ABSTRACT

Today’s manufacturing industries are very much concerned about the quality of their products. They are focused on producing high quality products in time at minimum cost. Welding is a widely used manufacturing process and its quality plays key role. Hence proper welding procedure is required to achieve the desired quality.

Although a weldment formed by fusion welding exhibits a monolithic structure, the joint varies in metallurgical structure from point to point with significant variation in mechanical properties. This is because welding results in development of a temperature gradient with highest temperatures encountered in the middle of the weld pool and ambient temperatures along the direction transverse to the weld axis. The extent of the zone so affected depends primarily upon heat input per unit time, welding speed and physical properties like melting point, thermal diffusivity etc, of work material.

The inherent local non-uniform heating and cooling cycle associated with the fusion welding processes like MIG results in complex thermal stresses and strains which may finally lead to development of residual stresses and distortion in the welded structures. Whereas residual stresses can reduce the service life of a structure or even cause catastrophic failures, distortion usually results in misalignment with consequential difficulties in assembly as well as poor appearance of the finished product or structure. It is, therefore imperative to get prior knowledge of the possible effects of welding parameters on the structure for the proposed welding procedure and set-up. The rapid cooling associated with welding often leads to metastable structure which may change with time, due to natural ageing resulting in a possibility of embrittlement of the structure. Full annealing is the simple method to homogenize the structures but that may cause grain growth, coarsening of the metallurgical structure and undesirable loss of mechanical properties in the parts of the weldments like low carbon and low alloy steels. To develop a stress free and comparatively stable structure, other important heat treatment processes are also absolutely necessary.

To investigate the effect of mechanical properties after heat treatment processes, in the proposed research work experimental investigation on the effect of heat treatment on mechanical properties was carried out on both similar and dissimilar welded joints. The butt joint weldments
of similar and dissimilar metals are prepared using MIG arc welding process with Argon as shielding gas while welding is carried out. In similar metals case, IS2062 metal plates were used and in dissimilar metals case, the combinations: IS2602–EN8, IS2602–EN9, and IS2602–EN31 metals were used for the investigation. The heat treatment processes annealing, normalizing and tempering are applied for both similar and dissimilar metals butt joint weldments. Further to investigate the effect of heat input the weldments are prepared with low heat and high heat inputs. Four butt joint weldments are prepared one for without heat treatment and remaining three for each welding process, to compare the results with low & high heat inputs.

The mechanical properties are evaluated from the weldments before and after heat treatment. The tensile, impact and hardness are evaluated with ASTM standards. The grain size and phase volume fraction microstructure analysis carried out with optical microscope are analyzed using metal plus foundry software. The both mechanical properties and microstructure analysis of butt joint weldments are compared with and without heat treatment process. In the weldments of IS2062-IS2062, IS2602-EN8, IS2602-EN9 cases, annealing heat treatment process was found to be quite attractive heat treatment process. In IS2602-EN31 weldments by heat treated by normalizing process as well as tempering process are quite attractive.

**Key Words:** Fusion Welding, Low heat input, High heat input, Heat Treatment processes, Mechanical properties, Metallurgical properties.