Process Improvement through Hybrid Laser-Mig Welding in Medium Scale Farm Equipment Industry

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Abstract- Hybrid laser-arc welding, originally proposed in the 1970s, but more recently of renewed interest, combines deep penetration keyhole laser welding with an arc welding process in a single process zone. The hybrid process offers the benefits of the separate processes, and overcomes some of their respective drawbacks, such as the lower tolerance to joint fit up of laser welding, or the higher heat input of arc welding, which increases distortion and subsequent re-work costs. These costs have been estimated to be up to 15-30% of the total labour cost for new construction. Consequently, hybrid welding is already applied in some industries, including shipbuilding, as well as being extensively researched for a variety of materials and industrial applications. For hybrid welding of steel plates, high power output CO2 lasers have typically been used.

This paper presents an investigation about hybrid laser-MIG welding in construction steels .An introduction about welding processes involved in this paper Main characteristics, advantages and drawbacks are summarized.

Keywords – **Hybrid laser-arc welding, Mig, Laser Welding , Hybrid Welding**

I. INTRODUCTION

Welding, the process used to join two or more pieces of metal together by applying thermal energy or pressure, is a precise, reliable, cost-effective method for joining materials. This technique is widely used by manufacturers to join metals and alloys. Thus welding is essential to produce most of usual objects, from big structures such as bridges and ships, to vehicles, to microelectronic components.

1.1 Arc welding:-

Arc welding processes use a power source to create an electrical arc between the electrode and the work piece, in order to join two metal pieces by fusion

Different groups of arc welding processes:

- Shielded metal arc welding (SMAW).
- Gas-shielded arc welding, including metal inert gas (MIG), metal active gas (MAG) and tungsten inert gas (TIG).
- Submerged arc welding (SAW).

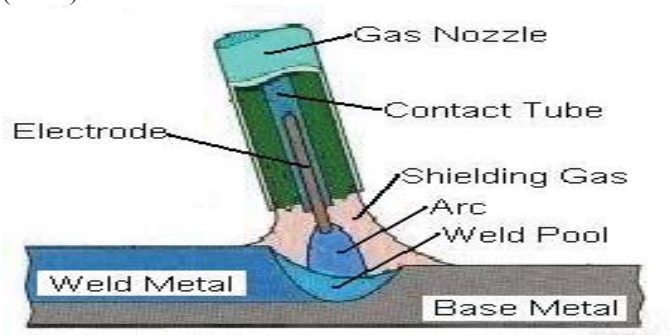
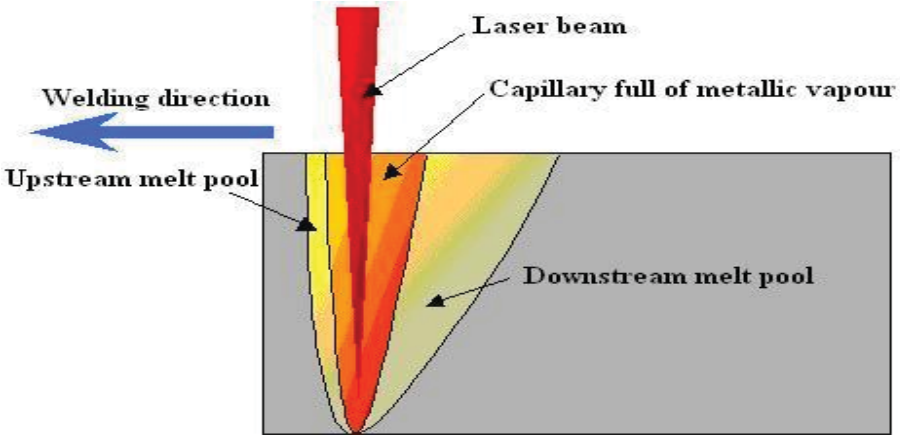


Fig. Shows MIG arc welding

1.2 laser welding

Laser welding is a keyhole fusion welding method which is obtained by a high power density, laser power is often in the range of 0.3-3 KW for Nd: YAG laser, and 5-10 KW for CO2 laser, achieved with focusing a laser light beam to a very small spot. Due to this small spot, the energy is very concentrated, with a focused power density at the weld surface in order of 106 W/cm2, which is one of the highest among the different welding processes available.

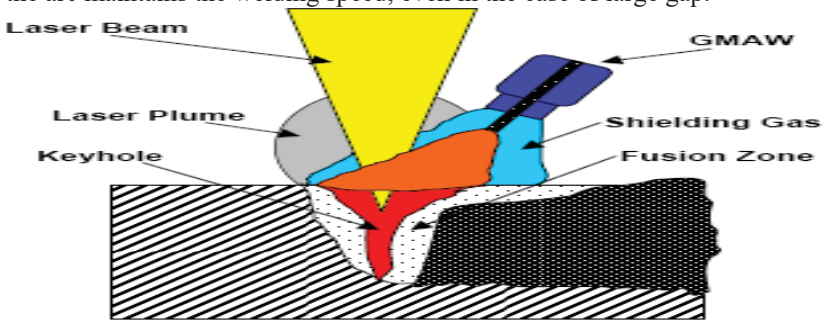


Schematic of laser welding

1.3 Hybrid welding

Hybrid laser-arc welding, originally proposed in the 1970s, but more recently of renewed interest, combines deep penetration keyhole laser welding with an arc welding process in a single process zone. The hybrid process offers the benefits of the separate processes, and overcomes some of their respective drawbacks, such as the lower tolerance to joint fit up of laser welding, or the higher heat input of arc welding, which increases distortion and subsequent re-work costs. These costs have been estimated to be up to 15-30% of the total labour cost for new construction. Consequently, hybrid welding is already applied in some industries, including shipbuilding, as well as being extensively researched for a variety of materials and industrial applications.

In the process, heat, momentum and molten filler material are transferred to the welding zone by the MIG/MAG process in order to enhance the action of the deep penetration welding laser beam. The penetration is determined by the laser alone, and the arc maintains the welding speed, even in the case of large gap.



Schematic of the hybrid laser welding

II. LITERATURE REVIEW

- *Development and Evaluation of CO2 Laser-MAG Hybrid Welding for Shipbuilding Steel*
  C H J Gerritsen, C M Allen (TWI) ,J. Mawella
  Defence Procurement Agency, Ministry of Defence, Bristol BS34 8JH, UK
  Paper presented at the 11th CF/DRDC International Meeting on Naval Applications of Materials Technology, held at Halifax (Nova Scotia, Canada) on 7-9 June 2005.

- *OVERVIEW OF THE EXPLORATION STATUS OF LASER-ARC HYBRID WELDING PROCESSES*
  P. Kah
  Lappeenranta University of Technology, LUT Mechanical PL 20, Lappeenranta 53851, Finland on November 18, *2011*
- *Laser welding of aluminium-steel clad materials for naval applications*

  G. Shi, P. Hilton and G. Verhaeghe
  Paper presented at Proceedings of the Fourth International WLT-Conference on Lasers in Manufacturing 2007 (LIM2007), Munich, 18 - 22 June 2007
- *Mechanical properties of Hybrid laser-MIG welding on lap joint*
  Alberto Jose
  Luleå University of Technology
  Department of Applied Physics and Mechanical Engineering
  Division of Manufacturing Systems Engineering

III. PROPOSED SOLUTION

To get around this problem, we combine laser welding with MIG welding. The laser delivers the high power densities needed for the deep welds and enables high welding speeds. This, in turn, reduces heat input and distortion.The MIG torch, meanwhile, bridges the gap between the parts and closes the joint using filler wire. Hence the hybrid technique is faster than MIG welding alone, and the parts are subject to less distortion

IV. DIFFERENT PARAMETERS IN HYBRID LASER MIG WELDING

- Laser-arc (or longitudinal) process separation i.e. the distance along the joint line between the impingement points of the two processes at the work piece surface.
- Lead process (and thereby MAG push or pull angle)
- Focus position
- Arc current type (pulsed or constant)
- Of these, the process separation and focus position proved particularly important.

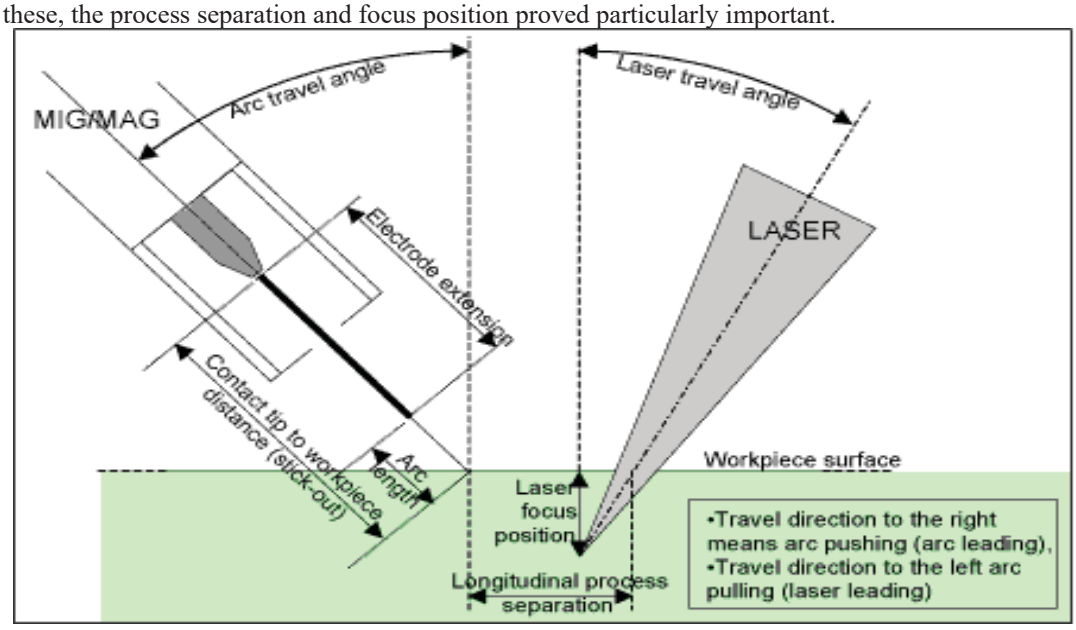
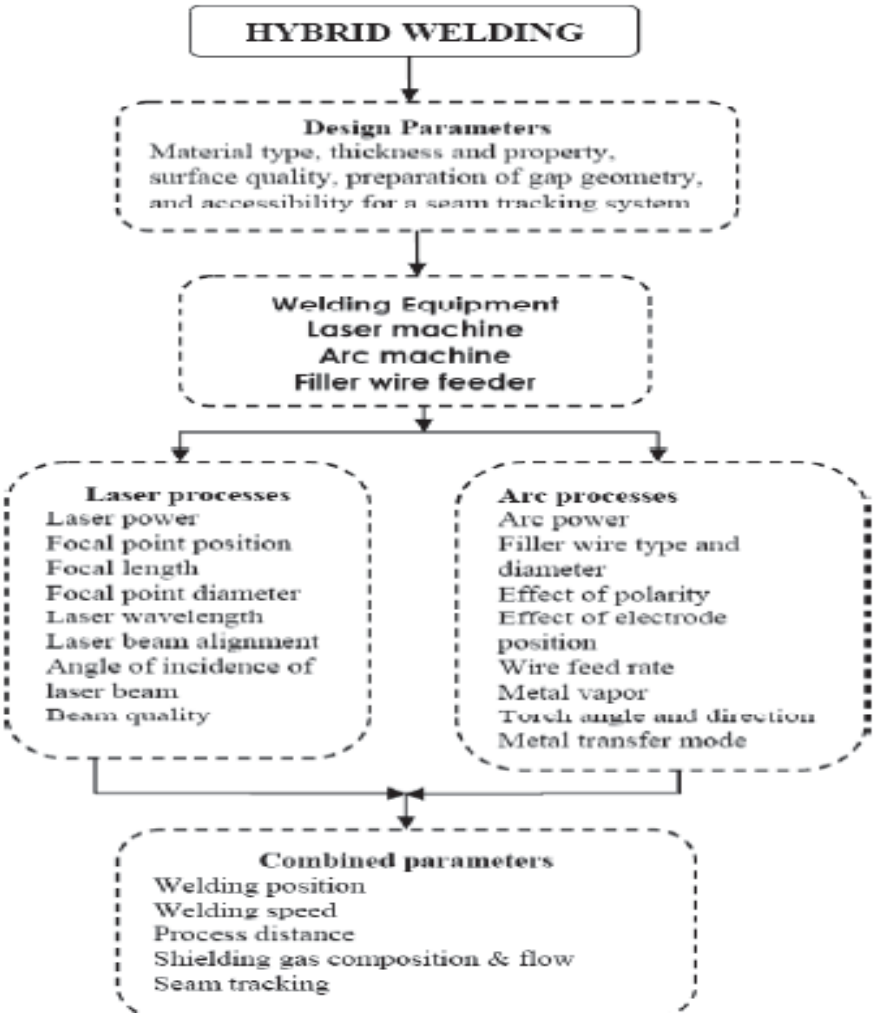


Diagram of Hybrid Set up and Key parameters

Flow chart of process parameters in hybrid laser mig welding



V. CONCLUSION

This paper has considered different methods which can be used to enhance the process improvement through hybrid laser-mig welding in medium scale farm equipment industry

After studying both welding process, i have conclude that the use of low values of current, voltage and wire feed induce a small weld bead increasing the probability of defects in the weld. There is no any significant difference between the hardness of both processes .Tensile strength of the weld increases in proportion to the weld bead width, because of the higher MIG parameters the wider weld bead, for constant weld bead hardness .FEM simulation is a powerful tool to achieve assessments close to the real behavior of the welding. But it is necessary keep developing this method to achieve a higher accuracy.

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