Further Development of the FSW Floating-Bobbin Technique

PUBLISHABLE SUMMARY

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Background

The previous Group Sponsored Project (GSP) 18887 'Assessment of Bobbin Friction Stir Welding for the Joining of Aluminium Alloys' demonstrated that the floating-bobbin friction stir welding (FSW) technique can offer the user many benefits compared to conventional FSW technique. However, thin section (<6mm) floating-bobbin welding proved to be the most challenging area of the technology.

Since the completion of that project TWI has undertaken some further development of thin section floating-bobbin FSW to assess if one-piece floating-bobbin FSW tooling could be deployed on a robot. This work has demonstrated that welds up to 600mm/min can be made on flat and curved components using TWI RoboStir™ system.

With the feedback from five sponsors (four previous GSP sponsors plus one new sponsor), this new project aimed to develop the floating-bobbin FSW technique particularly when welding aluminium alloys in 3mm and 2mm thickness, both on flat and curved components.

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Objectives

- Develop one-piece floating-bobbin FSW and pinless floating-bobbin FSW techniques to assess which of these tooling concepts is best suited to welding flat components in a range of aluminium alloys in 3mm and 2mm thicknesses.
- Develop the preferred technique for use on the TWI RoboStir™ system for linear and curvilinear welding.
- Produce demonstration parts using component materials provided by Sponsors.

Project Outcome

During the project, progress updates were issued monthly by e-mail and a meeting held half way through the project, where the Sponsors met to review the work and guide its progress. A detailed progress report was issued in advance of this progress meeting. A final meeting was held to present the overall project findings. All progress reports and the final report are available through a secure area on the TWI website. These documents summarise all the relevant project details and include:

- Bobbin tool designs and performance data.
- Joint properties.
- Assessment of weld stability and process reproducibility.

Benefits

Further development of the floating-bobbin techniques provided the following benefits to Sponsors:

- Experience and knowledge of an alternative welding technique which eliminates the risk of root defects, requires no backing bar and, due to a more uniform heat input, minimises component distortion.
- Information to allow evaluation of the robotic floating-bobbin welding techniques to aid in the justification of early adoption of the technology.
- Quantitative data on the reduced process forces which will result in lighter, simpler and cheaper fixturing and/or FSW machines.

Participants

The Sponsor Group comprised:

- Nippon Light Metal;
- Embraer;
- Sapa;
- AVIC BIAM;
- Kawasaki Heavy Industries.

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Scope of Work

Both the one-piece and pinless floating-bobbin techniques were developed and assessed welding a range of different aluminium alloy grades in two plate thicknesses 3 and 2mm. Tool development included different shoulder and pin geometries and materials and also assessing their effect on weld performance and properties.

Based on the results obtained the preferred technique was assessed for use on TWI RoboStir™ system for both linear and curvilinear welding. Particular attention was given to weld start procedures, maximising the welding speed and the shoulder geometry when making curvilinear welds.

Price and Duration

The project had a duration of one year and a budget of £120,000. There were five Sponsors each making a contribution of £20,000. TWI also contributed £20,000. The buy-back cost of this project is £20,000.

Further Information

For further information on how a Joint Industry Project (JIP) runs please visit:

http://www.twi-global.com/services/research-and-consultancy/joint-industry-projects/

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