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Sent to:
Members of AG 52

For information:
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Report and minutes

No 9

from the meeting **13-14 November** 2012 at Swerea Kimab in Stockholm, Sweden.

Present

Lars Cederqvist, SKB, Sweden (chair)
Mathias Lundin, Swedish Welding Commission, Sweden (secr)
Matts Björck, SKB, Sweden
Anna-Karin Christiansson, University West, Sweden
Jeroen deBacker, University West, Sweden
Leif-Magne Kaalaas, Marine Aluminium, Norway
Eva Lind-Ulmgren, Swerea Kimab, Sweden
Isak Nielsen, Linköping University, Sweden
Lina Nyblom, Sapa Technology, Sweden
Tero Purhonen, Posiva OY, Finland
Timo Salonen, Posiva OY, Finland
Henrik Schmidt, HBS Engineering, Denmark
Mikael Tigerström, SKB, Sweden and
Karl Fahlström, Swerea Kimab, Sweden

Minutes from the meeting 14 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 8) of the last meeting 2012-02-07/08 in Oskarshamn, Sweden

The minutes were checked and approved without changes.

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

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

Karl Fahlström is replacing Eva in the group. Eva is moving to work with corrosion at Swerea Kimab. Have no FSW projects at the moment within the joining framework.

Isak Nielsen is PhD student at Linköping University. He does work at SKB.

Matts Björck started at SKB in May, primarily working with oxide issues.

Tero Peuronen started at Posiva in July. He studied at Lappeenranta University.

Lina has worked with Sapa for 5 years, but up until recently not with FSW.

5. Presentations

a) HBS Engineering: Thermo-Mechanical modeling of FSW Copper Canister

Henrik presented about thermal and flow model of FSW in thick section copper (**Appendix 1**).

He presented the basic condition of the traditional CFD model and a description of thermo-mechanical model. One modeling takes 18 days.

Henrik showed a number of model results, plots, showing the flow fields, thermal field, plastic field, displacement fields etc as an effect of the tool working. E.g. illustrating the simulated result of offsetting the oxide line.

Henrik is working with further improvement of the models, making coupling between the models. The work is funded by SKB.

b) Sapa Technology: Fatigue and tensile properties of friction stir welds in AA6061-T6 and AA6082-T6 from production trials

Lina gave a presentation previously made by Jesus Mendoza (Sapa) at the 9th TWI Symposium (**Appendix 2**).

Experiments were performed on FSW welds in AA6082-T6 and AA6061-T6 with mechanical and visual (micro) testing.

Joint efficiency results from tensile test showed acceptable result. 77 % and 79 % respectively. The standard, ISO 2239-4 clause 6.3.3.3, states a 70 % reduction factor for T6.

Hardness test results were also acceptable and the two materials showed little difference.

Fatigue testing results for the two alloys were excellent compared to reference data, and also compared to Eurocode 9. Didn't find correlation between fatigue life and crack initiation point for AA6082. Also the scatter was smaller for AA6082. Noted that it seems over cautious to use Eurocode for design of FSW welds.

c) Posiva: Current welding activities and future plans

Timo presented the status of the Posiva activities on final disposal (**Appendix 3**).

Finland has 4 reactors and has two more projects on the way. The sixth reactor is planned to be started in 2025.

Plan an application for operating license for final disposal in 2018 and start of final disposal 2020. The excavation is almost ready and contracts for building the facilities are signed.

Has welded 58 lids with EBW between 2004 and 2012. The research work for EBW is almost finished. Have so far come to the same excellent results for FSW as SKB. Will decide on joining method for the lid in 2013.

Showed correlation between deformed fraction (elongation) and residual stresses. Since the test results showed less than 1 % elongation less than 50 MPa residual stress is expected.

TTK has one student doing master thesis on FSW funded by KYT.

d) Marine Aluminium: Some projects using FSW panels

Leif presented FSW status and activities at Marine aluminium (**Appendix 4**).

Has welded more than one million meters with FSW, no failures. First machine for commercial production in 1996. Handle panels 16x26 meters. The panels produced are mainly used for ship building, both for hulls and for super structures.

Leif mentioned a project in cooperation with University of Trondheim to simulate 3D forming of curved panels. The benefit is the smooth surface allowed, not possible with heat distortion from e.g. TIG welding.

Perform 180 degree bend test on all panels by cutting of and testing each end of each panel.

Only butt and fillet welds. No overlap is allowed by the classification societies.

Leif showed the Piece portal outside Oslo city hall which is FSW welded. He also showed some animations to illustrate helidecks and telescopic bridges.

Marine Aluminium will move at the end of the year to a new location with larger grounds.

e) SKB: Oxide particles during FSW welding of Cu

Matts presented the examination of the cause and influence of oxide particles (**Appendix 5**).

The issue originated from VTT testing creep and the correlation with oxide particle content.

From welding in air up until 2010 SKB is now testing welding under shielding gas.

Matts presented testing using shielding gas, tuning the process by offsetting the probe from the oxide line, changing the direction of the rotation and also determining cleaning procedures.

The aim is to have an oxide layer not exceeding 10 nm during welding.

f) University West: Activities at University West

Jeroen presented activities at UW the past year (**Appendix 6**)

ARoStir (Increased Automation of Robotics ...) application to KK foundation for a 2 year project

The equipment, Esab ROSIO FSW robot, used is basically a modification of ABB heaviest robot.

Worked with the handling of the deflection of the robot for which solutions are found compensating for the deflection.

Also worked with what parameters that has to be controlled to maintain a stable temperature.

Also tested welding in steel with boron nitride probe for GKN Aerospace (former Volvo Aero).

Also reported on a new Vinnova founded project called PTC Innovation to commercialize research results.

6. Messages and Reports – conferences, articles etc

TMS Annual Meeting 4-7 March 2013 in San Antonio Texas. The papers and abstracts are available at tms.org.

Henrik reported on the Mathematical Modeling of Thermal Fenomena conference in Graz, Austria. The software are getting more and more advanced. There seems to be a bright future for FSW in the automotive industry.

The 6 February 2013 will Henrik have a full seminar at his location.

7. Licence and patent issues

At TWI 9th symposium in Alabama license issues were discussed. No minutes yet. TWI did however not give any clear statement on the license issue.

It is not clear if TWI will have control of the patent for an additional five years.

Un-featured tools should be possible to use 2012-12-06 without violation the pattern. However, it might be a problem if you want to have a relation with TWI.

8. Short report on FSW standardisation activities in IIW

Mathias reported that there is a project within IIW Commission III on friction stir spot welding that is expected to mirror ISO 25239 as far as possible. Project leader is Mr Sylva.

Still need the formal start of a preliminary work item with resolution in C-III to support and activate the project in ISO.

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

9. Information projects – Inventory

Mathias explained the policy within the Svetskommissionen network to reach out with info outside the working group. To have an inventory (**Appendix 7**) of information projects that aim for spreading the word etc on FSW.

It was decided to aim for an article on state of the art FSW.

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

Cryo is still pending concerning their possible FSW activities.

Stefan will come back concerning a contact with Webra

Volvo Aero where sold and is now called GKN Aerospace. Karin reported that they will wait to join.

11. Arrangement for subsequent meeting(s)

The next meeting was decided for 1-2 October 2013 at Esab in Laxå or University West in Trollhättan.

12. Closure of the meeting (12.00 h)

The chairman thanked everyone for their attendance and contribution.

Meeting secretary



Mathias Lundin

Visit at Swerea Kimabs research facilities 14 November, 1-3 pm

The group moved on to visit the research facilities of Swerea Kimab, looking at the joining lab and also a lot of facilities for advance material and corrosion testing.