

Effect of welding current on mechanical properties of different grades of mild steel

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Abstract— steel is an alloy of iron and carbon or the other name of refined pig iron. In addition, other alloying elements such as silicon, sulphur, phosphorus and manganese are also found in many steels. Welding of steel is a process of joining steel by the application of heat and addition of filler material. Welding parameters such as current, voltage and volume of filler material consumption etc can be considered for studying their effect on mechanical properties. The study explains the effect of welding current on mechanical properties of steel. The results of investigation have been obtained through various mechanical tests such as tensile, compression and bending etc.

Keywords—steel, welding, current, voltage

I. INTRODUCTION

Steel is an alloy of iron and carbon or the other name of refined pig iron. In addition, other alloying elements such as silicon, sulphur, phosphorus and manganese are also found in many steels. There are many grades of available in the market and three grades of steel are used for the present study namely ST-42 (commercial mild steel), AISI-1018 (hot rolled mild steel) and IS-2062 (bright mild steel). The reason for choosing these grades is due to change in chemical composition. Welding in these grades can be done by many types of welding. The type of welding used in this study is arc welding. The aim of this study is to study the effect of welding current on mechanical properties of mild steel. The parameter varied for this study is welding current. Voltage and volume of filler material consumption are considered in this study as they are internally depend on welding current. The chemical composition of steel grades used for study is as follows:

ST-42 (commercial mild steel)

%	C	Mn	S	P	Si
	0.20	0.4-0.70	0.050	0.050	0.10-0.35

AISI-1018 (hot rolled mild steel)

%	C	Mn	S	P	Si
	0.15-0.20	0.60-0.90	0.050	0.040	0.10-0.20

	0.20	0.90			0.20
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IS-2062 (bright mild steel)

%	C	Mn	S	P	Cr
	0.25	-	0.055	0.055	0.20-0.35

II. EXPERIMENTATION & METHODOLOGY

The selection of material has been made on the availability of material and their usage in the market. There are many grades of mild steel available in the market in that we are selected three grades as follows.

Table 3.1 Composition of Material Selected

Material	%				
	C	Mn	S	P	Si
ST-42	0.20	0.4-0.70	0.050	0.050	0.10-0.35
AISI-1018	0.15-0.20	0.60-0.90	0.050	0.040	0.10-0.20
IS-2062	0.25	-	0.055	0.055	0.20-0.35

Table 3.1, 3.2 and 3.3 shows the different types of grades of mild steel and its composition i.e., ST-42 (commercial mild steel), AISI-1018 (hot rolled mild steel) and IS-2062 (bright mild steel). These are the grades commonly used in engineering works (grills, tower building, molding rods, automobile parts etc.)

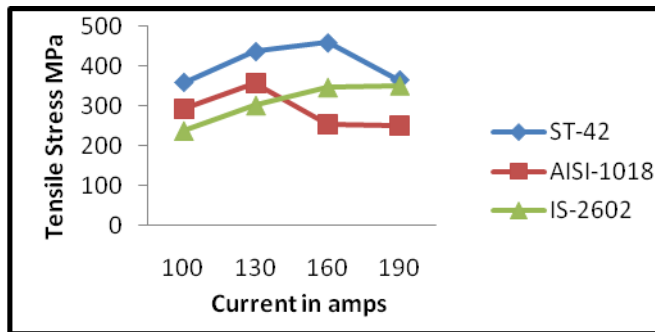
In the above research the influence of different weld parameters such as welding current, arc voltage and volume

consumption of electrode on the mechanical properties like tensile strength, compressive strength, bending strength as been made and tensile, compression and bending tests were conducted for the different grades of mild steel by varying the welding current of 100, 130, 160 and 190 A. Three specimens were prepared for each welding current and the average reading is taken for analysis.

III. RESULTS & DISCUSSION

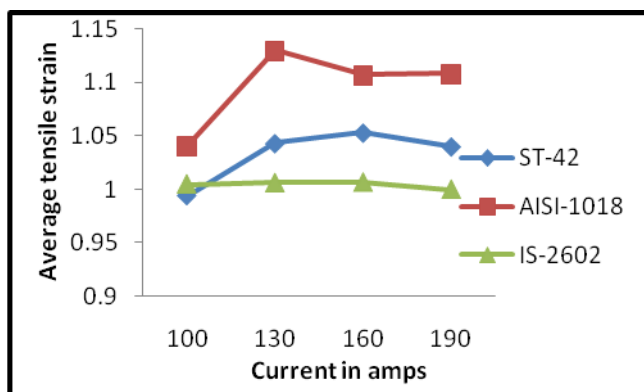
Tensile test

The tensile test has been conducted in UTM (UTN-40 model) and the averages of 3 test reading were taken for analysis. The graphs from the obtained reading have been plotted and as shown in graph 4.1, 4.2 and 4.3.



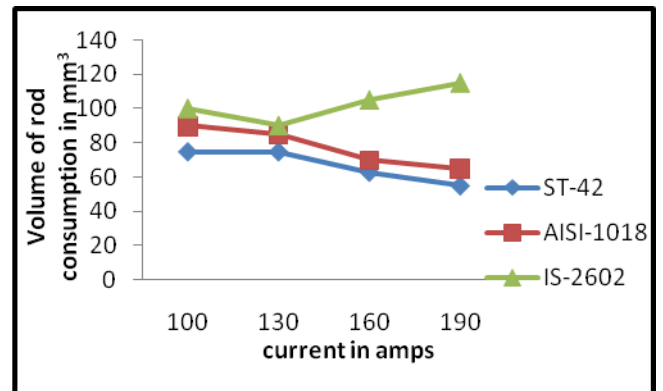
Graph 4.1 Variation of tensile stress on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.1 shows the variation of tensile stress on different grades of mild steel with respect to variation of current. From the above graph we can see that the tensile strength increase for all the steel grades as current increase up to 160A and then tensile strength decreases. When compared to with each other ST-42 grade of steel has more strength. The ST-42 grade of steel has maximum strength at 160A.



Graph 4.2 Variation of tensile strain on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.2 shows the variation of tensile strain for different grades of mild steel with respect to variation of current and in this it can be observed that the strain is increasing as current increases up to 160A and then the tensile strain decreases. It also can be observed that for current of 130A AISI-1018 has maximum stain and for the current of 190 A IS-2602 has minimum strain. When compared to different grades of steel AISI-1018 grade of steel has more strain capacity then other two different grades of steel.

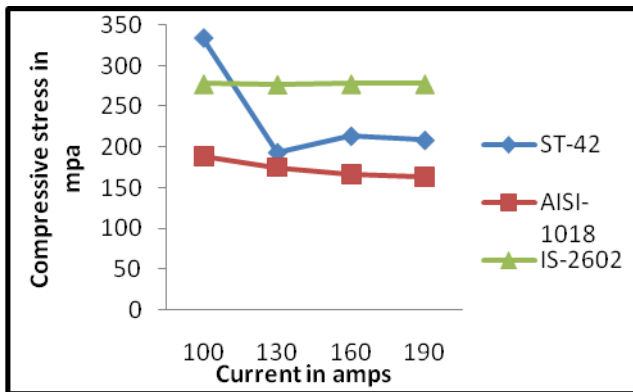


Graph 4.3 Variation of volume of electrode consumption on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above Graph 4.3 shows that the volume of electrode consumption with respect to variation of current. It can be observed that the volume consumed decreases as the welding current increases for all the different grades of steel. The maximum consumption of electrode is for IS-2602 grade of steel.

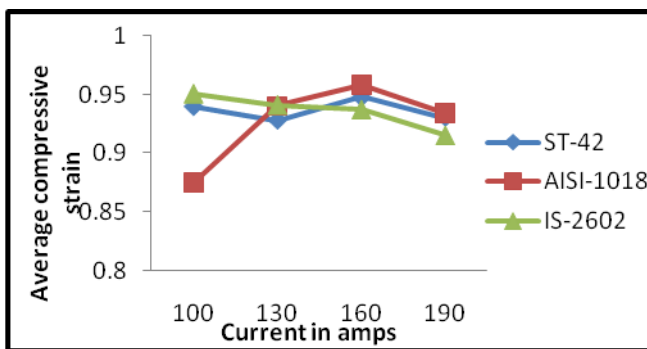
Compression test

The compression test has been conducted in UTM (UTN-40 model) and the average of 3 test reading was taken for analysis. The graphs from the obtained reading have been plotted and as shown in graph 4.4, 4.5 and 4.6.



Graph 4.4 Variation of compression stress on different grades of mild steel for 100, 130, 160 and 190 A of welding current.

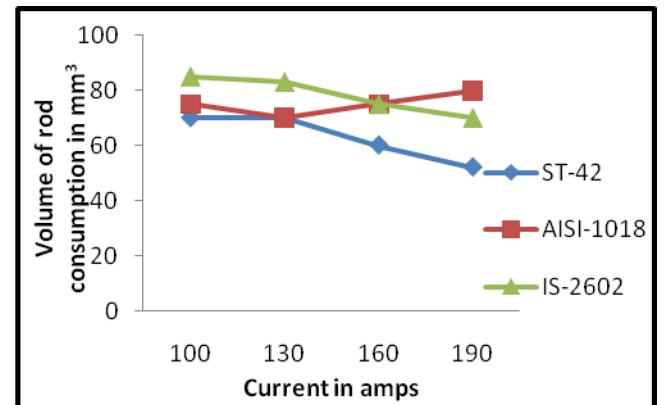
The above graph 4.4 shows the variation of compression stress for different grades of mild with respect to variation of current. It can be observed that the compression stress keeps on decreasing as the welding current increases. The ST-42 grade of mild steel has more compression strength for a welding current of 100A. When compared with three different grades of steel the ST-42 has more compression strength.



Graph 4.5 Variation of compressive strain on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.5 shows the variation of compressive strain for different grades of mild steel with respect to variation in welding current. From fig 4.5 it can be observed that the compressive strain keeps on increasing as the welding current increases for all the different grads of mild steel upto 160A and then decreases. The AISI-1018 mild steel has more

compressive strain at 160A.

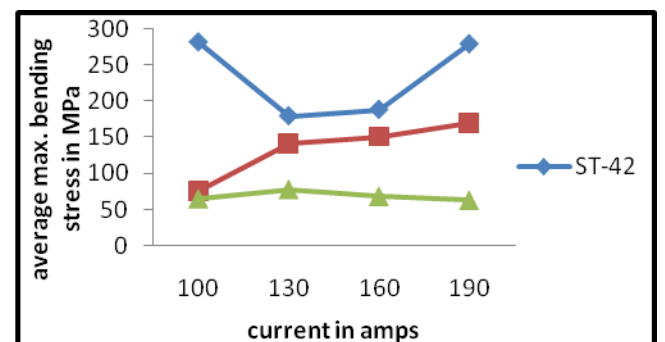


Graph 4.6 Variation of volume of rod consumption on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.6 shows the variation of volume of electrode rod consumption on different grades of mild steel with respect to variation in welding current. From fig 4.6 it can be observed that the volume of electrode rod consumed keeps on decreasing as the welding current increases. The ST-42 grade of mild steel has least volume of electrode rod consumption for a welding current of 190A. when compared to different grades the ST-42 grade of steel consumes less volume of welding electrode rod.

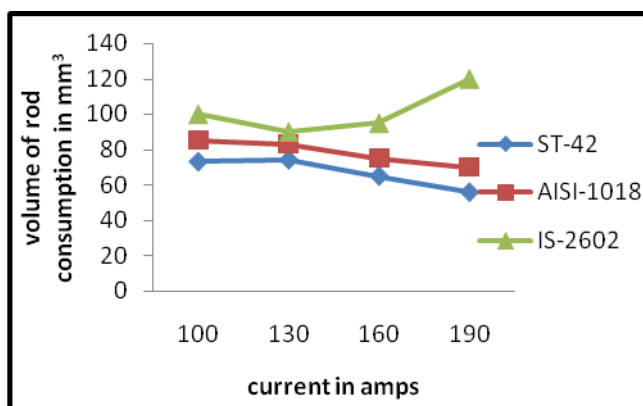
Bending test

The bending test has been conducted in UTM(UTN-40 model) and the average of 3 test reading were taken for analysis. The graphs from the obtained reading has been plotted and as shown in graph 4.7and 4.8.



Graph 4.7 Variation of bending stress on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.7 shows the variation of bending stress on different grades of mild steel for variation of welding current. From fig 4.7 it can be observed that the bending stress keeps on increasing as the welding current increases. The ST-42 grade of mild has more bending stress when compared to all other grades of mild steel.



Graph 4.8 Variation of volume of rod consumption on different grades of mild steel for 100, 130, 160 and 190 A of welding current

The above graph 4.8 shows the variation of volume of electrode rod consumption on different grades of mild steel for variation of welding current. From fig 4.8 it can be observed that the consumption of volume of electrode rod decreases as the welding current increases. The ST-42 grade of mild steel consumes less volume of electrode rod when compared to other grades of mild steel.

IV. CONCLUSIONS

In the present study we have welded for ST-42, AISI-1018 and IS-2602 grades of mild steel for 100, 130, 160 and 190 A of welding current and conducted tensile, compression and bending tests. The following are the conclusion obtained.

1. The tensile stress gradually increases for all the grades of mild steel upto welding current of 160A

- and then decreases. The ST-42 grade of mild steel has more tensile strength when compared to AISI-1018 and IS-2602 grade of mild steel. The maximum tensile strength obtain is at 160A.
2. The tensile strain gradually increases for all different grades of mild steel upto welding current of 160A and then decreases. The AISI-1018 grades of mild have more tensile strain when compared to other two grades of mild steel.
3. The compression strength decreases for all the grades of steel as the welding current increases. The ST-42 grade of steel has more compression strength when compared to other two grades of mild steel.
4. The compression strain gradually increase as the welding current increase upto welding current of 160A and then decrease for all different grades of mild steel. The AISI-1618 grade of mild steel has more compressive strain at 160A.
5. The volume of consumption of electrode rod keeps on decreasing as the welding current increases. The ST-42 grade of mild steel consumes less volume of electrode when compared to other two grades of mild steel.

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