



Report and minutes

No 5

from the meeting **13-14 October 2009** at Helsinki University of Technology, Espoo, Finland.

Present:

Lars Cederquist, SKB, Sweden (chair)
Mathias Lundin, SWC, Sweden (secr)
Sylve Antonsson, ESAB, Sweden
Sören Claesson, Bodycote, Sweden
Johan Fremling, SAPA Technology, Sweden
Hannu Hänninen, Helsinki University of Technology, Finland
Leif Magne Kaalaas, Marine Aluminium, Norway
Johan Nordström, ESAB, Sweden
Jorma Pitkänen, Posiva, Finland
Timo Salonen, Posiva, Finland
Tapio Saukkonen, TKK, Finland
Kati Savolainen, Helsinki University of Technology, Finland
Henrik Schmidt, Technical University of Denmark, Denmark
Mikael Tigerström, SKB, Sweden
Fredrik Tuveesson, University West, Sweden

Minutes from the meeting 14 October

1. Opening of the meeting (08.30 h)

The chairman Lars Cedrqvist opened the meeting thanking Kati Savolainen for the invitation to the Helsinki University of Technology, and also for the nice social evening the day before.

Special welcome to Fredrik Tuveesson, Jorma Pitkänen, Hannu Hänninen and Timo Salonen to their first meeting.

Round of presentation. Noted that Henrik Schmidt is leaving DTU at the end of the year. Also noted that Bodycote changed name to Exova.

Apologies where noted from Joakim Hedegård, Kari Lahti, Eva Lindh-Ulmgren, Mikael Soron.

2. Approval of the agenda

The agenda was approved with the addition of a presentation by Kati Savolainen under item 6.

3. Minutes (nr 4) of the last meeting 2009-02-24/25 in Copenhagen, Denmark

The chairman briefly went trough the minutes which where approved with no changes.

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

Fredrik Tuveesson, new to the group, is newly employed at University West, UW, in Trollhättan. He comes from Linköping Technical University where he recently finished his MSc in engineering, and is newly employed as a welding engineer at UW.

Fredrik gave a presentation of UW and their future plans in the field of FSW (**Appendix 1**)

Production Technology Center, PTC, at UW is founded by Volvo, Saab Automobile and University West. They will be able to examine Doctors in 2012. Working also with e.g. fusion welding, thermal spraying, visualisation and simulation.

The newly started project StiRoLight, "Robotised FrictionStir welding in light weight material", is involving Inovatum, Saab Automobile, ABB, Volvo and UW. Will shortly get a robot for FSW delivered from Esab to UW. New PhD-student, Jeroen De Backer, from Belgium just started and will perform the research work. Will present a paper at FSWP 2010 in January in Lille, France.

The PhD is aiming at expanding the process window and create a construction handbook for FSW. Trails will be made in Al 5182, 6016 and 7xxx in butt and lap joints. Will also be testing titanium. Unclear if the project will deal also with FSSW (spot welding).

UW is employing four (4) new professors in Welding, NDT, Thermal Spraying and Production. It's the intention that the FSW work will be subordinated the new professor in welding.

Jorma Pitkänen, Posiva (equivalent to SKB in Sweden) will present Posiva activities during the afternoon visit at VTT.

5. Presentations

Initially it was noted that Sandvik is no longer focusing on FSW and the presentation from Mr Hertel on Quality of FSW in steel is removed from the agenda.

a) *Localization of plastic strain in the copper nuclear waste canister (Kati Savolainen)*

Kati presented findings when comparing FSW with Electron Beam Welding, EBW (no appendix). Stress-Strain Curves (with ordinary transverse tensile test) are looking less good for EBW, giving large grain sizes. Grain size gradient is much smaller with FSW. EBW also show less ductile welds.

Kati also showed films using the Optical Strain Measurement technique.

Discussed if the resolution is enough for FSW, which gives grain sizes around 50 µm. Next step would be to produce a FE-model.

b) *Tool design (pin and shoulder) at SKB, with following discussion. Two aspects: wear and pin fracture (Lars Cederqvist)*

Lars presented SKB work on elimination of the risk of tool fracture during sealing welds on the copper canister (**Appendix 2**). If it happens during welding it is going to be very expensive extracting the nuclear waste. Also focus on minimizing excessive flash.

Different surface treatment for the probe was tested. Also eliminating MX feature in the area of the probe with most stress (middle section of the probe). Eliminating MX totally gave cavities.

Surface treated shoulder gave less heat (Less friction) and produced even flash throughout the weld. Will try carburized surface to try to get even larger friction coefficient.

It's a delicate balance between the heat produced by the shoulder and the probe respectively. If not enough heat is generated from the shoulder the strain on the probe will be too high. If trying to get more heat from the shoulder with more force the risk of excess flash is eminent.

The tool is examined with PT before and electron microscopy after welding.

c) *FSW within ESAB (Sylve Antonsson)*

Sylve summarized the activities from the beginning of ESABs involvement in FSW (**Appendix 3**). The process was developed, or lounged in 1991, with ESAB as a project member from the project start in 1992. First machine installation, the ESAB Super Stir, at Marine Aluminium in Norway, have welded over one (1) million meters with no defects.

Sylve gave further examples of machines delivered to:

Boeing in Huntington Beach, LA (1998)

Two installations for Boeing in Atlanta for welding rocket fuel tanks.

SAPA, that also was a project member from the beginning. The machine for panel welding has three welding heads, two from the top and one from the bottom.

For Automotive industry, installations at Tower Automotive.

Hydro Aluminium in Magnor Norway for welding electric motor housing.

TWI and also DanStir invested in gantries (DanStir moved its equipment to Holland).

IS in France bought for AeroSpace application R&D

SKB for trials on nuclear waste canisters.

Alenia Spazio also AreroSpace.

In 2002 Legio system was launched as a standard system. First one delivered to KMT in Finland. Several institutes have placed orders on 1m equipment, to be able make tests to approve the process for production. Examples of deliveries:

Cewac, Belgium Institute with also shop activities.

CSM, Italy for production

SLV, Berlin for R&D

AJT, USA equipment for circumferential welds, for pipes and flanges.

SMF, Germany ... welding of Vestas motorhouse.

LPSC-ISRO, India for Rocket fuel tank production.

Spirit Aero Systems, USA for production of panels for air crafts.

IST, Portugal for R&D.

Sespele, Russia for longitudinal and circular welds for tanks for trucks.

Rapid Technic, Switzerland

WEBRA in Sweden for 2D welding of coolers.

Discussed future possibilities with FSW with robot and also welding of steel. Also discussed that LEGIO 7 could be suitable for welding of 50 mm copper.

d) Forming of Nordic Friction Stir Welding Centre (Henrik Schmidt)

Henrik reported he is leaving the DTU and starting a new enterprise with a competence centre for FSW in Copenhagen. He bought a small work shop. Collaboration with MegaStir, GKSS, TWI, Vestas, DTU and USC.

Being able to do investigations on all types of applications, producing real samples with equipment to FEM simulation. Different materials, application and assist in tool design.

Will hold a TWI R&D licence. Henrik can be contacted at hbs_engineering@yahoo.dk

6. Messages and Reports – IIW Annual Assembly, Essen Fair, articles etc

The worlds largest welding fair “Schweissen und Schneiden” in Essen was 14-19 September 2009. See also www.essen-welding-show.de.

News concerning FSW was robotised FSW. TWI was not present on the fair.

The members of the group that was attending the fair gathered for a short briefing. Present was Eva Lindh-Ulmgren, Kati Savolainen, Kari Lahti, Johan Norström, Mathias Lundin. The following was noted:

Companies presenting FSW:

Manufacturing Technology Inc. – standard FSW, no real news

Klaus Raiser – standard FSW, no real news

CYTEC Systems – presented FSW with 7 axis KUKA robot. Says they have installations in production at Airbus, BMW och Audi. Also showed dissimilar joint aluminium to steel.

ESAB – presented robotised FSW. Sales start was 14 September.

Otherwise a very thin display of FSW on the fair. Does not reflect the boom the process have had the last decade.

The robot in ESABs both is sold to Höskolan Väst (Inovatum, Anna-Karin Christiansson).

They have a new project, STIROLIGHT, with Volvo AB (+Aero), Saab Automobile, ABB and ESAB. Lars Pejryd is project leader.

Johan is participating in GSP, "Group Sponsored Project", at TWI

Kari reported on a meeting with Mega Stir "which was an eye opener". Have sold one installation in 8 years. Supports only the companies interests in oil & gas. Mega Stir is a spin of from the tool manufacturing at Mega Diamond. They anticipate under water welding on large depth as a big application. The tool cost for welding of steel, including licences, is \$3-5000 per tool. For some of Esabs machines costumers bought a Mega Stir tool holder and are welding in steel. Global Tubing FSW are welding steel pipes in production (4-5 mm). See further www.global-tubing.com/technology/welding.htm. Also check www.youtube.com/watch?v=1bDrbvpr_ks.

Esab is at the moment transferring one of its equipments (that weld in steel with Mega Stirs tool system) from USA to Laxå. Esab is concentrating to a global centre of excellence in Laxå.

University/SLV i Berlin have done hybrid FSW with induction pre-heating. They used ESABs equipment and developed the tool themselves.

Talked about license issues being the biggest constraint for growth of the process.

Discussed issues on a fixed bobbin tool. TWI has a project with Hitachi, Kawasaki, ESAB & SAPA.

KIMAB project: NDT for Laser induced UT no contact with the work piece. No commercial product. The company that made the prototype does not exist anymore. KIMAB is discussing with IOS, Intelligent Optical Systems to make the process commercially available.

Discussed Finnish companies possible to invite to WG 52: SDX (ex Aker Yards), TALGO – makes aluminium railway vehicles, Kitkahitsaus Jari, Koivisto Auto – makes aluminium buses. Boat manufacturers e.g. Buster possible appliers of FSW.

And Swedish companies: Webra, Enköping (possible competition with SAPA) is making cooling blocks and have substituted adhesive bonding with FSW with equipment recently bought from ESAB. Lasertool in Norrköping. Earlier manufacturing cooling blocks for ABB. Bombardier in Västerås have people looking in to FSW. Hägglunds should have a possible interest.

The TherMec conference in August in Berlin with 25 FSW papers that supposedly will be available, see www.thermec.uow.edu.au. Mikael Soron said he have the papers if anyone is interested. The conference will be again in two years.

International Seminar on Weldability in Graz in 27-30 September. Deals only with modelling. They are now regarding FSW as a separate field.

The conjunction with the upcoming conference, the 8th International Symposium on Friction Stir Welding will be held 20-22 May 2010 in Germany. See also www.twi.co.uk, there will be a licence holders meeting, see item 7 below.

7. Licence and patent issues

Discussion on the future concerning FSW patents. In December 2011 the original patent expires. 2016 the patent for featured tools expires. There are four kinds of licences: Academic, R&D, Site licence and Machine licence.

The question is how the licence system will change following the expiry of the patent(s). As concluded above this is a constraint on the growth of the process. Logically the system for licences will change, maybe toward paying for the use of featured tools.

It was discussed if the constraint imposed by patents makes it more difficult to sell equipment.

It was decided to approach TWI with a request to clarify the future of the licence system. Decided to draft a letter to TWI and ask for clarification on the above issues. Possible also invite a relevant TWI representative to our next meeting to present possible answers.

(Secr. Remark: Finding wording of the issue difficult without damage to the cause a letter was refrained from.)

AG 52 will return to the matter in coming meetings.

8. Short report on FSW standardisation activities in IIW (ISO/DIS 25239-1 to -5)

Was on 2nd DIS-ballot until 23 September. Swedish comments on all parts also includes comments from AG 52. Will be handled by IIW Commission III Working Group B1 at intermediate meeting at GKSS in Geesthacht, 7 December 2009.

Most comments last time where rejected.

It is really important to have some representative to support the comments. Johan Fremling was positive to explore the possibilities to go in as a delegate in B1 after Lars Mohlkert.

There where an invitation by George Desantos starting a standardisation project on FSSW.

Documents concerning ISO 25239 is posted at www.svets.se/ag52 (under "Info & documents").

9. Working program and member issues (prospective participants etc)

The secretary explained that for the sake of financing of the activities he will later on send an invitation for membership in Swedish Welding Commission, see www.svets.se/medlemskap

Should be contacted for possible participation in the working group: WEBRA in Enköping, Bombardier in Västerås, Lasertool previously in Norrköping, Hägglunds.

Belgian PhD student engaged in the activities at University West should be invited to the group.

At SAPA a KTH student is engaged in a project for which Johan Fremling will send details to the secretary.

10. Arrangement for subsequent meeting

The next meeting was decided for 13-14 April at ESAB Laxå.

SECR. NOTE Due to the transfer of ESAB facilities to Gothenburg and the "8th International Friction Stir Welding Symposium", 18-20 May 2010 in Germany, the meeting time and place is changed to 7-8 September, day one at ESAB in Gothenburg and day two at UW in Trollhättan (45 min with car, to be arranged)

Suggested items for presentations:

- Project at University West
- Welding of steel

Please contact the chair, Lars Cederqvist, or the secretary, Mathias Lundin, on additional agenda items.

More details to come in the meeting invitation.

11. Closure of the meeting

The chairman thanked everyone for their attendance and contribution, and Kati Savolinen for the invitation and the very nice arrangements at Helsinki University, specially noting the nice sauna evening.

Technical visit to VTT and Helsinki University

A tour of the facilities at VTT and the Laboratory of Engineering Materials at Helsinki University, was arranged after the meeting session.

Meeting secretary



Mathias Lundin