Member Report Number: 1068/2016

Industrial Member Report Summary – Key Findings for Industry

Preliminary Trials of Sliding Seal Reduced Pressure Laser Beam Welding

TWI Core Research Programme

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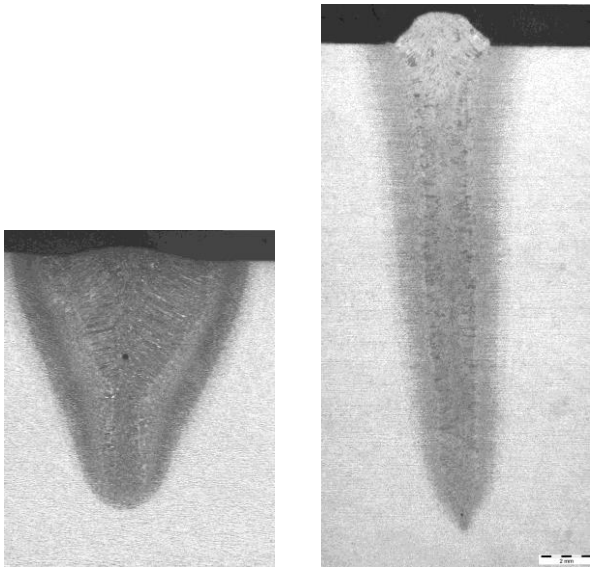
Industrial need

Many fabrication industries have applications requiring thick section, high productivity, high quality, low distortion joining processes. Narrow gap arc welding processes can be used, but can have their limitations (e.g. productivity, distortion etc), which impact on product quality and/or cost.

Beam welding processes, operating under vacuum in a chamber (normally using an electron beam), are capable of achieving penetration depths relevant to these applications, but capital investment costs and dictates on component size and/or complexity can dissuade potential users of these processes.

Electron beam welding at a reduced pressure (0.1-10mbar) inside a sliding, sealing chamber has been developed as a means of overcoming these barriers to uptake.

In this work, this approach has been adapted to laser beam welding, to confirm the benefits reported when welding at reduced pressure, as opposed to at atmospheric pressure, as would be the convention with laser beams. This approach has then been developed further, in a preliminary evaluation of robotic welding at reduced pressure, using a new, smaller chamber design.



a) b)

Comparative melt runs in steel:
(a) Conventional run at atmospheric pressure;
(b) Same run but at reduced pressure.

Key findings

- Reduced pressure laser beam welding can successfully be carried out using a chamber design adapted from reduced pressure electron beam welding, resulting in increases in penetration depth of up to 70% in S275 steel and 30% in Ti-6Al-4V.
- Reduced pressure laser beam welding can also be carried out successfully using a smaller, robot-mounted chamber design.
- Using a 5kW fibre laser beam with the robot mounted chamber, penetration depth increases from 10 to 20mm in S275 steel, and 13 to 20mm in Ti-6Al-4V are possible, albeit further design improvements are now required.

How to benefit from this work

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