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EXPERIMENTAL INVESTIGATION ON AGGLOMERATED FLUXES IN SUBMERGED ARC WELDING

Manne Kaushik[1] *and Abid Musa Mulla*[2]

[1]PG Student, [2]Professor

[1]Department of Mechanical Engineering, Rajarambapu Institute of Technology, Islampur, India.

[2]Department of Mechanical Engineering, Rajarambapu Institute of Technology, Islampur, India.

Abstract: Submerged Arc Welding is an advance arc Welding Process become a most Popular Choice when a high level of Weld Quality or Considerable Precision Welding is required. However, the major Problems of Submerged Arc Welding Process are its slow welding Speed and limited to lower thickness material in Single Pass. In this Work, Submerged Arc Welding has been performed on 12mm SAE 1062 with using various types of Agglomerated fluxes. Wide range of Welding Speed, Voltage, and Current has been tested for obtained a full Penetration Welding. Agglomerated fluxes has also been used to improve the weld depth. After Performing Welding by maintaining different gap between the Plates to be welded, weld bead geometry and tensile Strength of the weld has been investigated. It is observed that, by maintaining an appropriate gap full Penetration welding of Plate is Possible which gives strength almost Similar to base material.

Index Terms **- Submerged Arc Welding, Agglomerated fluxes, Submerged Arc Welding**

I. INTRODUCTION

Submerged Arc Welding is an arc Welding Process in which arc is Concealed by a blanket of granular flux.Heat for Submerged Arc Welding is generated by the arc between Consumable wire and the work Piece.The arc is maintained in a Cavity of molten flux or Slag ,which refines the weld metal and Protects it from atmosphere Contamination.Alloys ingredients in the flux may be Present to enhance the mechanical Properties and Crack resistance of the weld deposit.The Figure Shows Set up for Automatic Submerged Arc Welding.An electrode is Continously fed into the joints by mechanical Powered drive rolls.A layer of granular flux,just deep enough to Prevent flash through is deposit infront of the arc.Electrical Current,which Produced the arc is Supplied to the electrode though the Contact tube.The Current Can be either direct Current (dc)with electrode Positive (reverse Polarity),with electrode negative (Straight Polarity) or alternating Current(ac).The Figure Shows the melting and Solidification Sequence of Submerged Arc Welding.After Completion of Welding and Solidification of weld metal,the unused fluxes may be Screened and reused.The Solidified Slag may be Collected,crushed,resized,and blended back into new flux.Re Crushed Slag with unused or Virgin flux are Chemically different from new flux.Blends of recrushed slag may be Classified as Welding flux,but cannot be Considered the Same as the virgin flux.

Arc Welding is adaptable to both Semiautomatic and fully automatic operation although the later,because of its inherent advantages is more Popular.In Semiautomatic Welding,Welder Controls the travel Speed,direction and the Place of the Weld.A Semiautomatic Welding gun is designed to transport the flux and wire to the operators,who weld by dragging the gun along the weld joint.Semiautomatic electrode diameters are usually less than 2.4 mm to Provide Sufficient flexibility and feed ability to the gun assembly manually guiding the gun over the joint requires Skills because the joint is obscured from the view by the flux layer.In automatic SAW travel Speed and direction are Controlled mechanically.Fluxes may be automatically deposited infront of the arc,while the unused flux may be Picked by a Vaccum recovery Systembehind the arc.To increase deposition rate or Welding Speed,more than one wire Can be fed Simultaneously into the Same weld Pool.The Figure Shows the twin arc Process in which the two electrodes are fed into the Same weld Pool while Sharing a Common Power Source and Contact tip.In tandem arc SAW,Multiple electrodes are arranged with one infront of the other.Each electrode has an independent Power Supply and Contact tip.The Spacing,Configuration ,and electrical nature of the electrodes may be arranged to Optimize welding Speed and bead Shape.

Principle of Submerged Arc Welding:

The Welding Procedure Starts with the deposition of flux on the welding joint. In the Cooling Condition of the flux it behaves like an insulator. Movement in the arc can be initiated by the movement of the tool through the workpiece. The heat which is Created by the flux will Soften the granular flux material. The flux moves into a complete conduction state when it is completely melted. This starts the current flow to the electrode via the molten flux which allows being in contact with the external environment. The left and undissolved flux will be considered as wastage and removed after the completion of the entire process. By a Constant Speed level ,the electrode will move towards the joint to get Connected to it. When this Connection is moderately automatic then the Condition moves in line with the welding top Position, whereas in Automatic SAW there has to be a Separate drive to allow the Welding Position to be at the top. By the assistance of the Self adjusting concept, the arc length is maintained at Constant, where there is a reduction in the arc length, then the arc Voltage and Current levels will get increased. when the length of the Arc is more than the Specified length, then the arc voltage and current levels will get decreased.

II. EXPERIMENTAL SET-UP:

The Welding set up for Submerged Arc Welding Consists Following Components:

1. Welding Current, 2. Electrode Polarity, 3. Current Density, 4. Welding Voltage, 5. Travel Speed, 6. Electrical Stick out, 7. Flux Layer Depth.

Table 1: Experimental Planning for Submerged Arc Welding of Mild Steel

SL.NO	Type of Flux	Travel Speed (Run)	Voltage (V)	Current(A)
1	AWS/SFA5.17: F7AZEL8	50	20	300
2	WELMET FLUX 81L	45	20	350
3	Cao245L	50	20	350
4	AWS/SFA5.17: F7AZEL8	52	20	350
5	AWS/SFA5.17: F7AZEL8	52	20	350
6	AWS/SFA5.17: F7AZEL8	52	25	320
7	Welmet Flux 81L	50	22	300
8	Welmet Flux 81L	50	20	330
9	Welmet Flux 81L	50	20	350
10	Cao245L	45	20	350
11	Cao245L	45	20	350
12	Cao245L	50	20	380
13	Cao245L	50	20	380
14	Cao245L	52	22	340
15	Cao245L	52	22	380

Sample Preparation for Study the weld bead geometry:

After Performing the Submerged Arc Welding of mild Steel Plate, Welded Specimens were cut at the Perpendicular to the weld Scan direction with the Dimension of 20 *10 mm for taking optical microscope image of the weld zone. These welded Specimens were cut with the help of wire electro discharge machine. After Cutting the Samples, Polishing &Chemical etching were Performed at the weld Cross Section, before taken the optical image. Specimens were Prepared by usual metallurgical Polishing method using different grit size Sic Polishing Paper and Subsequent Diamond Paste Polishing. Nital Solution Consist of ethyl alcohol (97%)and conc Hno3 (3%) has been used for etching the weld cross Section by Dipping the Polished Surface in it for 10sec.Melting depth or Weld Penetration was Checked for each weld Sample from the Change in microstructure using an optical microscope.

Submerged Arc Welding Process with Tio2 Flux

Submerged Arc Welding Provides high quality weld and good bead Surface. However, Compare to other arc welding Processes like Plasma arc welding and Tungsten inert gas welding, Submerged Arc Welding exhibit low Penetration /melting depth in the workpiece. Therefore, it is required to improve the Penetration/melting depth of Submerged Arc Welding Welded joint. This can be done with help of inorganic Powders generally called Activated flux. Applications of activated fluxes in Various arc welding Process for ferrous, non-ferrous and dissimilar materials give higher Penetration Compared to welding done without using flux. The Presence of flux narrow the arc Concentrated energy into a Small area and reduces surface tension of a molten Pool. This results in increases the depth of Penetration of the weld joint.

Agglomerated fluxes are Prepared using single Component of any oxides (Cao, Fe2o3, Tio2, ZnO, MnO2, and Cr2O3) in Powdered form or mixture of these Powders. Activated fluxes then added in a liquid Solvent like acetone of 5 to 10 ml of the flux Powder and Stirred to make it has homogeneous Paste, ready to be applied on the weld Surfaces. A Coating approximate 0.1mm thick was applied to the Surface of the Strip using a Paint Brush (10-12 mm) width Prior to the welding.

SAW welding of mild steel by varying gap between workpieces to be welded.

It has been observed from the Previous experiments that, during autogeneous SAW welding of thick mild Steel Plates either using flux or without flux, when Plates are kept Side by Side and no gap Provided between them, the depth of Penetration or melting depth is limited to a certain Value and molten material does not flow towards the bottom side of the joint. It is found from the literature, that during welding using filler rod, for the flow of molten material Proper grooving is Provided or Some gap is maintained between plates to be weld. Therefore, in this work, in order to increase the depth of Penetration in Weld, Submerged Arc Welding was Performed by maintaining a gap between workpiece to be Welded. An attempt has also been made to Study the effect of gap between plates during Submerged Arc Welding of mild steel for using no filler rod.

In Submerged Arc Welding method depth of Penetration is low at weld zone in thick mild steel plate. For the Purpose of increment of the depth of Penetration in weld Submerged Arc Welding was performing with maintain gap between workpiece. All these results increase in depth of Penetration. The 100 mm length welds were obtained along welding direction without application of wire. Total 15 experiments were Performed and welding. Welding Process done with Constant Speed and same value of fixed parameters as Conventional SAW welding Process.

III. RESULTS AND DISCUSSION:

Table 2: Welding Experimental Results Details

SL.NO	TRAVEL SPEED	VOLTAGE	CURRENT
1	50	20	300
2	45	20	350
3	50	20	350
4	52	20	350
5	52	20	350
6	52	25	320
7	50	22	300
8	50	20	330
9	50	20	350
10	45	20	350
11	45	20	350
12	50	20	350
13	50	20	380
14	52	22	380
15	52	22	340
16	52	22	380

IV. CONCLUSIONS:

Findings of the Present investigation can be Summarized into following Points:

1. The result of the Submerged Arc Welding Process Performed show that, maximum depth of penetration was obtained with Parametric Combination of minimum welding Speed and maximum current.
2. When the Same Procedure is repeated with additional utilization of Tio2 flux, depth of Penetration increases in Comparison to the Conventional welding, but Some crack on the weld zone was observed for using flux.
3. with welding Speed, another set of experiments were done by maintaining a gap between workpiece to be welded. It is observed that, with a gap of 1mm, defect free welding with Proper material flow obtained through out the joint for higher welding Current.
4. Comparing the three methods of Submerged Arc Welding, depth of Penetration and tensile Strength of weld joint is maximum when adequate gap is maintained between the Components to be welded.
5. From the graphs Plotted, it can be inferred that welding width and depth increases with increase in welding Current and gap maintained between the components to bewelded.

V. FUTURE ASPECTS:

If Welding is Possible with minimum welding Speed, depth of Penetration will increase. Optimal gap maintains between two work Pieces to be welded so obtained higher melting depth. All these results Provide better Strength to the weld joint.

SAW welding Process Performed with using filler material so thick plate weld and Provides higher depth of Penetration and better Strength.

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