Technological Challenges In Arc Welding & Cutting Processes

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During the next decade or so there will not be any spectacular development of newer welding or cutting processes other than the processes emerging called "gluing or adhesives" which is being developed at various laboratories now. The emphasis however will be on step-by-step development of the existing processes to improve quality and productivity in general and to reduce the demands on skill levels of the welder. Therefore, the development will be seen in three segments.

EMERGING	GROWING	MATURING
Gluing or Adhesives	Robotics	Stick Electrodes
Laser Application	Automation	Submerged Arc Welding
Plasma Welding	MIG/MAG	
High Speed Welding	TIG Welding	Gas Welding
Inverter Technology	Cored Wires	MMA Welding
Off Line Programming	Iron Powder Addition	
Flexible Manufacturing Systems	Environment Equipment	
Computer Integrated Manufacturing		
Expert system		

The areas will be selected and given priorities by the users.

In this descussion I shall not deal with the less significant weldig processes like electric beam welding etc but would like to concentrate on areas of gluing and high speed welding and on some use of electronics which have contributed to substantial improvement in the welding power supply systems.

GLUING (ADHESIVES)

The question is whether this is a threat to the conventional fusion welding of metals. The answer till to date is 'no' or 'not for the time being' because of certain severe technical limitations such as

- maximum temperature restricted to 200°C
- low tensile strength - 3 to 10 kg/mm
- long curing time
- potting time too short
- limited life for glued joint under humid conditions

In addition to this there are other obstacles such as

- Environmental Problems
- Lack of Knowledge

Many exclusive applications have been identified for use with adhesives opposite to welding and these range from aircraft and automobiles to footwear and micro electronics. New areas are also being explored by organisations like TWI in the UK and they cover machine tools, rubber to metal bonding, aluminium structures, automotive repair, building and construction industries and so on. Quite obviously this is a new area and the innovative minds of the scientists and technologists will cretainly make a major break through in the knowledge barrier and gluing may one day become a major replacement of fusion welding processes. As of now we have seen the increasing use of gluing in thr plastics industry and also in the automotive industry.

HIGH SPEED WELDING

This is derived from MIG/MAG welding process where very high speed welding is possible with deposition rates ranging from 2kg/hr to a maximum of 25 kg/hr using 1.2mm solid wire. This has been made possible by the use of Rapid Arc TM and rapid TM iechniues of metal transfer using unconventional welding parameters. Since the deposition rate is very high it

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has to be understood that this process essentially requres mechanised welding.

Conventional mechanisation or Robot techniques are recommended. The advantages of Rapid Arc and Rapid melt are

- increased welding speed
- greater deposition rate
- little or no surface slag
- better penetration profile
- better side wall fusion
- smooth transition between weld reinforcement and the base metal
- small new investment

These will result in short cycle time, elimination of bottlenecks, lower production costs and faster production opportunities. MIG/MAG welding can now be extended to the areas where so far Submerged Arc welding had the only solution in terms of deposition rate and quality.

RAPID ARC TM

This is a welding process designed to increase welding speed without the welding defects which are associated with high welding speed using conventional parameters such as under cuts, high reinforcements etc. The process selects a higher wire stick out and very short spray arc and use of I2R heating. It is superior to short circuit and conventional spray arc in relation to both deposit rate and welding speed. It provides a better finished profile which is comparable with that of submerged Arc Welding.

RAPID MELT TM

This is a process which is intended to increase deposit rate when welding heavier metal thicknesses. There can be 2 types of transfers - moderated spray arc and rotating arc.

Moderated spray creates a narrow extremely deep penetration profile because of large droplets being forced down very strongly to the molten pool. The property of gas mixtures plays s significant role particularly the addition of Helium. In the case of rotating arc the penetration profile is very broad and this gives a good side wall fusion because the arc is switched around within the permitted zone of metal transfer and the arc force is directed towards the side walls. This creates an excellent transition to the weld bead and the base metal. Here again the properties of the gas mixtures are brought into use to produce the desired results.

These processes combined are also termed in certain documents as T.I.M.E. Process which is 'Transferred Ironised Molten Energy Process".

USE OF HIGH PERFORMANCE ELECTRONIC DEVICES

The developments have been in the following order -

- Thyrsistor
- Gate Turn off Thyrsistor
- Bipolar Transistor
- Power Mosfet
- *IGBT (Insulated Gate Bipolar Transistor)

The introduction of IGBT has created a kind of revolution in the design engineering of power electronic devices used in inverter technology. Inverters have become much more reliable - they take on smaller control circuits and more reliable components and finally they are second to none in terms of maintaining accuracy of welding parameters. These devices are being widely used in the developed countries and we have also seen the use of double inverter for AC/DC applications in a single power source with 3 phase input power supply.

CONCLUSION

The developments that I have just described are pnly three of the many step-by-step developments taking place over the world - the necessistices are mostly driven by market forces. The priority for the welding manufacturers can now be defined in the following order –

1 Provide a base for quality throughout
2 Develop a layer of dependability on quality
3 Develop another layer of costs effectiveness on dependability
4 Finally achieve a flexibility layer on the cost effectiveness

Competitiveness arising out of the combined four layered priorities will always remain the key word when the welding market decides its own requirement.