International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

JOINING OF METALS BY THE APPLICATION OF MOLTEN METAL

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Abstract: *Bonding of metals is becoming an important technology as it has found wide application in different engineering and mechanical industries. In this project bonding of metals using molten metal was investigated with emphasis on the effect of bonding condition on bonding strength. Joining of metals are usually done by welding, brazing, soldering, bonding, riveting and adhesive joining. We are planning an alternate method for join of metals by using molten metal. In our project we join both similar and dissimilar metals such as other joining process. Through our process we can join conductive and non-conductive metals. In our joining process we have been using lead, copper and brass as molten metal and stainless steel, aluminium and mild steel as the metals to be joined. As internal stresses are not developed, the life time of the joined pieces are high when compared to other joining process. The intermetallic compound layers are not formed in our process. The study shows that quality metal bonding can be achieved with the application of appropriate bonding technique.*

INTRODUCTION

Here the methods involved in our joining process and the properties of metal used in our project. The detailed discussion regarding our process and properties of the materials , The testing methods, Methodalogy of the process, Advantages&Disadvantages, Results are given below.

PREPARATION OF METAL

The metals are prepared for required shapes and the metal is also surface finished by surface machining process. After vertical boring drill is made on work piece by the use of drilling machine. Various drill size of 2mm, 5mm, 3mm are drilled using various drill bits made by high speed steel and alloy steel having hardness greater than that of stainless steel and EN materials of different grades.




Work piece after machining

REASON FOR CHOOSING COPPER AS MOLTEN METAL:

- Gets melted easily at 1083
- It is found combined in over 270 different materials.
- Good weight to strength ratio.
- Easily available material.

MOLTEN METAL OF COPPER

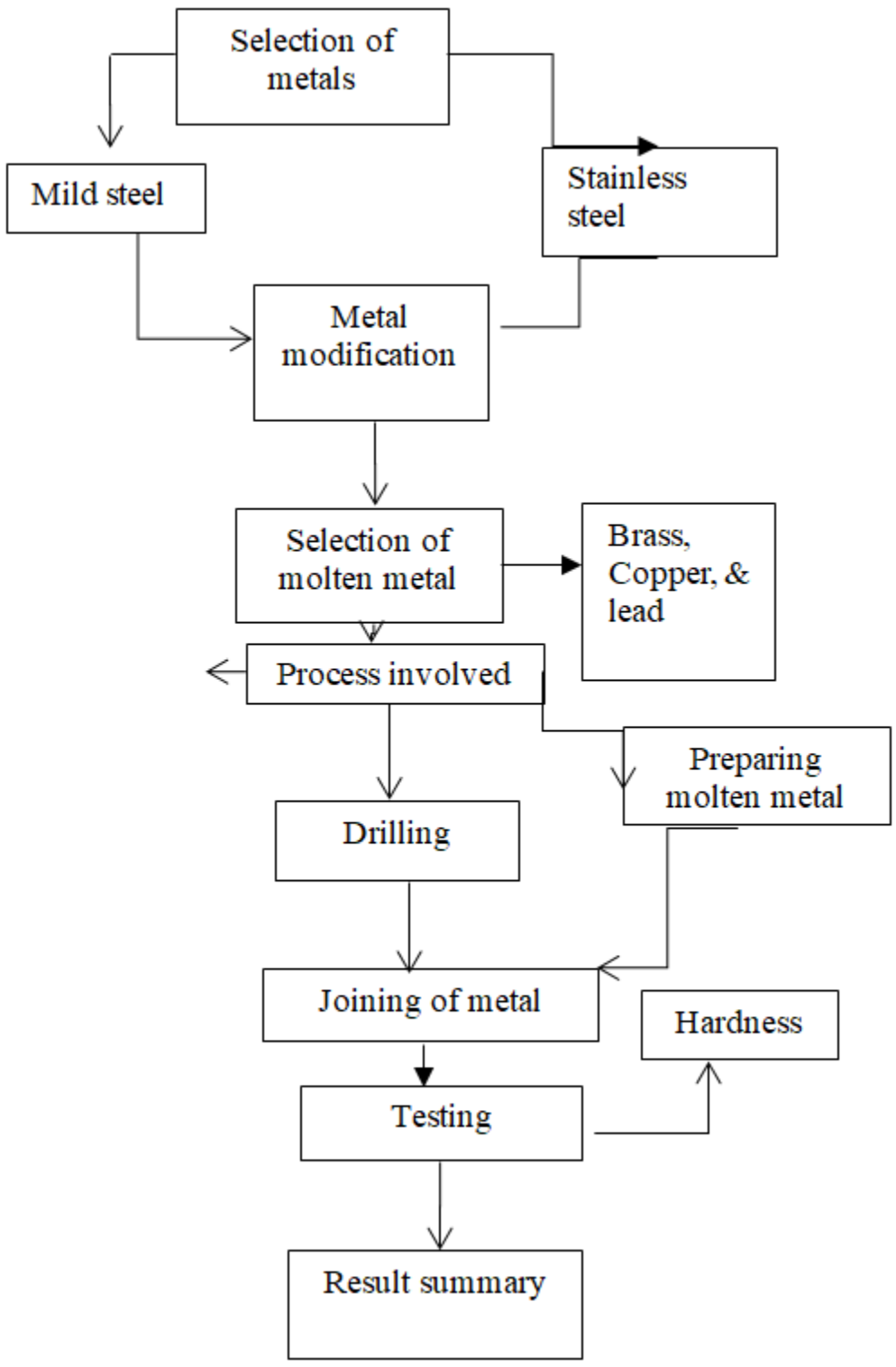
Copper is chosen as the molten metal because of its soft and strong nature. It is non-magnetic and ductile in nature which can be mould into different shapes easily.

Fig 3.3 Melted metal

Copper also known for its excellent rust resistance property and hence when used at joints provide excellent bonding and provides long life to the joint copper is also found abundant in the earth crust, though costlier than aluminium it provides good properties than aluminium

Fig.3.4 Finished work pieces to be tested

METHODOLOGY



TESTING

HARDNESS TEST (ROCKWELL HARDNESS TEST)

The Rockwell hardness test method as defined in ASTM E-18 is the most commonly used method. The Rockwell test is generally easier to perform and more accurate than other type of hardness method the Rockwell test method is used on all metals,except in condition where the test metal structure on surface condition would introduce **too much** variationswhere the indentation would be too large for the application;or where the sample size or sample shape prohibits its use.

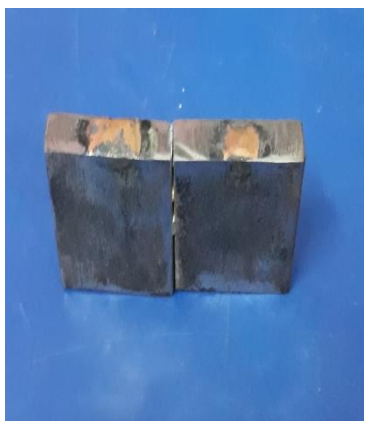
Fig.4.1 Hardness testing machine

RESULT AND DISCUSSION

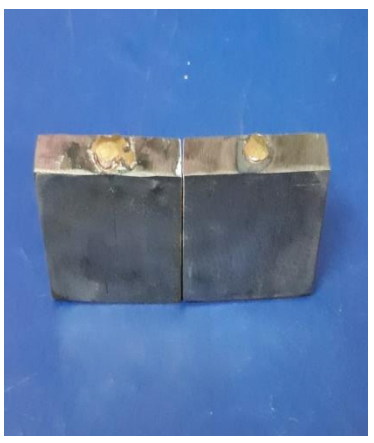
This process describes joining of metals (similar and dissimilar) by the application of molten metals. This method is an alternate for joining of metals using other traditional metals. We have successfully joined metals such as mild steel -stainless steel, stainless steel - stainless steel, aluminium - aluminium and communication of electronitrate with different grades like grade 19,24,41 using copper as a joining metal

SS-SS(COPPER)

AL-AL(LEAD)



MS-MS (BRASS)



SS-MS (BRASS)

5.1 HARDNESS TEST

The specimen to be tested or machined to the required size for the hardness testing the strength of the specimen is determined using the Rockwell hardness testing machine the result found in tabled below,

Material	Scale	Diameter of intentation	Load in kg	Reading			Rockwell Hardness number
				1	2	3	
AL-AL(LEAD)	BLACK	DIAMOND	60	14	15	13	14
M.S-M.S(BRASS)	BLACK	DIAMOND	150	96	99	88	94.3
S.S-S.S(COPPER)	BLACK	DIAMOND	150	104	94	88	95.3
M.S-S.S(BRASS)	BLACK	DIAMOND	150	120	116	119	118.3

Result of hardness test

From the tabular column it is found that brass gives the best joints then lead and copper. Thus it is clear that molten material joining us most effective while done by automated for mass production under factory on trying different combination of metals different strength of bonding can be obtained as well.

5.2 ADVANTAGES

- Moten metal joining method has very lower residual stresses when compared to weld joining Mass production can be achievable by machine automation technology
- Gas inclusion may not occur
- No crack might be found as like in weld joints.
- possess higher bonding strength when molten metal fuses to the base metals at high temperature
- No requirement for cleaning.
- Becomes more harder than at initial stage by aging.
- Rapid joining solidification.
- There is no need for addition for filler to avoid coalescence as in welding process
- The material property of the metal pieces does not change during our process
- The dangers such as melting of work piece in welding process are avoided completely.

5.3 DISADVANTAGES

- Dismantling the joining metal components by the molten metal is very difficult.
- Difficult to join complicated and other complex metal geometry comes in huge structures.
- Re-melting of joining components to dismantle by reversible process will affect the base metals further application behavior.
- It is very difficult for removing the solidified molten metal in the base metal once joined.

CONCLUSION

1. The result confirms that joining of metals by the application of molten metal has been more stronger than other joining process
2. The usage of molten metal does not change the properties of the metal
3. Hardness testing of our project has given positive result when compared with welding process
4. Formation of internal stress is completely avoided in our project
5. There is no formation of crack developed between two metal pieces in our project
6. There is no occurance of heat affected zone.

PHOTOGRAPHY

Tested Workpieces

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