Research and Development

We give below brief abstracts of research work carried out in Metal Joining Laboratory, Department of Metallurgy, Indian Institute of Technology, Madras during 1979-80. Compiled by Dr. D. R. G. ACHAR, I.I.T., Madras.

1. Direct Cladding of Copper onto Steel using Oscillating MIG Technique (S. V. Dilipan, —M.S. Thesis—1979).

   There has been increasing use of copper and its alloys for cladding components which have to handle fluids that need non-toxic and non-corrosive atmospheres. Also it has been found that they perform better under reducing conditions unlike stainless steel, aluminium and titanium which are better in oxidising conditions.

   Both fusion and non-fusion welding processes are being used to clad copper and its alloys onto steel. The fusion processes like manual metal arc welding, metal inert gas arc welding have definite advantages over non fusion methods for cladding because of their versatility. In the case of non-fusion processes like roll-bonding, explosive cladding, though dilution and intergranular penetration could be precisely controlled, the size and shape of the components that can be cladded form the limitation.

   The present work was directed in using oscillating metal inert gas technique and investigating the possibility of directly cladding copper onto steel based on the following considerations, (i) it is possible to deposit a wide layer of clad metal in a single pass as in the case of submerged arc strip cladding. (ii) The process can be easily automated and thus operational errors could be eliminated and (iii) Further there is very little reported work on the development of oscillating metal inert gas technique indigeneously.

   The first phase of the work consisted of designing an oscillating mechanism for the existing metal inert gas torch and fabricating the same. The second phase was devoted to evaluate conditions under which dilution of iron into copper can be controlled to the minimum. The third and the last phase of the work dealt with studying the nature of the clad obtained.

   The oscillating equipment that has been fabricated to carry the metal inert gas welding torch and oscillate, met the requirements effectively. Both the frequency and the amplitude could be varied through changing the motor speed and eccentricity of the pin respectively with considerable accuracy.

   Of the various parameters investigated it was observed that the effect of oscillating frequency and cladding speed was most predominent.

2. MMA Welding of HSLA Steels—HAZ Toughness Studies (P. Dhandapani, M. Tech. Project—1980).

   In this work, the heat affected zone (HAZ) toughness of MMA weldments of high strength low alloy steel is evaluated by taking charpy V-notch specimens.

   Investigations were carried out by placing the notch in the coarse grained region of the HAZ, which is considered to be the most sensitive region of the heat affected zone.

   Impact test results are correlated to the heat inputs, test temperatures, and to the microstructures obtained. Detailed metallographic study and hardness survey were carried out to enable the correlation.

   Fractographic studies were carried out using Scanning Electron Microscope (SEM) to obtain further information on variation of mode of fracture with heat input and test temperature.

3. Under Water Welding and Cutting—The State of the Art (I. Gowrishankar, M.Tech. Project—1980).

   Under water welding and cutting operations are becoming increasingly important due to large scale spurt in the offshore oil industry. A number of processes are being developed for the under water applications to deal with various underwater welding problems.

   The objective of the present investigation is to make a survey of the existing underwater welding and cutting processes. The report contains a detailed account of the various underwater welding and cutting processes, which are divided into five groups. The first section deals with the underwater manual metal arc welding, in which various aspects of welding are discussed. The second section deals with the welding processes which are used inside a chamber immersed in the water. Details of a recently developed technique to create a dry zone locally in the joint vicinity is discussed in section three. Section four contains miscellaneous welding processes like underwater firecracker welding and explosive welding etc. Section five deals mainly with the current developments in underwater cutting.

   Experimental work is also carried out to a limited extent, to study the nature of the underwater MMA welding processes. The results obtained from the experiments illustrate the differences between the air and underwater welding processes.

4. Full Plate Single and Multilayer Copper Cladding on Steel by Oscillating MIG Technique (R. Manohar, M. Tech. Project—1980).

   The work reported here is a continuation of the previous investigations to clad copper onto steel directly using a MIG oscillating method. In the present work, investigations were carried out to produce multilayer clads and to study their effect on clad properties.

   Clad properties were estimated by conducting face and side bend tests, metallographic studies and microprobe analysis. From the investigations carried out, it is indicated that crack free full plate multilayer clads are possible with minimum iron dilution and integranular penetration.

5. Metal Transfer and Arc Characteristics in Metal Arc Welding (S. Raja, M. Tech.—1980).

   Arc welding processes constitute a very important part of industrial production techniques. The consumable electrode processes offer higher thermal efficiency and higher deposition rates. For technical reasons such as good penetration, good bead appearance, a narrow heat affected region and for economic reasons like cost of post weld cleaning, power requirements and welding speed, a study of metal transfer characteristics becomes imperative. Since the occurrence of these characteristics is due to a complex interaction between the arc and the metal droplets, both arc characteristics and metal transfer mechanisms have to be studied.

   In this investigation, a study of the arc characteristic and metal transfer mechanism has been conducted using 35 mm still photograph, with and without suitable filters, 16 mm high speed photography, and high speed multichannel oscillographic recording techniques. Preliminary results indicate that droplet transfer depends on the coating type in manual arc welding electrodes. This investigation forms a part of continuing programme to study metal transfer mechanisms.

6. Fracture toughness studies of grain-refined electro-slag weldments (M. N. Vijayashankar, M. Tech.—1980).

   Electroslag welding processes, viz. wire-electrode as well as consumable guide types, give a weld joint possessing lower toughness. The higher heat inputs associated with these processes result in coarser grains both in weld metal and heat affected zone. The normalising heat treatments carried out on these welded joints result in higher production costs, for an otherwise economical process.

   In this investigation, the improvement in grain size of the weld metal has been studied by the addition of suitable grain refiners to the liquid weld metal. Results of the experiments indicate improvement in grain size, leading to a higher impact toughness and comparably higher COD values for the weld metal in the as-welded condition.