

AG 52 FSW Processing

2013-11-20
D-no 2083/2013

Circulated to:
Members of AG 52

For information:
Bertil Pekkari

Report and minutes

No 10

from the meeting **6-7 November** 2013 at University West, Sweden.

Present

Lars Cederqvist, SKB, Sweden (chair)
Mathias Lundin, Swedish Welding Commission, Sweden (secr)
Gunnar Bolmsjö, University West, Sweden
Jeroen deBacker, University West, Sweden
Vesa Kiiskinen, ESAB Global Automation, Finland
Wojciech Osikowicz, Sapa Technology, Sweden
Tero Purhonen, Posiva OY, Finland
Sven-Olof Sjöväg, Sapa Technology, Sweden
Stefan Stoltz, Esab AB, Welding Automation, Sweden
Jörgen Säll, Esab AB, Sweden
Fredrik Tuveesson, Westinghouse, Sweden
Pedro Vilaça, Aalto University, Finland

Minutes from the meeting 6 November, 8 to 12.30 am

1. Opening of the meeting

The chair bid everyone welcome and started the meeting. He also thanked Swerea Kimab for last night excellent dinner at Victoria Tower.

2. Approval of the agenda

The agenda was amended with some more presentations and approved

3. Minutes (nr 9) of the last meeting 2012-11-13/14 in Stockholm, Sweden

The minutes were checked and approved without changes.

4. Short presentation of the organization and activities of new participants

A short round of presentation was made noting the following for new participants.

Vesa Kiiskinen, ESAB Global Automation, is since 2 weeks globally head of product management for SAW and FSW.

Fredrik Tuveesson, Westinghouse, (earlier at University West) is welding coordinator for fuel rods and spare parts.

Pedro Vilaça is professor of welding and NDT at Aalto University, Finland. He worked with modeling, NDT and also FSW for a number of years.

5. Presentations

5.1 Adaptive force and spindle speed control of FSW, based on temperature feedback, Jeroen DeBacker, University West.

Before Jeroen came to his topic he showed steel welding. The force was 10 kN with high vibration during start, but which stable when welding temperature was reached. Will do X-ray tomography and other NDT.

Jeroen then presented recent result of his main work with 3D FSW (**Appendix 1**)

Measure temperature is not as easy with thermocouples when the work piece is not so large. Idea is to use the tool and work piece as a thermo couple, TWT-sensor. Measuring the voltage between the tool and the work piece. Measure something relative and not the absolute temperature. Patent for this is pending.

Jeroen explained how this measurement is used for control of the process parameters. He showed example of the application with a work piece with varying heat distribution. Primarily the rpm is controlled. If the tool rotation speed (rpm) is approaching the limits, the force is controlled.

With this it's possible to weld an unknown alloy.

Jeroen presented temperature measurement for A2060 where the optimum welding temperature showed to be 410 °C, giving the best tensile properties. A2060 is interesting to examine because it has about the highest properties on the market, and is difficult or impossible to weld with other welding processes.

5.2 New equipment and applications, Stefan Stoltz/Mikael Soron, ESAB

Stefan presented an historical perspective on FSW machines and featured news on modern FSW equipment (**Appendix 2**).

He presented a number of equipment series and showed video clips of different applications, e.g. an example of the use of a bobbin tool head.

Noted that SAPA is producing 500.000 m of FSW welds per year.

The latest gantry has the possibility to weld 80 m (or no limit) long and 10 m wide panels, with up to 6 m/min welding speed.

Stefan also presented orally about Boeing/NASA Vertical Assembly Center, and the equipment for welding of rocket fuel tanks.

5.3 Compensation by temperature regulator for axial force changes, Lars Cederqvist, SKB

Lars presented SKB chosen method for the welding of the so called “capture joint” of the copper canister. No slides can be amended yet.

Three thermocouples in the tool is used, one in the probe, one on the shoulder inner diameter and one on the shoulder outer diameter. The probe temperature is the most important parameter for defect free result.

Also using imbedded thermocouples on the advancing and the retreating side respectively.

Lars presented the types of defects that may occur. He further presented the cascade control for the temperature measurement control.

The result from trials with reversed welding direction which was no success since it gave more sensitivity for tool failure.

A 2,5 mm thermal expansion of the diameter of the canister during welding is an issue that have to be controlled and resolved. This is made by a tool depth controller.

5.4 Welding method selection process including FSW results, Tero Purhonen, Posiva

Tero presented the work made by Posiva concerning the end disposal of nuclear waste in Finland (**Appendix 3**).

The estimation is that the end disposal can start in 2022. Posiva will make their choosing of welding method (FSW or EBW) for the sealing of the canisters in the end of this year, 2013.

Final disposal can start after 30 years of cooling of the fuel in temporary disposal plants.

Tero run an animated clip to present the whole procedure of handling, filling, sealing, testing and placement of the canisters in the bedrock.

Noted that the plan if defects are discovered during NDT is to re-open and re-loading the canister. That is no repair welding is planned. Noted that SKB has done repair welding trials.

The list of requirements on the management and properties for the system of end disposal is substantial.

Tero described investigations in comparing FSW and EBW. He noted that FSW has less risk of stress corrosion due to less residual stresses in the more critical surface area.

Tero concluded with presenting the trials of welding of 5 lids this spring (2013) at SKB.

5.5 Issue of repairing in use reactor parts, Fredrik Tuveesson, Westinghouse

Fredrik raised an issue/problem with managing repair of old nuclear facilities seeking ideas for solutions. Today this is handled with Electro Discharge

Machining, EDM, to stop the propagation. Fredrik is looking for a solution for handling the EDM void. The material could be mild steel, stainless steel or Inconel.

Discussed the possibility of friction plug welding. It is a challenge because of the limited space. Also discussed if it is enough to close the crack which is possible with FSW with a retractable probe. In any case the main challenge is to overcome the problems with the access.

Pedro showed a clip of Fiction Hydro Pillar, FHPP, for plug welding of steel.

5.6 Application on NDT System for the Detection of Imperfections and Characterization of FSW Joints, Pedro Vilaça, Aalto University/FCTUNL

Pedro initially presented welding of coils for electrical power transformers. The measuring and maintaining of the conductivity is critical (**Appendix 4**).

He also briefly touched on R&D work in friction stir processing such as surfacing and channeling.

Also presented different types of defects, such as root flaw (weak or intermittent linking), lack of penetration (kissing bond), particle alignment (residuals from the shoulder), and how to detect and sizing them. Root defects are the target defects for NDT.

Innovations in the Eddy Current technique.

5.7 Short update on changes in Sapa, Wojciech Osikowicz, Sapa Technology

Wojciech briefly presented new ownership of Sapa as a new joint ventures between Orkla and Hydro, that own 50 % each of the “new Sapa”. 23 000 employees in 40 countries.

6. Messages and Reports – conferences, articles etc

Lars noted three upcoming conferences in FSW.

Thermec 2013, 2-6 December 2013, Las Vegas, USA. <http://www.thermec.org>

FSWP, 30-31 January 2014, Nantes, France. http://website.ec-nantes.fr/fswp14/Plaqueette_FSWP2014.pdf

FSW symposium, 20-22 May 2014, Beijing, China. <http://www.fswsymposium.co.uk/>

Pedro reported briefly on IIW activities on FSW at the Annual Assembly in Essen in September.

7. Licence and patent issues

It was noted that un-featured tools are to use since December 2012 without violation the patent.

It was noted that it shall be possible to use featured tools without violating the patent, from January 2015 in Europe and September 2015 in US, respectively.

8. Short report on FSW standardisation activities in IIW

Mathias reported on the project within IIW Commission III (B1) for a friction stir spot welding standard:

ISO/CD 18785-1 to -5 Friction stir spot welding – Lap welds in Aluminium

Part 1: Vocabulary

Part 2: Design of weld joints

Part 3: Qualification of welding operators

Part 4: Specification and qualification of welding procedures

Part 5: Quality and inspection requirements

Project leader is Jorge F. dos Santos, Germany. New work item proposal is approved. Expect to mirror ISO 25239 as far as possible. DIS available by end 2014

As a member of Swedish Welding Commission one has access to the documents produced by C-III.

9. Information projects – Inventory

Last meeting it was discussed to write a popular article on state of the art FSW, to inform on and promote FSW processing, to be published in the magazine Svetsen. This could also be sent to the other Nordic countries for translation and publication in their magazine.

Jeroen has written a paper for Svetsen nr 4/2013, published in couple a weeks, on robotic/automated FSW. This could be rewritten and amended to meet the aim above.

10. Working Program and member issues (prospective participants etc)

Jeroen and Gunnar get back to Saab Aerospace (Magnus Calin) on the participation in the working group. They also continue to approaching GKN Aero.

Jörgen will contact Webra on possible participation.

11. Arrangement for subsequent meeting(s)

The next meeting was decided for 22-23 September 2014 at Alto University, School of Engineering, in Helsinki.

12. Closure of the meeting (12.20 h)

The chairman thanked everyone for their attendance and contribution.

Meeting secretary



Mathias Lundin