Finnish Recovery Boiler Committee

SKYREC STEERING COMMITTEE MEETING IX

TIME March 17th, 2010 10.00 – 16.00

PLACE Pöyry Finland Oy, Vantaa

PARTICIPANTS

Lasse Koivisto	Andritz Oy, Varkaus
Timo Peltola	Sandvik, Helsinki
Keijo Salmenoja	Chairman of Finnish Recovery Boiler Association
Timo-Pekka Veijonen	Stora Enso Oyj
Hiroshi Matsuo	Sumitomometal Industries,Ltd.
Mika Paju	Oy Metsä-Botnia Ab, Joutseno

Group members without a right to vote:

Esa Vakkilainen	LUT, project coordinator
Markus Nieminen	Finnish Recovery Boiler Association, secretary

APPENDIXES

I	Project budget
II	Project schedule
III	LUT: Pulp mill optimal steam pressure levels – question list to mills
IV	LUT: Once-through and reheater recovery boiler concepts – final report 17.2.2010
V	ÅA: Laboratory tests of superheater materials – preliminary report 5.1.2010.
VI	VTT: Mill tests of superheater materials - status report 9.2 (finnish)
VII	VTT: Mill tests of superheater materials - Probe PI-diagram (finnish)
VIII	OY: Ceramic structural materials – status report 14.3.2010 (finnish)
IX	Boildec Oy, Field testing of furnace materials – test report 21.1.2010
X	Boildec Oy, Field testing of furnace materials – status report 9.3.2010
XI	VTT, Effect of water quality and different chemicals on magnetite layer properties – status report 10.2.2010 (finnish)
XII	Teollisuuden Vesi Oy: TOC-removal methods and applicability for recovery boiler make-up water treatment – Final report 22.1.2010
XIII	OY: Reduction of TOC from recovery boiler make-up water – presentation 5.3.2010 (finnish)
XIV	OY: Reduction of TOC from recovery boiler make-up water – final report 12.3.2010 (finnish)
XV	OY: Reduction of TOC from recovery boiler make-up water – further research topics 12.3.2010 (finnish)

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Steering committee and their substitutes
Durability Sub Committee, Black Liquor Sub Committee
Board of the FRBC
MNN, OMP, EPT/Files

1 CALLING MEETING TO ORDER

1.1 Abcences

Matti Tikka	UPM-Kymmene Oyj, Kymi, chairman
Kalle Salmi	Metso Power Oy, Tampere
Martti Korkiakoski	Tekes
Reijo Hukkanen	Stora Enso Oyj, Oulu
Olli Talaslahti	Oy Metsä-Botnia Ab, Rauma

2 MEMOS OF THE PREVIOUS MEETINGS (5/2009) AND (1/2010)

The memos of the previous meetings were accepted.

3 BUDGET

Budget (situation 15.3.2010) is presented in Appendix I.

All participation fees are now collected, total sum 455 000 eur. Most of the projects will end during year 2010.

4 TIME SCHEDULE

Schedule (situation 15.3.2010) is presented in Appendix II.

Our one year extension application was accepted by TEKES. Now all projects should be completed by the end of June 2011 and final report written by the end of October 2011.

5 ONGOING PROJECTS

5.1 LUT, Pulp mill optimal steam pressure levels (WP1, S2)

Work has three parts:
Part 1. Collect data steam pressure levels in use and reasons for those levels
Part 2. Calculate annual averege steam balances for both modern and traditional about 600 000 ADt/a pulp mill. Evaluate investments costs between different pressure levels and affect of various electricity price to the chosen pressure levels. Calculations with/without power boiler and with fine paper integrate.
Part 3. Find out means to increase power to heat ratio in existing pulp mills during mill modernization.

Part 1. is currently going on. Question list (Appendix III) has been send to the mills and currently 8/15 answers have been received.

Jussi Saari, LUT, will make the work as part of his doctoral thesis. Project is completed by the end of November 2010. Black liquor sub-committee will supervise the project. Work will be done in English but reported also in Finnish. Cost 16 000 €.

5.2 LUT, Once-through and reheater recovery boiler - concept studies (WP1, S3)

Preliminary report was send to the project participants for comments in the beginning of December 2009 and final report in February 2010 (Appendix IV). Results were presented in previous steering committee meeting December 16th.

Metso has commented the profitability of Case E (reheater) compared to other cases. In Case E steam exits the turbine drier than for example Case C

Reheating is currently used in power boilers so it is profitable. Vakkilainen to contact for example Foster Wheeler and find out why they use reheating.

Final report was accepted but Vakkilainen will make extra report about reheating. Invoice of 33 800 eur has been paid.

5.3 Åbo Akademi, Co-firing of black liquor and biomass – laboratory combustion tests, part 2

Project consists of two separate works: One consists droplet combustion tests with wood and lean BL, cost 16 500 €. Second will focus on better understanding the behaviour of nitrogen in biosludge, price 7100 €. Total cost: 23 600 euros. Project was ordered in steering group in e-mail meeting 29.1 – 2.2.2010. Project is started and will be completed tentatively by September 2010.

Nikolai DeMartini will ask can Metso or Innventia supply lignin lean black liquor or will ÅA make it in laboratory. Biosludge is coming from Kymi.

5.4 Åbo Akademi, Laboratory tests of superheater materials (WP2, T3)

Corrosion tests with 10CrMo, T91, Sanicro 28, HR11N were made under alkali sulfates and chlorides containing synthetic ashes in reducing (5% CO + 95% N2 – 2 l/min) atmosphere. Results are compared to previous project (SOTU II) were similar tests were made in oxidising atmosphere. Cost 37 000 eur.

Test results and preliminary conclusions were presented in the steering committee meeting December 16th 2009. Preliminary report was received in 5th January, 2010 (Appendix V). Patrik Yrjas has promised final report by the end of March. All figures will be burned to a CD and delivered to project participants.

Comments to the report:
- Mission statements is missing from the introduction
- Page 2: what type of black liquor salt 5, salt 8, salt 9 and salt 10 would represent?
- Page 2: N_2 is missing from text 5% CO, 95% N_2 with flow of 2.0 l/min
- Page 6: figure 6, clearly point out the melt formation places
- Page 10: areas around the cracks were depleted, not cracks
- Page 12: figure caption is missing
- End of page 12: what is meant by *"different materials react differently"*
- Beginning of page 12: "no bars means no oxide layer detected" - there is always an oxide layer. The message should be that the oxide layer thickness was below the detection limit
- Calculate salts 5, 8, 9, 10 real T0 (with sulfides) and normal T0 (oxidizing)
- General diccussion about ambient/reducing conditions
  - Why corrosion problems in reducing conditions start to occur above 550 °C, in ambient atmosphere already at 500 °C
  - Test arrangements, are the conditions reducing?
  - We would like to hear suggestions for further research/additional tests

Items to be clarified:
- Previous test results in oxidising atmosphere were pretty consistent, but test results in reducing atmosphere needs more explaining.
- Difference (0 vs. 62) in corr. prod. thickness with two samples of HR11N
- What does the corrosion thickness number mean; could corrosion be shown like steel loss from the base line?
- Oxygen partial pressure at the test conditions?
- Is nickel somehow affecting the test results?

5.5 VTT, Mill tests of superheater materials, (WP2, T3)

Corrosion field tests of superheater tube materials are made with VTT's cooled deposit/corrosion probe in Joutseno recovery boiler. Materials (table below) were chosen in meeting IV, 8th Semtember 2009. Project cost: 108 000 eur.

AISI 347	**San 67**	**Alloy 28 (HR21, San 28)**	**TP310**	**HR11N**	**Super 625***

* 50 Ni – 21.5 Cr – 17.5 Fe – 9 Mo

Project intermediate report (9.2.2010) in Appendix VI (in finnish) and PI-diagram of cooling system Appendix VII.

Project status 10.2.2010
- Construction of the probes and cooling system is complete
- Leak and cold tests have been carried out
- Materials have been received and samples are ready
- Thickness of samples is measured before test and after the test corrosion rate can be estimated with SEM.
- Mounting flanges have been ordered from Botnia Mill Service, estimated delivery time Week 7.

After the flanges have been received, short test run (24 h), to check that everything works, can start and after that the first mill test (1000 h) with two probes. Probes will be mounted through a manhole located on 10.5 floor, nearest sootblower is about 1 m away, no protection is desinged againts it.

First test is tentatively started at week 12. Schedule to be checked.

5.6 FRBC's Material recommendation (WP3, P1)

Durability committee will make a suggestion of the table of contents. After that tenders can be asked from Hannu Hänninen, Aalto University and Pekka Pohjanne, VTT. Budget reservation is 25 000 eur.

Proposition should be ready in June 2010. Secretary will discuss about the issue with Reijo Hukkanen.

Separate groups need to be formed for preparing a furnace and superheater material recommendation and a water quality recommendation. Durability subcommittee will make a suggestion for persons to be included in each group.

5.7 Oulun Yliopisto, Ceramic structural materials (WP3, P2)

Project will be executed in two phases in Oulu mill. Quick (duration two week) test with all materials is done first. Longer test with 3-4 best materials after that and then is decided which samples microstructure is studied. Project is completed tentatively by the end of May 2010. Cost 15 000 €. Microstructure study extra cost 1025 € / sample.

Status report, March 14th, 2010
- quick test was postponed from December 2009 to February 2010
- frameworks is made from fireproof steel
- sample materials are dried, burned and mounted to frameworks
- two frameworks, 5 bricks per framework, Hassle D39A used as reference material.
- quick test was started 16.2.2010 and ended 2.3.2010

Results from quick test are received (Appendix VIII, in finnish). All materials have suffered damages, ZrO_2 and spinel samples broke when frame was taken out. Some materials have absorbed smelt chemicals by diffusion. Next step is to decide which materials chosen to the longer test. Reijo Hukkanen to give comments about the test results before the decision is made.

Comments:
- what is the total material lost, now only the height is measured
- what is the effective material lost, colour change area included if hardness is changed. Has hardness changed?
- discussion needed about the change in the colour
- frame has probably hindered the penetration and protected the samples

5.8 Boildec Oy, Field testing of furnace materials (WP3, P3)

Corrosion field tests of furnace materials are made with Boildec's probe in Joutseno recovery boiler. Project is about year behind schedule. Secretary to ask updated schedule from Karjunen. Project cost: 100 264 eur.

Before fourth attempt of the first test, probe was tested without specimens, report 21.1.2010 see Appendix IX (in finnish). During the tryout liquor spray guns positions were altered to minimize wet black liquor sprays on the probe. More electric heaters are installed and condenser insulated to gain better pressure/temperature control before fourth attempt is started.

Fourth attempt (1000h) was started 2.3.2010 and test is currently going on as planned (average surface temperature 433 °C, target 440 °C), except the upper thermo element inside material the AISI 304L (3R12) broke 8.3.2010. According to Timo this should not be a problem because earlier tests have showed that when probes pressure is over 3 bar, temperature are

below 530 °C. If everything goes as planned first test is completed in the middle of April.

Interim report 9.3.2010 (in finnish) Appendix X.

Next test (test 2) should be started immediately after first test is completed and materials to the second test should be verified. Materials (see table below) were decided in steering committee meeting IV, January 8th 2009 and confirmed in this meeting. Material "Welded 25% Cr" is coming from Metso, welded S28 from past project. If Metso does not have that material, Sandvik can manufacture similar material (code 4C54) in their lab. Sample should be workshop quality, preferred tube diameter is 63.5 mm.

Test 1: Feb 18 – Mar 31, 2009	Test 2: Apr 11 – May 23, 2009	Test 3: Aug 4 – Sep 15, 2009
AISI 304L (reference material) Ordered more 16.3	AISI 304L (reference material) Ordered more 16.3	AISI 304L (reference material) Ordered more 16.3
AISI 310S Ordered more 16.3	Sandvik 67 OK	Sumitom OK, Sumitomo "R"
Sanicro 38 Ordered more 16.3	HR11N OK	Open OK, Sumitomo "N"
Sanicro 28 Ordered more 16.3	Welded 25 Metso or Sandvik	Open To be specified

Test run number 4 is planned to be a reference run.

5.9 VTT, Analysis of the furnace test materials (WP3, P3)

Contract with VTT includes preparation and analyses of test specimens four times, cost 29 000 eur. Now specimens are prepared four times, this extra cost will be charged in the last invoice. Extra cost will be some thousands euros.

5.10 VTT, Effect of water quality and different chemicals on magnetite layer properties (WP4, V3)

Amine test have finally started in January 2010. Challenges in tuning of the equipment have delayed the project about 5 months, for example problem with the lead-in insulation. Report in Appendix XI (in finnish).

Chosen amines:
- cyclohexylamine
- 2-amino-2-methyl-1-propanol
- morpholine

Evaluation of amine degradation products and ex-situ measurements from test specimens will be executed during February. No test results received yet.

Project completed tentatively by the end of May 2010.

5.11 Teollisuuden Vesi Oy, TOC removal methods and their applicability in make-up water treatment (WP4, V1)

Work consist two parts: “Ion exchange and organic load” (part A) and “TOC removal methods” (part B). Part A is done with resins from Kotka and Rauma. Part B is literature work. Total cost 45 500 eur.

Final report for comments (Appendix XII, in finnish) was send to steering group and durability sub-committee January 22nd. Durability sub-committee comments were (meeting February 10th 2010):

- examples of typical resin brands should be included when discussing type I and type II resins.
- summary should be more detailed

Report was accepted. Teollisuuden Vesi will write more detailed summary, Maija Vidqvist has suggested to publish the results as an article in a scinetific journal.

5.12 Oulun Yliopisto, Reduction of TOC from recovery boiler make-up water (WP4, V1)

TOC-measurements have been made in four different water supply plants (Stora Enso, Kemira, Oulun vesi (Veitsiluoto and Kurkelanranta)). Also the affect of ion exchange resin lifetime to TOC-removal is studied and made pilot tests with activated carbon. Cost of the master's thesis is 10 000 eur.

Presentation (Appendix XIII) and final report (Appendix XIV) was send to the steering committee March 12th 2010 for comments. Both are in finnish.

Conclusions:

- Iron based flocking agents seems to remove TOC better than an aluminium based
- Demineralised water TOC-content doesn’t increase much during ion exchange cycle time (resin life time)
- Active carbon filter seems promising method to decrease TOC-content

5.13 FRBC’s Water quality recommendation, (WP4, V1)

Durability committee is preparing table of contents for water quality recommendation. Secretary will discuss issue with Reijo Hukkanen. Budget reservation is 25 000 eur.

Water quality recommendation should include practices what to analyse and how often and also operating instructions what to do when a value exceeds the limit.

Separate groups needs to be formed for preparing a furnace and superheater material recommendation and a water quality recommendation. Durability

subcommittee will make a suggestion for persons to be included in each group. Each group's work will be reported to the steering committee.

6 PROPOSALS

6.1 International co-operation

Keijo Salmenoja and Jim Keiser, ORNL have discussed about collaboration opprotunities between SKYREC and ORNL project "improving heat recovery in biomass-fired boilers". Presentations of ORNL project kick-off meeting will be placed on SKY website.

6.2 Others

6.2.1 Oulun Yliopisto, Reduction of TOC from recovery boiler make-up water

Further research topics, appendix XV:
- Active carbon: biologically active carbon vs. absorption
- Disinfection needed after active carbon filter
- Active carbon life cycle
- Iron based flocking agents
- UV-radiation (185 nm)
- Qualitative water analyses

Reijo Hukkanen will make more exact proposal for further research

6.2.2 Teollisuuden Vesi Oy, TOC removal methods and their applicability in make-up water treatment

Investment costs and operating costs of different TOC removal methods would be interesting. Rought estimate about investment and operation costs (eur / m3 water) between methods when base line is normal ion exchange process.

Secretary will discuss with Hukkanen is this covered in Oulu's future work or should an offer be asked from Teollisuuden Vesi Oy.

7 PROJECT IDEAS

7.1.1 Taking out pyrolysis gas from recovery boiler

Idea is to take out pyrolyse gases from RB and use it as fuel lime kiln. There is many open items like emissions, gas cleaning..

Keijo Salmenoja and Esa Vakkilainen will arrange meeting with Mikko Hupa, ÅA during the ICRC 2010.

8 OTHER ISSUES

8.1 Translating project reports to english

Secretary will check what SOTU II project reports needs to translated to english for Sumitomo and who would translate the reports.

9 NEXT MEETINGS (MEETING CALENDAR FOR 2010)

2010 meeting calendar:

- Next meeting IV: June 15th at 10.00 a.m, Pöyry Finland Oy, Vantaa
- Meeting V: September 14th
- Meeting VI: December 15th