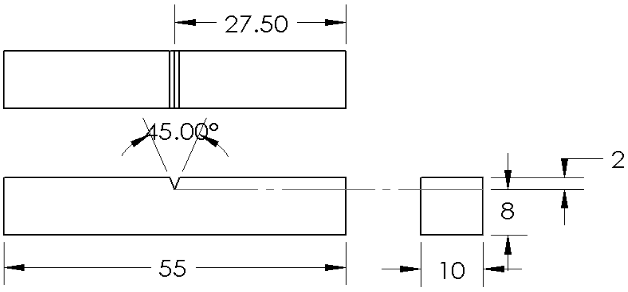


Fig. 3.1 A standard tensile test specimen [9].

Table 3.1: Geometry and Dimension of standard tensile specimen [9]

Sl. no.	Geometry	Dimensions (mm)
1.	G, Gauge length	50 ± 0.1
2.	W, Width	12.5 ± 0.2
3.	T, Thickness	0.127 ≤ T ≤ 19.05
4.	R, Radius of fillet	12.5
5.	L, Overall length	200
6.	A, Length of reduced section	57
7.	B, Length of grip section	50
8.	C, Width of grip section	20

It was planned to perform Charpy impact test. Standard Impact test specimen and actual impact test specimen used for Charpy test was shown in Fig. 3.2 and 3.3. Since actual thickness of welded plate was 4 mm hence sub standard thickness was taken for impact test. Dimension of test specimen for charpy test was shown in Fig. 3.3 and its dimensions were recorded in table 3.3.

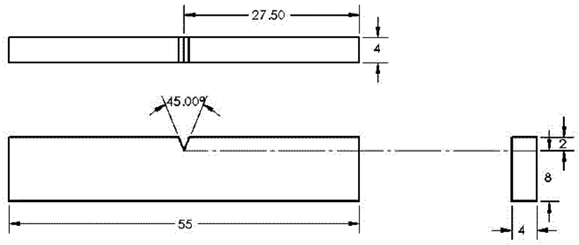


All dimensions are in mm

Fig. 3.2 Standard notched Charpy impact test specimen [10].

Table 3.2: Standard geometry and dimension of Charpy impact test specimen

S. No	Geometry	Dimension
1.	L, Overall length	55.0 ± 0.1
2.	W, Width	10 ± 0.13
3.	T, Thickness	10 ± 0.13



All dimensions are in mm

Fig. 3.3 Actual Charpy impact test specimen.

Table 3.3: Actual geometry and dimension of Charpy impact test specimen

S. No	Geometry	Dimension
1.	L, Overall length	55.0 ± 0.1
2.	W, Width	10 ± 0.13
3.	T, Thickness	4 ± 0.13

4. Methodology

Plate of AISI 304 SS was procured from the market. To confirm the material chemical analysis was done and the result of the chemical analysis was tabulated in table no. 4.1.

Table 4.1: Chemical analysis of AISI 304 stainless steel

Elements	Specified value	Obtained value
C %	0.08 Max	0.06
Mn %	2.00 Max	1.38
Si %	1.00 Max	0.50
S %	0.030 Max	0.019
P %	0.045 Max	0.024
Cr %	18.00 to 20.00	18.20
Ni %	8.00 to 11.00	8.11

Welding plates having dimension 320 mm × 100 mm × 4 mm were prepared and were placed adjacent to each other with 2 mm as the root gap as shown in Fig. 4.1. Multiple trails were performed to obtain the optimum TIG and MIG welding parameters to obtain good welded joint. ER308 was used as filler wire for the welding purpose. The optimum welding condition and process parameters were tabulated in table no. 4.2 and 4.3.

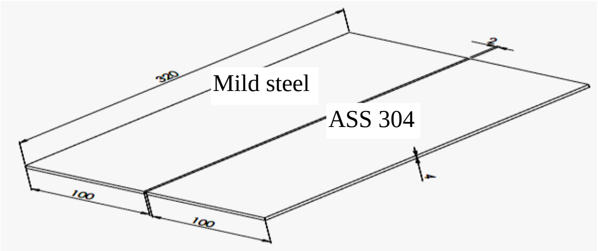
Table 4.2: Welding condition and process parameters for MIG welding

Process Parameters	Value
Average welding current (A)	224
Average arc voltage (V)	24.4
Average welding speed (mm/min)	280
Electrode wire diameter (mm)	1.2
Shielding gas flow rate (L/min)	6

Wire feed rate (m/min)	6.3
Electrode polarity	DCEP
Number of passes	1.0

Table 4.3: Welding condition and process parameters for TIG welding

Process Parameters	Value
Average Welding current (A)	119
Average arc voltage (V)	15.3
Average Welding speed (mm/min)	66
Electrode wire diameter (mm)	1.2
Shielding gas flow rate (L/min)	7
Electrode polarity	DCEN
Number of passes	1.0
Electrode	Thoriated tungsten



All dimensions are in mm

Fig. 4.1 Geometrical dimensions of plates to be welded in butt joint position.

5. Results and discussions

5.1 Tensile test evaluation

The welded joints were cut using power hacksaw and then machined to the required dimensions for preparing tensile test specimens. The specimens were prepared as per ASTM Standard [9]. The base metal tensile specimen for ASS 304 and mild steel were shown in the Fig. 5.1 and Fig. 5.2 respectively. The welded tensile test specimens by MIG welding and TIG welding using pure argon as a shielding gas are shown in Fig. 5.3 to Fig. 5.6. Broken tensile test specimens in tensile test were shown in Fig. 5.7 to 5.12. The tensile test results of a set of four samples were recorded from table 5.1 to table 5.6. Table 5.1 contains the data of UTS of base metal of ASS 304. Table 5.2 records the data of UTS of base metal of mild steel. Table 5.3 contains the data of transverse UTS of specimens welded by MIG welding. Table 5.4 records the data of longitudinal UTS of specimens welded by MIG welding. Table 5.5 records the data of transverse UTS of specimens welded by TIG welding. Table 5.6 records the data of longitudinal UTS of specimens welded by TIG welding.

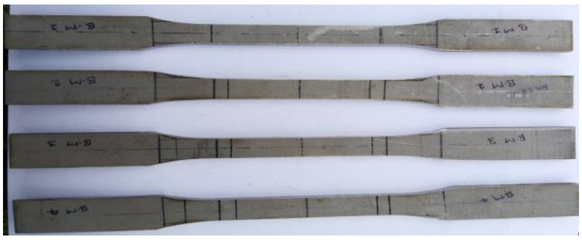


Fig. 5.1 ASS 304 base metal tensile specimens.

Fig. 5.2 Mild steel base metal tensile specimens.

Fig. 5.3 Welded specimen using MIG welding for transverse tensile testing.

Fig. 5.4 Welded specimen using MIG welding for longitudinal tensile testing.

Fig. 5.5 Welded specimen using TIG welding for transverse tensile testing.

Fig. 5.6 Welded specimen using TIG welding for longitudinal tensile testing.

Fig. 5.7 Broken tensile test specimen of ASS 304 base metal in tensile test.

Fig. 5.8 Broken tensile test specimen of mild steel base metal in tensile test.

Fig. 5.9 Broken specimen welded by MIG welding after transverse tensile testing.

Fig. 5.10 Broken specimen welded by MIG welding after longitudinal tensile testing.

Fig. 5.11 Broken specimen welded by TIG welding after transverse tensile testing.

Fig. 5.12 Broken specimen welded by TIG welding after longitudinal tensile testing.

Table 5.1: Evaluation of UTS of ASS 304 base metal

Specimen No.	Width W mm	Thickness T mm	Area mm^2	Load kg	UTS MPa	Average UTS MPa
1.	12.68	4.13	52.41	3060	572.76	580.4
2.	12.61	4.09	51.61	3040	577.84	
3.	12.54	4.08	51.16	3030	581.00	
4.	12.34	4.06	50.22	3020	589.92	

Table 5.2: Evaluation of UTS of mild steel base metal

Specimen No.	Width W mm	Thickness T mm	Area mm^2	Load kg	UTS MPa	Average UTS MPa
1.	12.40	4.15	51.46	2420	461.33	462.4
2.	12.32	4.13	50.88	2350	453.09	
3.	12.48	4.17	52.04	2460	463.73	
4.	12.51	4.16	52.04	2500	471.27	

Table 5.3: Transverse UTS of specimens welded byMIG welding

Specimen No	Width W mm	Thickness T mm	Area mm^2	Load kg	UTS MPa	Average UTS MPa
1.	12.64	4.13	52.20	2630	494.25	490.7
2.	12.33	4.10	50.55	2510	487.10	
3.	12.60	4.11	51.78	2650	502.05	
4.	12.39	4.13	51.16	2500	479.28	
Note: All the specimens were broken in mild steel base metal						

Table 5.4: Longitudinal UTS of specimens welded by MIG welding

Specimen No.	Width W mm	Thickness T mm	Area mm^2	Load kg	UTS MPa	Average UTS MPa
1.	12.64	4.65	58.86	3450	575	565.3
2.	12.55	4.66	58.56	3490	584.64	
3.	12.53	4.62	57.98	2900	510.66	
4.	12.60	4.65	58.59	3530	591.04	

Table 5.5: Transverse UTS of specimens welded by TIG welding

Specimen No.	Width Mm	Thickness mm	Area mm^2	Load kg	UTS MPa	Point of breaking
1.	12.31	4.14	50.90	2530	495.35	MS plate
2.	12.65	4.13	52.24	2540	476.97	Welded joint
3.	12.28	4.12	50.59	2390	463.44	MS plate
4.	12.71	4.12	52.36	2470	462.77	Welded joint
Average UTS MPa					474.6	

Table 5.6: Longitudinal UTS of specimens welded by TIG welding

Specimen No.	Width W mm	Thickness T mm	Area mm^2	Load kg	UTS MPa	Average UTS MPa
1.	12.47	4.59	57.32	2810	480.91	476.8
2.	12.40	4.63	57.49	2770	472.66	
3.	12.31	4.57	55.42	2700	477.93	
4.	12.57	4.58	57.57	2790	475.54	

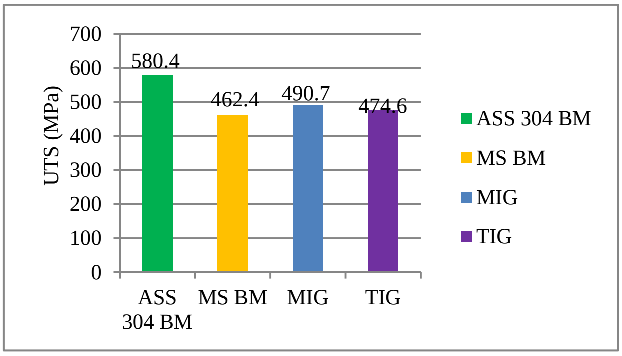


Fig. 5.13 Comparison of transverse UTS of base metal and welded specimens.

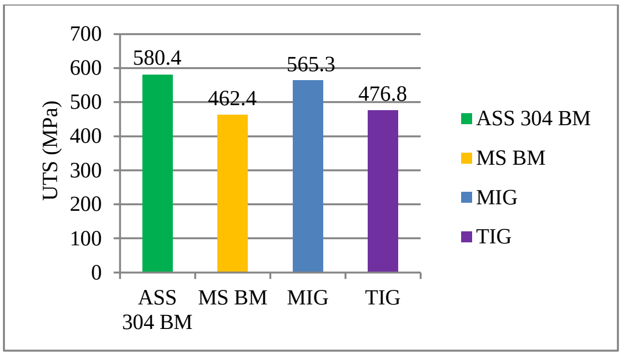


Fig. 5.14 Comparison of longitudinal UTS of base metal and welded specimens.

Fig. 5.13 compares the UTS of base metal and transverse welded specimens. Fig. 5.14 compares the UTS of base metal and longitudinal welded specimens. Tensile strength of MIG welded specimens were found higher than the TIG welded specimens in both transverse and longitudinal welded joints. Location of fracture in case of MIG welded specimens was found in mild steel plates that means that the strength of welded joints were more than the mild steel plate.

To check the ductility of the welded specimen percentage elongation of the specimens were calculated and and compared. Table 5.7 and 5.8 contain the data of percentage elongation of base metal ASS 304 and mild steel respectively. Table 5.9 and 5.10 contain the data of transverse and longitudinal percentage elongation of specimens welded by MIG welding respectively. Table 5.11 and 5.12 contain the data of transverse and longitudinal percentage elongation of specimens welded by TIG welding respectively.

Table 5.7: Elongation result of ASS 304 base metal

Sample no.	Gauge length mm	Elongated length mm	Elongation mm	Percentage Elongation
1.	50	80	30	60
2.	50	80	30	60
3.	50	78	28	56
4.	50	78	28	56
Percentage average elongation				58

Table 5.8: Elongation result of mild steel base metal

Sample no.	Gauge length mm	Elongated length mm	Elongation mm	Percentage Elongation
1.	50	64	14	28
2.	50	65	15	30
3.	50	60	10	20
4.	50	60	10	20
Percentage average elongation				24.5

Table 5.9: Transverse percentage elongation of specimens welded by MIG welding

Sample no.	Gauge length mm	Elongated length mm	Elongation mm	Percentage Elongation
1.	50	62	12	24
2.	50	59	9	18
3.	50	62	12	24
4.	50	60	10	20
Percentage average elongation				21.5

Table 5.10: Longitudinal percentage elongation of specimens welded by MIG welding

Sample no	Gauge length mm	Elongated length mm	Elongation mm	Percentage Elongation
1.	50	58	8	16

2.	50	58	8	16
3.	50	60	10	20
4.	50	62	12	24
Percentage average elongation				19

Table 5.11: Transverse percentage elongation of specimens welded by TIG welding

Sample no.	Gauge length (mm)	Elongated length (mm)	Elongation (mm)	Percentage Elongation
1.	50	59	9	18
2.	50	57	7	14
3.	50	55	5	10
4.	50	56	6	12
Percentage average elongation				13.5

Table 5.12: Longitudinal percentage elongation of specimens welded by TIG welding

Sample no.	Gauge length (mm)	Elongated length (mm)	Elongation (mm)	Percentage Elongation
1.	50	54	4	8
2.	50	54	4	8
3.	50	54	4	8
4.	50	55	5	10
Percentage average elongation				8.5

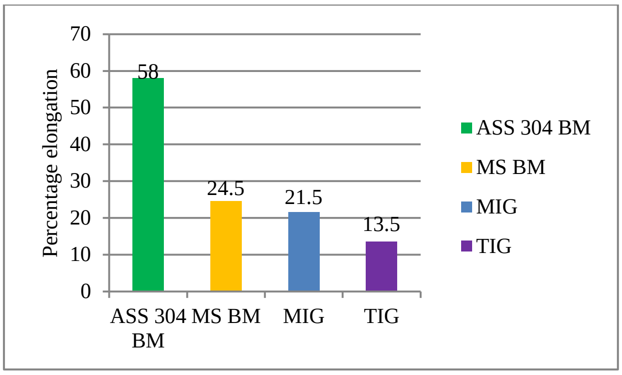


Fig. 5.15 Comparison of transverse percentage elongation of welded joint and base metal.

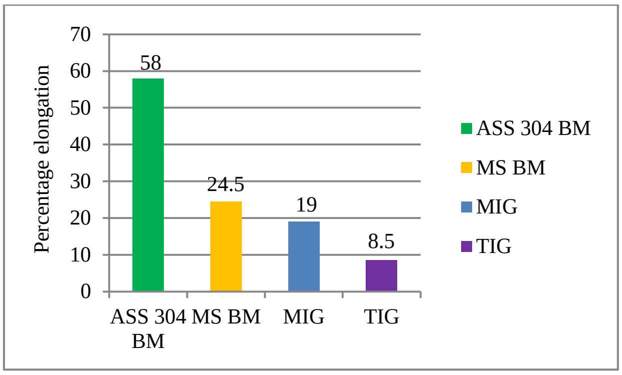


Fig. 5.16 Comparison of longitudinal percentage elongation of welded joint and base metal.

Fig. 5.15 compares the transverse percentage elongation of welded joint and base metal. From the figure it can be seen that the transverse percentage elongation of welded specimens was reduced in comparison of both the base metals. In case of TIG welding it was found lowest.

Fig. 5.16 compares of longitudinal percentage elongation of welded joint and base metal. From the figure it can be seen that the longitudinal percentage elongation of welded specimens was also reduced in comparison of both the base metals. In this case also the percentage elongation in TIG welding welded specimens was found lowest.

From Fig. 5.15 and 5.16, it can be seen that the longitudinal percentage elongation of welded specimens was less than the transverse percentage elongation of welded specimens.

5.3 Impact strength evaluation

The Charpy impact test was conducted to determine the resistance of a specimen against shocks. The test bar, notched in the centre, was located on two supports. The prepared samples of base metal and welded joints were shown in figures from Fig. 5.17 to Fig. 5.20. The test was carried out for 4 samples in one group and average of the test result was calculated. Broken samples of base metal and welded joints were shown in in figures from Fig. 5.21 to Fig. 5.24. The average impact strength of the samples was calculated and recorded in tables from table 13 to 16. The notch impact strength is calculated as per the following formula:

$I = K/A$ Where, I = Impact strength in J/mm^2

K = Impact energy absorbed by the specimen during rupture in joules

A = Area of cross section of specimen below the notch before test in mm^2.

Fig. 5.17 ASS 304 base metal sample for impact test.

Fig. 5.18 Mild steel base metal sample for impact test.

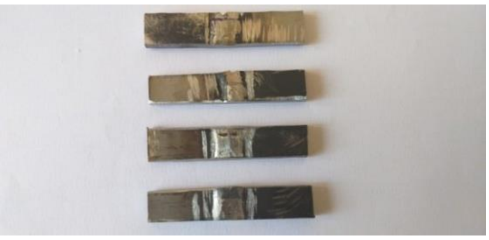


Fig. 5.19 MIG welded sample for impact test.

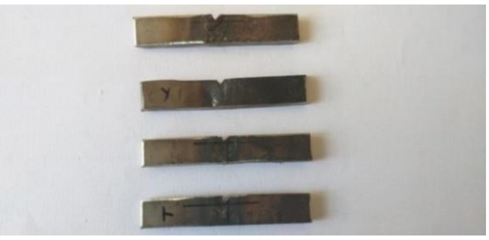


Fig. 5.20 TIG welded sample for impact test.

Fig. 5.21 Broken samples of ASS 304 base metal after impact test.

Fig. 5.22 Broken samples of mild steel base metal after impact test.

Fig. 5.23 Broken samples of MIG welding after impact test.

Fig. 5.24 Broken samples of TIG welding after impact test.

Table 5.13: Charpy impact strength of ASS 304 base metal

Sample No.	Width mm	Thickness mm	Area mm^2	Energy absorbed Joule	Impact strength J/mm^2
1	8	4	32	43.65	1.36
2	8	4	32	44.63	1.39
3	8	4	32	47.57	1.48
4	8	4	32	41.20	1.28
Average impact strength J/mm^2					1.37

Table 5.14: Charpy impact strength of MS base metal

Sample No.	Width mm	Thickness mm	Area mm^2	Energy absorbed Joule	Impact strength J/mm^2
1	8	4	32	30.41	0.95
2	8	4	32	29.43	0.91
3	8	4	32	28.44	0.88
4	8	4	32	28.93	0.90
Average impact strength J/mm^2					0.91

Table 5.15: Charpy impact strength of MIG welded specimen

Sample No.	Width mm	Thickness mm	Area mm^2	Energy absorbed Joule	Impact strength J/mm^2
1	8	4	32	31.39	0.98
2	8	4	32	29.43	0.92
3	8	4	32	28.44	0.89
4	8	4	32	28.93	0.91
Average impact strength J/mm^2					0.92

Table 5.16: Charpy impact strength of TIG welded specimen

Sample No.	Width mm	Thickness mm	Area mm^2	Energy absorbed Joule	Impact strength J/mm^2
1	8	4	32	25.01	0.78
2	8	4	32	24.03	0.75
3	8	4	32	25.99	0.82
4	8	4	32	27.46	0.86
Average impact strength J/mm^2					0.81

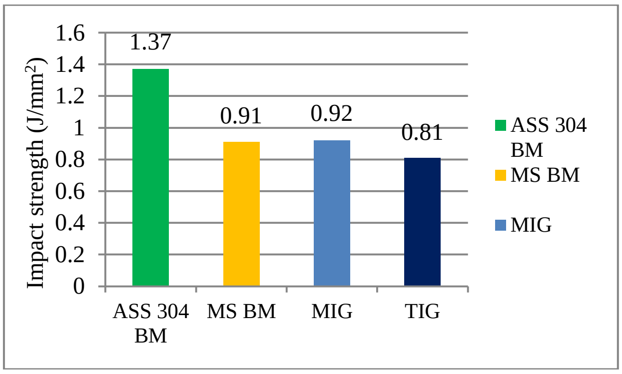


Fig. 5.25 Comparison of toughness value of weldments with base metal.

Fig. 5.25 compares the toughness of the welded specimens with base metal. The impact strength of MIG welding welded specimens were found lower than ASS 304 base metal. The impact strength of TIG welding welded specimens were found lower than the base metal ASS 304 and mild steel both. The impact strength of MIG welding welded specimens were found higher than the TIG welding welded specimens. More austenite phase was generated during MIG welding due to decrease of ferrite to austenite transformation ratio with the increase of heat input and slower cooling rate [8], [11]. Due to formation of more austenite phase impact strength of MIG welding welded joint was increased.

5.4 Microstructure evaluation

Study of microstructure of the welded joint was also done. Sample for microstructure was prepared and study was done under optical microscope.

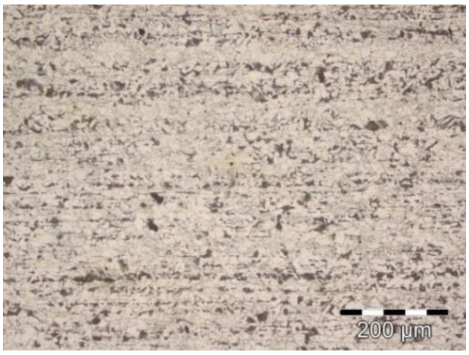


Fig. 5.26 Base metal mild steel.

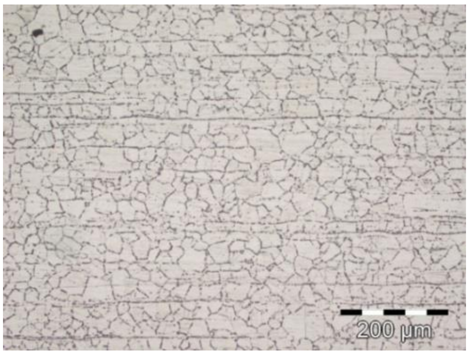


Fig. 5.27 Base metal ASS 304.

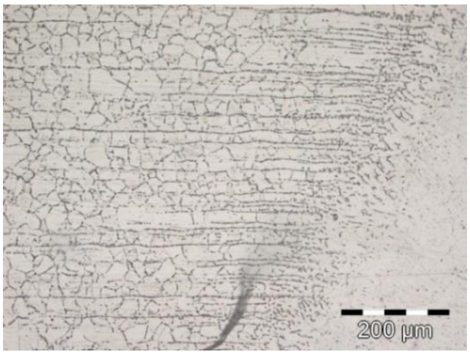


Fig. 5.28 ASS, ASS HAZ and weld metal zone.

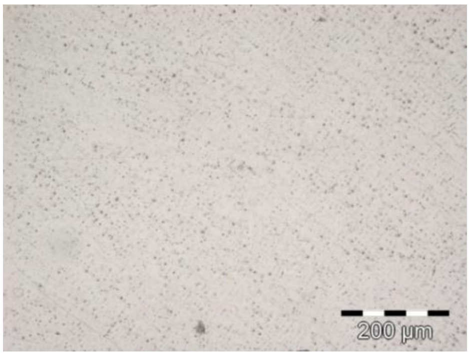


Fig. 5.29 Weld metal zone.

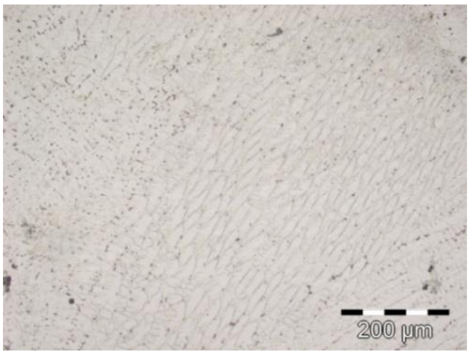


Fig. 5.30 Weld metal zone and mild steel.

Figure 5.26 and 5.27 show the microstructure of base metal mild steel and ASS 304. Figure 5.28 shows the microstructure of base metal ASS 304, ASS HAZ, and weld metal zone. Elongated grains can be seen near the fusion boundary. Fig 5.29 shows the microstructure of weld metal zone. Equiaxed austenite grains can be seen in the weld metal zone. Fig. 5.30 shows the microstructure from the mild steel side. All the microstructures were found defect free, hence good welded joint can be obtained between mild steel and ASS 304.

6. Conclusions

On the basis of experimental results the following conclusions may be drawn:

1. During transverse longitudinal test all the specimens were broken in the mild steel portion due to lower

strength of the mild steel. Since no MIG welding welded specimen was broken from the welded joint hence joints with more than 100% efficiency can be obtained in this case.

2. Longitudinal UTS and transverse UTS of welded joints were found lower than the ASS 304 base metal and higher than the mild steel base metal.
3. Transverse UTS of weldments welded by MIG welding were found higher than the transverse UTS of weldments welded by TIG welding.
4. Longitudinal UTS of weldments welded by MIG welding were found higher than the longitudinal UTS of weldments welded by TIG welding.
5. Transverse and longitudinal percentage elongation of weldments welded by MIG and TIG welding were found lower than the base metal elongation.
6. Due to higher impact strength of the MIG welded specimens the percentage elongations in case of MIG welding welded specimens were found higher than the TIG welding welded specimens.
7. Impact strength in case of MIG welding welded specimens were found lower than the ASS 304 base metal.
8. Impact strength in case of TIG welding welded specimens were found lower than the base metal ASS 304 and mild steel both.
9. Due to formation of more austenitic phase in weld metal zone in case of MIG welding the impact strength of MIG welding welded specimens were found higher than the TIG welding welded specimens [8], [11].
10. The microstructure investigation showed the defect free microstructure in all zones. It can be concluded that good welded joint between mild steel and ASS 304 can be obtained

References

1. John A. Brooks and John C. Lippold, Selection of Wrought Austenitic Stainless Steels, ASTM Handbook, Welding, Brazing and Soldering, vol. 6, pp. 456-469.
2. Radha Raman Mishra, Visnu Kumar Tiwari and Rajesha S, A study of tensile strength of MIG and TIG welded dissimilar joints of Mild steel and Stainless Steel, International Journal of Advances in Materials Science and Engineering, vol. 3, April 2014.
3. Keyur Panchal, Experimental Investigation of TIG Welding on Stainless Steel and Mild steel plates, Journal of Engineering Technologies and Innovative Research, vol. 3, issue 11, Nove 2016.
4. Bahadir Işcan, Volkan Onar and Arzum Ulukoy, Investigation of the Mechanical Properties of AISI 304 Austenitic Stainless Steel Joints Produced by TIG and MIG Welding Methods Using 308L Filler Wire, International Journal of Innovative Research in Science Engineering and Technology, vol. 6, issue 10, May 2017.
5. A. Joseph, Sanjai K. Rai, T. Jayakumar and N. Murgan, Evaluation of Residual Stresses in dissimilar Weld Joints, International Journal of Pressure Vessels and Piping, vol. 82, 2005.
6. Brijesh Kumar Maurya, Balwant Pratap, Avaneesh Kumar and Gopal Rana, Experimental Analysis of Dissimilar Metal Welds of Mild steel and Stainless Steel, International Research Journal of Engineering and Technology, vol. 4, issue 5, May 2017.
7. Wichan Chuaiphan, Somrek Chandra-ambhorn, Satian Niltawach and Banleng Sornil, Dissimilar Welding between AISI 304 Stainless Steel and AISI 1020 Carbon Steel Plates, Applied Mechanics and Materials, vol. 268-270, 2013.
8. Jing Wang, Min-xu Lu, Lei Zhang, Wei Chang, Li-ning Xu and Li-hua Hu, Effect of Welding Process on the Microstructure and Properties of Dissimilar Weld Joints between Low Alloy and Duplex Stainless Steel, International Journal of Minerals, Metallurgy and Materials, vol. 19, June 2012.
9. Standard Test Methods for Tension Testing of Metallic Materials, E 8M, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, United States.
10. Standard Test Methods for Notched Bar Impact Testing of Metallic Materials, E 8M, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, United States.
11. R. Badji, M. Bouabdallah, B. Bacroix, C. Kahloun, B. Belkessa and H. Maza, Phase transformation and mechanical behaviour in annealed 2205 duplex stainless steel welds, Materials characterisation, vol. 59, 2008.