AN INVESTIGATION ON EFFECT OF PROCESS PARAMETERS ON WELD BEAD PROFILE OF MODIFIED 9CR-1MO STEEL BY PULSED GMAW

S. Krishnan[1], D.V. Kulkarni[1], A. De[2]

[1]Larsen& Toubro Limited, Heavy Engineering IC, Powai Campus, Mumbai 400072 , India
[2]Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai 400072

Abstract

Environmental regulations requiring reduced CO2 emissions coupled with demand for greater efficiency are demanding greater use of advanced creep resisting steels such as modified 9Cr-1Mo (P91) for high temperature components in the power generation industry. Traditionally, modified 9Cr-1Mo steels are welded using gas tungsten arc welding, shielded metal arc welding and submerged arc welding processes. In order to reduce costs and downtime, particularly for site repairs, recently there is much interest in the use of high productivity welding processes; particularly gas shielded welding processes such as Gas Metal Arc Welding (GMAW). However, the situation with GMAW, particularly with active gas mixtures, is more complex because of the variable recovery of key elements such as Mn, Si, and Nb/Cb. It has been reported that the solid wire Gas Metal Arc Welding (GMAW) process has not found widespread use in the industry mainly due to concerns over lack-of-fusion, sensitivity to welder error and demands for more sophisticated power sources. However, in recent past, as a process of potentially high productivity, interest in GMAW for welding P91 materials is increasing for Industrial applications.

In the present investigation, bead-in-groove trials are performed on a 12mm thick modified 9Cr-1Mo material by pulsed current gas metal arc welding (GMAW-P) process. Two primary parameters like current and weld travel speed are considered in the present experiment and their effect on weld bead geometry, weld metal toughness and weld metal microstructure are discussed. The samples are also subjected to chemical analysis, oxygen content measurement, and inclusion level & hardness survey after PWHT. Response surface methodology (RSM) design approach is used to develop a mathematical relation between the input variables (current and speed) and responses. The developed model is then compared with the experimental results; it is found that the deviation falls within the limit of a 95% confidence level. The direct and interactive effects of the process parameters are also discussed in the present paper.

WELDING OF ACRYALICS USING LASER BEAM: AN EXPERIMENTAL INVESTIGATION

Rajib Kumar Mandal [1], Asish Bandyopadhyay [2] and Santanu Das [3]

[1,3] Department of Mechanical Engineering, Kalyani Government Engineering College, Kalyani- 741235, West Bengal, India
[2] Department of Mechanical Engineering, Jadavpur University, Kolkata- 700 032, India
Email: [1] rajibengineering@yahoo.com, [2] asishbanerjee@yahoo.com, [3] sdas.me@gmail.com

Abstract

Laser beam welding (LBW) uses high energy density beam making it suitable for welding of wide category of materials. As energy density around the focal point of laser beams is quite high, this technique is being increasingly used in the fabrication industry. Since laser beams follow the principle of optics, it can be easily regulated by selecting appropriate lenses. In this paper, a report on the experimental work involving laser beam welding (LBW) is presented where lap joints of two acryalic (polycarbonate) flats- one opaque and the other transparent, are tried to make. Laser beam passes through the transparent piece of plastic flat, and is focused on to the opaque flat around the interface region. Laser beam gets absorbed in the opaque flat in the interface region and generates heat energy causing local melting, and subsequent welding of both the flats. This method is named as through transmission laser welding. The bonding between the two components is likely to occur by interpenetration of molecular chains in the area that is promoted by fluidity of acrylic during welding. Process parameters such as clamping pressure and current are varied at some selected scanning speeds to explore the appropriate condition to obtain sound, strong weld joint within the experimental domain. The laser has a repetitive operating current less than 60 A with pulse frequency of 0.25-10 kHz. The used 30 W laser system is having spectral width of 1.69 nm, beam divergence of less than 0.20 N.A. and beam diameter of 800 µm with a wavelength of 809.40 µm. Scanning speed of 240, 280, 320 and 360 mm/min, current flow of 25, 28, 31 and 34 A, and clamping pressure of 20, 30, 40 and 50 Kg/cm^2 are chosen in this work. Sound welded joint between transparent and opaque acryalic components with high weld strength above 8 MPa is obtained under scanning speeds of 280 and 360 mm/min and 20 Kg/cm^2 clamping pressure with weld current setting of 28, 31 and 34 A. Suitable heat input to the weld interface may have resulted in this observation. Therefore, these conditions may be recommended to apply to obtain large weld strength.