Chapter-5

CONCLUSIONS AND SCOPE OF FUTURE WORK

5.1 Conclusions

The effect of GMA welding parameters i,e Welding current, Arc voltage, Shielding gas flow rate, Wire feed speed, and Gas mixture, Heat input, and thickness of materials were studied on mechanical properties and microstructure on IS 2062 steel weldments and AISI 304 steel weldments using the light optical microscope (LOM),and scanning electron microscopy (SEM). Chemical analysis of the inclusion was completed by using EDS.

On the basis of experimental results the following conclusions may be derived:-

(1) In this study, it has been observed that for IS 2062 steel a minimum yield strength of 229 MPa at 3.58 kJ/mm heat input and for AISI 304 steel a minimum yield strength of 316MPa at 2.78 kJ/mm heat input respectively were obtained. As the heat input increase, then the mechanical properties such as ductility, toughness, tensile strength, fatigue strength, and microstructure of welded structure decreases but on increasing the heat input can cause the expansion towards the microstructure's grain size. The decrease in toughness was observed in both the Course grain heat affected zone (CGHAZ) and Fine grain heat affected zone (FGHAZ) and in worst cases, the welded AISI 304 break unexpectedly because of the brittle zone in the HAZ region.

(2) The ultimate tensile strength of IS 2062 steel weldments and AISI 304 steel weldments decrease on increases in the heat input. Maximum of the ultimate tensile strength of IS 2062 steel weldment is 532.6MPa at 4.47 kJ/mm heat input which is 23.01% greater than the base material and ultimate tensile strength of AISI 304 steel weldments are 670MPa at 3.01 kJ/mm heat input respectively which is 23.13% greater than of the base material.

(3) The maximum toughness of IS 2062 steel weldment is 232 joule at 3.88 kJ/mm heat input and maximum toughness of AISI 304 steel weldment is 270 joule at 1.89 kJ/mm heat input respectively and in both cases the toughness of weldment was found approximate 80%.

Toughness of workpiece and for AISI 304 steel weldment there is an increasing in the toughness with increasing the heat input value due to an increasing in δ-ferrite contents.

(4) The maximum microhardness (VHN) of IS 2062 steel weldment is 206 at 3.88 kJ/mm heat input which is 29% greater than the base material and maximum microhardness (VHN) of AISI 304 steel weldment is 210 at 3.01 kJ/mm heat input respectively which is 4.28% greater than the base material.

(5) The maximum %age elongation of IS 2062 steel weldment is 20 at 3.88 kJ/mm heat input which is 25% greater than the base material and maximum %age elongation of AISI 304 steel weldment is 28 at 1.89 kJ/mm heat input respectively.

(6) The grain sizes of AISI 304 welded joints were different at different gas flow rates and wire feed speeds. From experimental result it was observed that grain size of weldment and base metal is influenced with increases in the heat input value. In AISI 304 steel weldment the amount of the δ-ferrite contents increased with increasing heat input.

(7) The amount of δ-ferrite content in the weld deposit increases with increasing the value of heat input.

(8) SEM image (Toughness) of IS 2062 steel weldment shows that on low heat input mode of fracture was ductile whereas on high heat input image shows a brittle fracture.

(9) For IS 2062 steel weldment the SEM image of a tensile fractured surface of welded joint reveals that the fracture mode is brittle. It shows dimples with bright cleavage and microhardness (VHN) value change throughout weldment by varying the shielding gas flow rate.

5.2 Scope of future work

On the basis of present investigation, the following suggestions may be made for future work-

- Different shielding gases and their mixture can be used for welding of IS 2062 steel and AISI 304 steel and their effect on mechanical properties and microstructure can be studied and compared with present findings.

- The effect of different welding conditions at different angles of V- groove (45° & 60°) and different thickness of base plate on the mechanical properties and microstructure of welds along with empirical model development may be studied in detail and a comparison can be made with the present findings.
- Few more other metals may be welded under different welding conditions, and the effect of these different GMA welding parameters on the mechanical properties and microstructure can be studied.
- Heat affected zone produced at weldment can be studied.
- Relieving of residual stresses during welding process can be studied.
- A comparison chart for different ferrous and nonferrous metals, welded in different welding conditions can prepare for changes in mechanical and microstructural properties welded by GMAW process.
- Process parameters used in GMAW can be optimized by applying an optimization technique such as ANN, Taguchi, RSM, Design of Metrix, and Fuzzy etc.
- Welding can be performed on vibrating condition on same process parameters and mechanical and metallurgical properties of different steels can be studied.
- In transverse direction macrograph, bead geometry, and depth of penetration can be analyse at different welding conditions.