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Report and minutes No 12

from the meeting **26-27 May** 2015 at SKB, Oskarshamn, Sweden.

Attendance

Lars Cederqvist, SKB, Sweden (chair)
Mathias Lundin, Swedish Welding Commission, Sweden (secr)
Matts Björk, SKB, Sweden
Gunnar Bolmsjö, University West, Sweden
Jeroen deBacker, TWI, UK
Henrik Hindsefelt, Sapa Technology, Sweden
Rebecka Nilsson, Esab, Sweden
Lina Nyblom, Sapa Technology, Sweden
Tero Purhonen, Posiva OY, Finland
Henrik Schmidt, HBS Engineering, Denmark
Ana Silva, University West, Sweden
Mikael Soron, AETech AB, Sweden
Mikael Tigerström, SKB, Sweden
Pedro Vilaça, Aalto University, Finland

Minutes from the meeting 27 May, 8 to 12.30 am

1. Opening of the meeting

The chair opened the meeting, welcomed everyone to SKB and started the meeting.

After the meeting there will be a visit of the research facilities at SKB.

2. Approval of the agenda

The agenda was amended concerning the presentations in item 5, and approved.

3. Minutes (nr 11) of the last meeting 22-23 September 2014 at Aalto University, Espoo Finland

The minutes where checked and approved with the following note/change: The date of the meeting was in 2014 and not 2013 as stated.

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

A short presentation of new participants was made, noting:

Rebecka Nilsson, Esab, Sweden, started as a sales manager since two month at Esab and is entering FSW as a new field.

Henrik Hindsefelt, Sapa Technology, Sweden, worked with FSW since two years as a research engineer.

5. Presentations

5.1 Posiva's FSW plan, Tero Purhonen

Tero gave a presentation on the status and plan of the work at Posiva with the storage of nuclear waste and the FSW process (**Appendix 1**).

He presented the timetable. Expecting to get the licens at the end of 2015 and starting the production in 2022. The deep repository map shows the magnitude of the project with storage 430 m below ground and that is expected to last for a 100 years.

Concerning the project plan the "Preliminary design of the welding system" is finished and the next steps is "Detailed design and manufacturing of the welding system" that is expected to go on until end 2017.

Tero showed the plan of the ceiling facilities with a "Multi-purpose room" for the ceiling of the canisters which cannot be accessed by humans. A number of failsafe systems are planned for various disturbances at the welding systems. Even for seismic events, even if those are very rare in Scandinavia.

5.2 Advanced Control of FSW of Ultra-HS Steels, Pedro Vilaça, Aalto University

Pedro presented projects on steel welding based on the monitoring of the magnetic permeability of the processed zone (**Appendix 2**).

They have recently developed monitoring system.

Life and ware of the tool is always going to be a competitive drawback for the FSW processing of steel. Applications where the tool cost is a smaller part of the cost it will still be of high interest, for instance where the gain in properties, e.g. toughness, is substantial.

Independent of the properties at the room temperature, steels have similar properties at the welding temperature.

Pedro meant that the possibilities of FSW for UHS steels can open up those steels for applications where e.g. toughness in the HAZ is critical.

5.3 Resent developments in Robotic FSW, Jeroen deBacker, TWI

Jeroen presented a summary of the on goings at his new employer TWI in Sheffield (**Appendix 3**)

TWI has 800 staff and 80 million pound turnover, and is growing, recruiting a lot of people. State their aim to provide impartial expert advice.

Jeroen showed example of weld in 70 mm plate thickness.

He further showed a Mobile FSW system which was developed as a prototype for welding of aluminium panels in shipyards.

Also part of the joint project FlexiFab he showed the robot welding system for that project located in Sheffield. Tests with bobbin and stationary tools. Turntable for circumferential welds that is not possible with only the robot. The FSW head is the developed with four sensors.

Jeroen urged everyone to use ISO 25239, especially for the testing and for the terminology, where you see a lot of different vocabulary in research papers.

Jeroen showed the benefits with the use of stationary shoulders for e.g. tailored blanks. Also an application with a lid where clamping is not needed since the lid is kept in place by the stationary shoulder.

Jeroen also showed Corner & AdStir welding technique with a shaped shoulder, and with added material with a wire fed in front of the welding head.

Flexifab video clips are on line, TWI Youtube channel.

Have also welded 2 mm titanium with SSFSW (stationary shoulder).

11th FSW Symposium 17-19 May 2016 – TWI Cambridge. To celebrate 25th anniversary of FSW.

5.4 ScanSTIR – A HPC framework for modelling FSW, Henrik Schmidt, HBS Engineering, Denmark

Henrik gave a summary of a presentation he gave one year ago in China on modeling of FSW (**Appendix 4**).

Henriks main field modelling that he explains as a tool for better understanding of your research and trials/testing.

ScanStir is a framework (HPC – High Performance Computer) that Henrik has developed for modelling of FSW.

Henrik showed machines, setups, trials and modelling with ScanStir in the Signa stir project.

The model can in about 10 minutes calculate a 3D model of, not only the heat distribution of the weld run, but also a residual stress distribution.

5.5 Automated Temperature controlled FSW – Robot application, Ana Silva, University West, Sweden

Ana gave a presentation on the continuation of the research activities at UV (**Appendix 5**)

Ana is a PhD student at UV. She has a background in material science from Portugal and has worked with FSW at Frauenhofer Institute.

Ana is working on better temperature measurement method selection for the thermocouples in the work piece and the probe respectively.

Next step is to place a thermocouple at the boundary (edge) between the probe and shoulder.

Showed how the temperatures vary depending on the material in the backing bar, "backing bar effect", and elaborated on the cooling rate effect on the temperature controlled process.

5.6 Resent issues of weld results related to the force control, Lars Cederqvist, SKB, Sweden

Lars presented how the force controller had changed characteristics so the force span was reduced from 7 kN to 4 kN resulting in 2.5 times larger variation in the position Z (spindle position), which could be the reason for unexpected cavities close to the surface. The force controller has been in the machine since the start and this happened after 584 welds.

The reasons for the defect formation where discussed.

5.7 New argon shielding gas chamber at SKB´s Canister Laboratory, Matts Björck, SKB

Matts presented work on argon shielding trials (**Appendix 6**).

The aim is to control the oxide formation during welding. Matts compared to previous two versions of gas shield chambers.

Used a diploma student for the building of the chamber.

The design prerequisites where full circumferential shield, right choice of sealing material, and adjusting of the clamping system.

Matts compared oxide thickness depending on the oxygen level in the shielding gas.

Showed results from different methods of cleaning the oxides, carbon ice blasting, Plasma cleaning, Laser cleaning and Mechanical cleaning. The two later methods gave the best results.

The cleaning is planned to be a separate operational sequence in production.

Also showed reduction of oxygen using hydrogen.

Planning to do metallographic inspections and oxygen measurements.

Future work also to investigate how much oxide that could be tolerated. Will also do trials on process control (cleaning/oxidation) using optical reflectometry.

6. Messages and Reports – conferences, articles etc

Upcoming events besides IIW Annual Assembly and TWI Symposium:

Conference 1-2 October 2015 in San Sebastian, Spain
http://www.lortek.es/?content=356;fswp-the-4th-international-conference-on-friction

Pedro mentioned that there will be 3 sessions on FSW at the IIW Annual Assembly in Helsinki in July on ship building, meeting with automotive, and some general presentations in Com III, and also some presentations in the conference on High Strength Materials – Challenges and Applications. The lab at Aalto will also have open doors for young professionals.

7. License and patent issues

Noted the following current status which the members concurred:

- Un-featured tools are possible to use without violating the patent since December 2012
- Featured tools are possible to use without violating the patent from,
  - January 2015 in Europe
  - September 2015 in US

Noted that this should induce an increase in the use by smaller companies.

However, the situation is messy concerning later patents, and the risk of intrusions and lawsuits is real.

Noted that one shall take care when moving in to this business because the license/patent situation is messy

Soron is currently reviewing the global patent situation for Esabs account. Maybe Esab is willing to share the outcome in the future.

Would not dare to suggest FSW for e.g. the oil and gas industry because of the risk of huge litigations.

Discussed how this situation could be change in the direction that the process is more used.

Concluded that spreading the message to SMEs through articles etc is a way to increase usage.

Noted that Pedro published in Finnish magazine. Pedro will send that for possible publication in the Swedish journal Tidningen Svetsen.

8. Short report on FSW standardisation activities in IIW

Mathias presented the status of the standardisation projects on FSW in IIW (**Appendix 7**). Project leading has changed to David Bolser from Boeing.

ISO/CD 18785-1 to -5 Friction stir spot welding – Lap welds in Aluminium, for which the launch date of the technical enquiry is unclear.
ISO 25239-1 to -5 Friction stir welding – Aluminium, was published in 2011.

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

9. Information projects – Inventory

Showed and amended.

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

Ole Midling is new participant from Marine Aluminium.

Mats Krants at Saab Aero in Linköping has shown interest. Gunnar mentioned a contact with them and their response where that they do not weld. Same for Volvo Areo. However they at producing lighter vehicles and are pursuing joining of e.g. aluminium, so they should be interested.

11. Arrangement for subsequent meeting(s)

Monday 16 May evening before the TWI Symposium in Cambridge was decided for the next meeting.

12. Closure of the meeting (12.10 h)

The chair thanked everyone for their contribution and closed the meeting.

After the closure of the meeting the SKB representative gave a tour of the research facilities at SKB.

Meeting secretary

Mathias Lundin