SOME STUDIES ON MIG WELDING OF ALUMINIUM AND ITS ALLOY 5083

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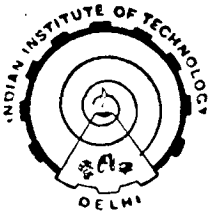
SUNIL PANDEY



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CERTIFICATE

This is to certify that the Thesis entitled,"SOME STUDIES ON MIG WELDING OF ALUMINIUM AND ITS ALLOY 5083" being submitted by Mr. Sunil Pandey to the Indian Institute of Technology, Delhi, for the award of the degree of "Doctor of Philosophy" in Mechanical Engineering is a record of bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of this Thesis which has reached the requisite standard.

The results contained in this Thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

With the ever increasing use of aluminium and its alloys it is but natural to find suitable means of fabricating them into different shapes. Welding with its intrinsic advantages naturally attracts the attention of a fabrication engineer. Welding of aluminium and its alloys unlike welding of low carbon structural steels, however, is not a straightforward technique. Thus inspite of the fact that aluminium is a weldable material it is not easy to establish proper parameters to achieve a sound weld. This is because of the lack of data on the different aspects of aluminium welds.

Due to the increased use of aluminium but a lack of data about its welding a situation is developing where basic research in this field is urgently called for particularly in a country like India where the said conditions are prevalent for quite sometime . In the light of these facts it was decided to investigate into the various aspects of welding aluminium so as to make whatever contribution possible towards better understanding of the vital fabrication technology. Research work was therefore undertaken with a view to studying different aspects of the problem viz., metal transfer, bead geometry and shape relationships, microstructure and microhardness, weld joint design and fracture toughness of weldments.

To carryout welding by mechanised means a manipulator was designed and developed with the help of which welding was done with control panel quite a distance from the site of welding so as to protect the investigator and the welder from the ill effects of fumes and harmful radiations.

The welding system itself was calibrated to determine accurately the welding current. And for that purpose a large number of experiments were carried out to develop a relationship between welding current on one hand and wire feed rate, arc voltage and nozzle to plate distance on the other.

Metal transfer studies were carried out with the help of high speed cine camera in conjunction with instrumentation tape recorder, storage oscilloscope and poloroid camera. The voltage-current transients were also recorded on the cine film along with the photographs of the arc.

Bead geometry and shape relationships were studied in two phases - first by varying each individual parameter of interest and subsequently by designing the experiments using fractional factorial technique. Mathematical models based on regression analysis were then developed, using digital computer, to predict the bead geometry and shape relationships including penetration,bead width, reinforcement height, penetration shape factor, reinforcement form factor and dilution.

Microstructure of welds were studied at different magnifications by projecting them on the television screen with the help of closed-circuit T.V.Camera Extensive microhardness

surveys of welds were carried out to make the study of microstructures, of different zones of welds, more comprehensive.

Final phase of investigations included the design of various types of butt welds which were welded by establishing suitable parameters for different weld runs. The successfully welded joints were then surveyed for macro-and microhardness followed by study of their microstructures. These welds were then evaluated for fracture toughness values using crack tip opening displacement (CTOD) and J-integral techniques. The fractured pieces were studied by scanning electron microscope (SEM) for investigation into mode of failures and the types of grains developed in different butt welds.

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