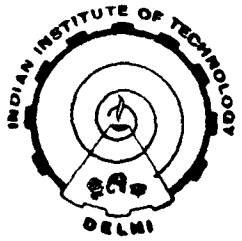
SOME STUDIES ON MIG WELDING OF Al-Zn-Mg ALLOY (7005)

by

MUKESH KUMAR

A thesis submitted
in fulfilment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY



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CERTIFICATE

This is to certify that the thesis entitled, "SOME STUDIES ON MIG WELDING OF Al -Zn -Mg ALLOY" being submitted by Mr. Mukesh Kumar 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 & supervision and has fulfilled the requirement 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

THESIS TITLE	-	SOME STUDIES ON MIG WELDING OF Al-Zn-Mg ALLOY (7005)
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A B S T R A C T

Al-Zn-Mg alloys have gained wider acceptance as materials for various civil, defence and automobile applications such as floating bridges, railways, sub-way carriages and cryogenic applications because of high strength , self ageing characteristics, quenching insensitivity, amenability to various forming techniques. However these alloys are prone to stress corrosion cracking and exfoliation corrosion. Such corrosion is very troublesome as it can affect any materials rending it catastrophically brittle. Such failures generally occur in corrosive environment and sustained loading which may be due to external load or due to internal stresses developed in the structure during fabrication/forming techniques.

Such restrictions and lack of any real understanding about welding parameters/techniques to reduce residual stresses to avoid failure due to SCC have greatly limited the use and development of the Al-Zn-Mg alloys. This has also put everyone, material fabricator and user alike, generally in a position of some uncertainty with the wider and more general exploitation of this alloy family. In the light of these facts it was decided to investigate into the various aspects of welding of Al-Zn-Mg alloys so as to make whatever contribution possible towards understanding of

the fabrication technology of Al-Zn-Mg alloys.

Research work was therefore undertaken with a view to study diffrent aspects of the problem viz. optimization of welding paramters,study of bead geometry and shape relationship, angular distortion, measurement of residual stresses, microstructure and microhardness study, weld joint design,fracture toughness of weldments and developing mathematical models for automatic welding.

The welding was carried out by a caliberated automatic machine. To study the effect of various welding parameters on different aspects in depth, it was decided to design the experiments based on fractional factorial technique and then run the experiments based on this. Mathematical models were constructed based on the results of above experiments. The models were validated by conducting a series of experiments.

Microstructures of welds were studied at different magnifications by projecting them on the television screen with the help of closed circuit TV camera. Extensive microhardness surveys of welds were carried out to make the study of microstructures of different welding zones more comprehensive.

Angular distortion study were carried out by measuring distortion of butt-welded plates with various joint angles, with the help of vernier height gauge. Residual stresses were measured using electrical strain gauge rossets as per ASTM (E837-81) method of centre hole drilling technique . Residual stresses were calculated in longitudinal as well as transverse directions.

In the final phase of investigations the specimens were prepared from butt welded plates for notch tensile testing.Specimens were tested by making double notch in the weld zone as well as in the HAZ and the pieces were tested as per ASTM (E338-81) method.

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