
International Energy Agency
Bioenergy Agreement
Task 32, Triennium 2004 - 2006
Biomass Combustion and Cofiring

Working Group Meeting
Arranged by:

Ingwald Obernberger, TU Graz, Austria

Content:

Minutes of the 3rd Task Meeting, triennium 2004 - 2006
Working Group Meeting-Biomass Combustion and Cofiring

March 16 - 18, 2005
Graz, Austria

IEA Working Group Meeting Task 32
Biomass Combustion and Cofiring
March 16 – 18, Graz, Austria

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Programme

Wednesday March 16, 2005: Field trip (1/2)

From	Topic
Until 13:45	Arrival in Graz and check-in in hotel Mercure
14:00	Video presentation on a biomass-fired CHP plant in Feldbach, based on a Stirling engine Location: BIOS Energiesysteme GmbH.
15:00	Departure by bus to Hartberg
16:00	Technical visit to biomass-fired CHP plant in Hartberg, based on a screw-type engine cycle
<i>19:00</i>	<i>Dinner in the eastern Styrian region</i>
21:00	Return to Graz

Thursday March 17, 2005: Task meeting and field trip (2/2)

Location: Hotel Mercure, Graz, Austria

From	Topic
08:30	Opening, news from IEA Bioenergy ExCo
08:45	Report of last meeting
09:00	Finalization of cofiring statement
09:30	Follow-up of handbook (2 nd edition and Chinese translation)
10:30	<i>Refreshment Break</i>
11:00	Global inventory of cofiring experiences (Task project)
11:10	Formation of Striated Flows during Biomass-coal Cofiring (Task project)
11:20	Biomass Impacts on SCR Catalyst Performance (Task project)
11:30	Determination of efficiency for automatic biomass combustion plants and comparison of efficiency and emissions for different operation modes (Task project)
11:45	Short country reports (facultative)
12:30	Planning of workshops, synergy with other networks
13:00	Next meetings
13:30	<i>Closing, lunch</i>
15:00	Departure from Hotel Mercure
16:00	Technical visit at the CHP plant in Leoben (ORC Process)
18:00	Return to Graz
19:00	Arrival in Graz
20:00	<i>Task 32 dinner in Graz</i>

Friday March 18: Seminar on aerosols from biomass combustion

Location: TU Graz, Austria

From	Topic
08:30	Registration
09:00	Welcome address <i>I. Obernberger</i> , Graz University of Technology (A) <i>S. van Loo</i> , IEA Bioenergy, Task 32 (NL) <i>E. Fercher</i> , Austrian Bioenergy Centre (A)
09:15	Fly ash and aerosol formation in biomass combustion processes – an introduction <i>I. Obernberger</i> , Graz University of Technology (A)
Session 1: PM immissions and health effects Chairman: <i>S. van Loo</i> , IEA Bioenergy Task 32 (NL)	
09:30	Co-ordinated international activities to abate European PM emissions <i>W. Winiwarter</i> , ARC systems research (A)
10:00	PM imissions in Austria – 2000 to 2004 <i>C. Nagl</i> , Department of Air Quality Control (A)
10:30	Coffee break
11:00	Health effects of ambient aerosols <i>H. Hauck</i> , Austrian Academy of Sciences (A)
11:30	Health relevance of aerosols from biomass combustion in comparison to diesel soot <i>N. Kippel</i> , Verenum Zürich (CH)
12:00	Lunch
SESSION 2: Aerosol formation and behaviour in biomass combustion processes Chairman: <i>C. Tullin</i> , SP (S)	
13:00	Release of aerosol forming species during combustion in pulverised fuel systems <i>R. Korbee</i> , ECN - Energy Research Centre of the Netherlands (NL)
13:30	Release of aerosol forming species in fixed-bed systems <i>Flemming Frandsen</i> , Technical University of Denmark (DK)

From	Topic
14:00	Modelling of aerosol formation <i>M. Joeller</i> , Graz University of Technology (A)
14:30	Aerosol and particle transport in furnaces <i>H.P. van Kemenade</i> , Technical University Eindhoven (NL)
15:00	The influence of aerosol particles on the melting behaviour of ash deposits in biomass fired boilers <i>R. Backman</i> , Umea University (S)
15:30	<i>Coffee break</i>
SESSION 3: Aerosol emissions and emission control Chairman: <i>I. Obernberger</i> , Graz University of Technology (A)	
16:00	Automated analyses of aerosols formed during biomass combustion by SEM/EDX <i>S. Mietsche</i> , Graz University of Technology (A)
16:30	Particle Emissions from residential biofuel boilers and stoves <i>L.S. Johansson</i> , Swedish National Testing and Research Institute (S)
17:00	Fine particle emissions from fluidised bed combustion of peat and wood <i>V. Linna</i> , VTT Processes (FIN)
17:30	Exhaust gas cleaning for small wood fired appliances – recent progress and field test results <i>V. Schmatloch</i> , Swiss Federal Institute for Materials and Testing (CH)
18:00	Particle precipitation in medium- and large-scale biomass combustion plants <i>M. Lixl</i> , Scheuch GmbH (A)
18:30	Summary and Conclusions

Attendance list

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Field trip part 1/2, Wednesday 16 March, 2005

Biomass-fired CHP plant based on Stirling engine, in Feldbach

After a brief welcome notice to all delegates to Graz, Ingwald Obernberger briefly explained the programme for the field visits. Various small and medium scale biomass based CHP plants based on three innovative CHP concepts have either very recently gone into commercial operation or are being constructed in Austria. This is partly a result of the attractive feed-in tariffs of approx. 0.12 to 0.16 €/kWh_e. While biomass CHP plants are usually based on steam cycles, these projects employ Stirling engines, a screw-expander or ORC systems.

The first plant that was initially on the agenda to be visited concerns a woodchip fired CHP plant in Feldbach, equipped with a Stirling engine that delivers 35 kW_e. Due to a few weeks of delay in the construction of the plant however, it was not possible to visit the plant at the time of the Task meeting. The details of the Stirling technology and the Feldbach plant in particular were therefore communicated in the form of a presentation at the office of BIOS, Graz, see Annex 1. Annex 2 contains a poster that summarizes the developments of biomass fired Stirling engine technology.

As the nominal electrical efficiency of the Stirling technology is rather limited (up to 12% has been achieved), only heat-controlled operation mode is considered meaningful. Experience exists with biomass-fired Stirling plants of 35 kW (a 35 kW_e prototype unit is in operation since 2002 and has over 12.000 operating hours and a 70 kW_e prototype is in operation since 2003 with over 3.000 operating hours). In 2005 a small-series production consisting of 7 35kW_e units is planned (one of these engines is the Feldbach project). As Stirling engines have previously been used mainly with natural gas, a key issue here is how to transfer heat from the dust loaded flue gas of a biomass combustion installation to the Stirling engine without immediate clog up of the required heat exchanger. A particular heat exchanger design has been developed for this purpose. The pilot plants built so far can be considered as a breakthrough.

Biomass-fired CHP plant based on a screw-type engine cycle

A visit was organised to a biomass fired CHP plant with a screw-type engine, located in Hartberg, Austria. This plant was built in 1987 and had a surplus of process steam, which could be made to use by addition of a superheater and a screw expander, which were commissioned in 2003. The prime mover is based on a slightly adapted vapour compressor, supplied by MAN that is used in reverse mode to generate 730 kW_e from 5.64 MW_{th} of steam (225°C, 25 Bar). The exhaust conditions are 1 Bar, 100°C (partly condensed steam). The electric efficiency of about 11% hardly decreases when used under part load conditions (down to 30%) the technology can be used in heat controlled mode. The technology is considered very compact, robust, easy to handle and is available up to 2 MW_e. A detailed assessment of this plant can be found in Annex 3, a 1-page poster is included in Annex 4.

Task 32 meeting, Thursday 17 March, 2005

Opening, news from IEA Bioenergy ExCo (Sjaak van Loo)

The third meeting of Task 32 in the triennium 2004-2006 took place on Thursday 17 March 2005 in Hotel Mercure, Graz. Practical arrangements were organised by Ingwald Obernberger.

Sjaak van Loo welcomed all Task members and an introductory round was made. For this meeting, Andreas Heinz represented the European Commission instead of Erich Nägele. Regretfully, no representatives from Australia, Belgium, Canada and Norway were represented at the meeting. The overhead sheets used by Sjaak van Loo to present several issues on the agenda of this task meeting are included as Annex 5.

The ExCo has earlier indicated that 10% of the Task Leaders budget is to be reserved for policy related issues. Although this has not yet been clearly indicated, it is the opinion of Task 32 that the workshops organised on the public perception of cofiring and aerosols can be seen as such activities. In its coming meeting (ExCo55) it is hoped that the ExCo will confirm this.

A new task on Bioenergy Systems Analysis has been launched since Jan 2005, with Sweden, UK, USA and EC as participating members. Task Leader is Dr Sven-Olov Ericsson of Spray, Sweden. Objectives of this Task 41 are to study and analyse the interaction between different parts of the energy system (eg. consumers, producers, fuel production) as well as the interaction of the energy system with other parts of society. The aim is to get a meta analysis of the larger context to facilitate the drawing of conclusions on priorities, decision making, policy effectiveness etc. The Task will cover technical, economic and environmental data in its work and support particularly the ExCo by providing a platform for interaction with the other Tasks. All deliverables from the Task's programme of work will be made available to all Members of IEA Bioenergy whether or not they are participants in the Task.

Germany has indicated that it intends to join the Bioenergy Agreement, South Africa has already agreed. In both countries biomass combustion and/or cofiring are important topics, however it is expected that South Africa is mainly interested in transportation fuels.

The ExCo has asked the Tasks for their corporation in performing a task-by-task gap analysis to assess where additional R&D knowledge is required in the near future, thereby making the work of tasks more effective.

The next ExCo meeting ExCo55 will be held in Copenhagen, a cofiring workshop is also planned. Jaap Koppejan will help in organising this workshop and provide input in the form of a presentation on the current status of biomass cofiring.

There are no details yet made available on earlier indications for the organisation of an IEA Bioenergy Conference.

The ExCo has earlier indicated that more attention should be paid to effective information dissemination in the member countries of individual Tasks. In order to make it easier for Task members to share the information generated, an electronic newsletter has been issued by the Task Leader.

TNO has prepared an analysis of all other IEA Implementing Agreements to identify where work is being done that relates to the work performed in Task 32. Of all 41 Implementing Agreements, 5 are considered to be of particular interest to Task 32. These are:

- Clean Coal Centre
- Clean Coal Science
- Fluidised Bed Conversion
- Energy Conservation and Emissions Reduction in Combustion
- Technologies for the Pulp and Paper Industry

Ad hoc contacts exist with contact persons for these IA's, but we will look for options where we can benefit from synergy in joint work, e.g. a joint workshop on fuel flexibility with the FBC Implementing Agreement.

Report of last meeting

There were no comments on the report from the previous meeting, which was held in Victoria, Sept 1, 2004. Earlier an option was given to all task members to respond to a draft version sent electronically. The final version will be distributed in print shortly after the meeting.

Finalization of cofiring statement

A draft statement on the relevance of biomass cofiring was earlier produced by Task 32 after the first workshop in this triennium, held in Rome, 2004. This statement was discussed at ExCo54, where it was concluded that the statement in its final form should be split into a summarizing policy paper that excludes the final conclusion, and a scientific background paper.

After the Task 32 organised workshop on Public Perception of Biomass Cofiring, held August 31, 2004 in Victoria, Canada, a second statement was produced to summarise the observations on this related issue. In discussion with Kees Kwant (Operating Agent of T32), it was agreed that we will integrate both draft statements to a single one-page policy statement, supported by a background paper. This revised statement will again be discussed at ExCo55.

Related to the cofiring statement, Andreas Heinz brought to the attention that a Technology Platform is currently formed on clean coal technology. It would be worth to provide input to this Platform particularly on biomass cofiring.

Task funded projects: general information

An overview of the current status of running Task 32 supported activities in the current triennium is provided below, a detailed description follows.

Activity	Current status
1. Internet site	Ongoing
2. Handbook of Biomass Combustion	Preparation of chapter started
3. Cofiring overview (Jaap Koppejan)	Finished, awaiting final permission for publication
4. Efficiency of biomass combustion (Thomas Nussbaumer)	Ongoing, to be finalised 2005
5. Striated Flows (Larry Baxter)	Reporting phase, report available 2005
6. SCR deactivation (Larry Baxter)	Reporting phase, report available 2005

Internet site

The Task 32 internet site attracts approx. 2500 visitors per month. Visitors are mostly interested in downloading meeting reports and publications. Another topic of continuing interest is the FUELSIM model, developed by Øyvind Skreiberg.

Follow-up of handbook (2nd edition and Chinese translation)

An agreement has been reached December 2004 with the Chinese Ministry of Agriculture for a Chinese edition of the Handbook of Biomass Combustion and Cofiring. It is currently under preparation and is planned to be released summer 2005.

The second edition of the Handbook of Biomass Combustion and Cofiring is now under preparation by Task 32. The book will be published by James & James. The approach for different chapters was presented by the coordinators for the different chapters, as agreed during the previous Task 32 meeting held Sept 2004. A summary is provided below:

Chapter 1 (Introduction)

This chapter will be rewritten completely by TNO

Chapter 2 (Basic Combustion Theory)

This chapter is to be thoroughly edited under coordination of Norway.

Chapter 3 (Biofuel production and supply)

This chapter is to be rewritten, and should include system perspectives. Work will be done mainly by Austria, with inputs from Sweden on system analysis.

Chapter 4 (Domestic wood burning applications)

This work will be edited under coordination Canada, with major inputs from Sweden

Chapter 5 (Industrial combustion):

This chapter will be edited by Austria, and include information on recent developments in control systems as supplied by the Netherlands

Chapter 6 (Power generation and cogeneration)

The existing chapter on power generation will be edited by Switzerland.

Chapter 7 (Co-combustion)

As a result of the rapid developments in the recent years, the existing chapter will be totally revised. Ash related issues will be discussed in the new chapter 8. The chapter will be coordinated by Australia, with major inputs from USA and UK.

Chapter 8 (Corrosion and ash deposition)

This new chapter will be written by UK and contain information related to ash deposition and corrosion. Major inputs will be provide by Austria and USA.

Chapter 9 (Environmental aspects)

The existing chapter on environmental aspects will be edited by Denmark. All countries will provide inputs in relation to national emission limits and standards related to dealing with by-products. Environmental aspects of cofiring are also to be included in this chapter.

Chapter 10 (Policy aspects)

This new chapter will contain different (support) policies related to biomass combustion in the member countries of IEA Bioenergy Task 32. It will be composed under coordination of the Netherlands with inputs from all member countries.

Chapter 11 (R&D Needs)

This chapter will be coordinated by Austria, however with contributions from all countries.

The timeframe for preparation of the individual chapters in draft and editing of the manuscript will be in accordance to the below time frame:

- Production of revised chapters by authors in draft (next Task meeting, Autumn 2005)
- Editing of the revised handbook to a revised draft (Autumn 2005 – Spring 2006)
- Discussion of first revised draft of new edition (Task meeting, Spring 2006)
- Finalization and printing of the revised handbook (Summer 2006)

Global inventory of cofiring experiences (Task project)

TNO has prepared an overview of installations where biomass and coal are cofired. This overview can be assessed on the Task 32 website as a searchable database. Bill Livingston mentioned he has experienced some technical difficulties in using the database, this will be examined and resolved. We are still awaiting permission from EPRI to release more detailed information on the approx. 40 cofiring trials that have been performed in USA.

Formation of Striated Flows during Biomass-coal Cofiring (Task project)

Although the research in this project has been finalised, we are still awaiting release of the final report. Larry Baxter has promised to provide this shortly after the meeting.

Biomass Impacts on SCR Catalyst Performance (Task project)

Although the research in this project has been finalised, we are still awaiting release of the final report. Larry Baxter has promised to provide this shortly after the meeting.

Determination of efficiency for automatic biomass combustion plants and comparison of efficiency and emissions for different operation modes (Task project)

This study is being coordinated by Thomas Nussbaumer (Verenum, Switzerland) with inputs from Jerome Delcarte (CRA, Belgium). It was initiated in 2003 to demonstrate how the conversion efficiency from delivered fuel to useful heat of automatic biomass combustion plants can be determined in a more cost effective and practical way, so that fuel deliveries can be paid on the basis of heat produced. As the average heating value for a whole heating season is determined, this method is suitable only in case of one single supplier.

Theoretical approaches have been developed by VERENUM, Switzerland to predict the dependence of annual efficiency on plant operation modes. Tests have recently been performed in an actual installation to evaluate how the theoretical approaches work out under practical conditions. Tests are still being performed with a 500 kW grate fired boiler at GRA, Belgium on the effects of dynamic operation of an automatic wood fired boiler on annual efficiency.

It is anticipated that with the developed method, annual plant efficiency of a typical automatic woodfuel fired heating system can be determined within 5% accuracy, which is considered acceptable for plant operators, keeping in mind current costs and inaccuracy of sampling and testing. The project is expected to be finished Autumn 2005.

Short country reports (facultative)

Brief country presentations were offered by all participants in the meeting. A summary is provided below:

Austria

The previous agreement for feed-in rates for electricity from biomass was differentiated for fuels and plant sizes, this agreement is valid for plants which achieved their building and operation permit before 31st Dec 2004 and will start operation till 30th June 2006. New rates are currently being negotiated.

There has been a large biomass conference in Graz, Austria in January 2005 with focus on central and Eastern European countries (Central European Biomass Conference 2005). It attracted 920 participants, and was translated into 6 languages. The conference had a strong emphasis on policies and applications, and was considered very successful. Further information as well as a book of abstracts is available from the Austrian Biomass Association (E-Mail: jauschnegg@lk-stmk.at).

Denmark

The company DK-TEKNIK, in which Denmark representative Anders Evald was employed, has merged with FORCE Technology.

One of the policies introduced by the new government that has been in operation since the 2004 elections, restricts the implementation of new bioenergy systems in areas where natural gas is being introduced. This is for competition reasons. Further, under the new regulations biomass plants get more capacity fees, and less generation fee.

Currently approx 1.4 Mton/year of biomass is being consumed in Denmark. Particularly the application of pellets has seen a large growth, with large growth in offers from Russia. In the last 6 months, the following major events have happened in Denmark:

- A successful pellet conference
- The Danish engineering society has organised a conference on cofiring.

European Commission

The Biomass Action Plan is one of the major drivers for implementation of bioenergy in Europe. Based on 2005, it provides targets for implementation in 2010. If implementation continues at the same rate, these targets will not be met. The B.A.P. should provide for appropriate actions. At present, needs inventory takes place with market actors. Likely actions in the BAP that is expected to come out in June are related to harmonising the market conditions, standardization, opening of international biomass trade, flexible national policies. More information can be found on the B.A.P. page of the DG-TREN site.

In a discussion that followed it was suggested that biomass could have a large contribution one the short term when used in stationary applications (particularly cofiring), whereas transportation fuels are anticipated to have a great influence on the longer term.

Switzerland

Some interesting examples of recent R&D projects on biomass combustion in Switzerland were presented by Thomas Nussbaumer, overheads presented are enclosed in Annex 6.

Recent projects have focussed on

- Development of low-particle wood combustion devices (Verenum & Müller)
- The health relevance of combustion particles (Verenum)
- ESP for Wood Stoves and Boilers (EMPA)
- Comfort Model for Wood Stove in Buildings (VHP)
- NOx Reduction, Air & Fuel Staging (Verenum & ETH)
- Process Control (Verenum & ETH & Industry)

The most important issues with regard to implementation of biomass combustion systems are in the areas of

- Quality Management for biomass combustion plants (PL R. Bühler, CH, D, A)
- Investigations on Ash Utilisation (W. Vock)
- Economic comparison of oil and wood (Canton Zürich)
- Large waste wood combustion (Schenkel for Berlin)
- Combustion of beer residues (Schmid for Heineken)

The Netherlands

In the Netherlands, latest statistics on energy production revealed that cofiring plays a dominant role in the production of renewable energy (1.8 TWhe in 2004). The share of renewable energy in the primary energy mix has reached 1.8%.

UK

Since Oct 2002, about 1.4 TWhe has been produced in UK using biomass cofiring installations. The value of a Renewable energy Obligation Certificate is now at a price level of approx. 50 £ per MWhe (approx 70 €/MWhe). Recently a seminar was organised in UK to discuss recent developments on cofiring in UK, the report is available on the website of DTI (The current long term Swedish Energy Research Programme ends in 2004. A new programme long term energy research programme is expected to be launched from 2005 but details are as yet unclear.

Sweden

Claes Tullin presented highlights on bioenergy development in Sweden, see Annex 7 for details.

The new long term Swedish Energy Research Programme has been launched in 2005, for the period up to 2011 with a budget of approx. 440 MSEK/year (49 M€/year). Increased emphasis is on R&D that generates results which will be implemented in relatively short term (less generic and more applied R&D, industrial involvement), as well as international cooperation. There are three large projects included:

- Synthesis gas production from biomass (160 MSEK)
- Black liquor gasification (ca 50 MSEK)
- Ethanol production (ca 140 MSEK)

A large project has been performed to assess the impacts on health and environment for (small-scale) biomass combustion www.itm.su.se/bhm (in Swedish, for further information please contact Claes Tullin, claes.tullin@sp.se).

In Borås, as part of a centre for energy and material recycling (CEM), two new BFB installations of 20 MW_{th} each have been modified for future research projects. The boilers are for instance equipped with a very large number of sampling possibilities and also the material balances are possible to close.

Finally, in 2006 there will be a World Bioenergy conference in Sweden, combined with a pellet conference.

Planning of workshops, synergy with other networks

In this triennium, 6 workshops are scheduled in connection with each Task meeting. A tentative planning is listed below, three have already been implemented.

- Jaap Koppejan (TNO), with the help of Anders Evald (FORCE, Denmark) will organise a workshop on small scale combustion systems at the next meeting in Paris, Oct 2005.
- It is yet uncertain where a workshop on fuel flexibility can be organised, Spring 2006. Claes Tullin (SP, Sweden) will find out options for this meeting.
- Bill Livingston (Mitsui Babcock, UK) will make arrangements for a workshop on corrosion and deposit formation, to be held Autumn 2006 in Scotland.

Topic	Organizing country	Planning
Co-firing	Netherlands	14 May 2004 (already done)
Public perception	Canada	30 August 2004 (already done)
Aerosols	Austria	18 March 2005 (with this Task meeting)
Small scale systems	Netherlands + Denmark	October 2005 (as part of the 14 th Eur. Biomass Conference)
Fuel flexibility	Sweden	Spring 2006 (possibly in connection to a FB Conference)
Corrosion and deposit formation	UK	Autumn 2006 (in connection to a ThermalNet meeting)

As was mentioned in earlier Task32 meetings, a European network named ThermalNet has recently been initiated to addresses commercialisation issues and providing support for more rapid and more effective implementation of all thermochemical bioenergy technologies in the market place. As the aims of CombNet closely link to those of Task 32, it is expected that some interaction will occur between this network and some tasks of the IEA Bioenergy Agreement, such as Task 32. An example is the planned corrosion and deposit formation workshop, to be held autumn 2006 in Glasgow.

Next meetings

The next Task 32 meeting will be scheduled during the 14th European Biomass Conference and Exhibition, which will take place 17-21 Oct, 2005 in Paris. We are trying to reach an agreement with the conference organisers for an official conference workshop on recent trends in small scale biomass combustion devices, which will enable us to attract a wider audience

for this workshop. The agenda of this upcoming task meeting and details of the conference seminar will be made available on the Task 32 website.

Time and place for the Spring 2006 task meetings are not yet defined, the autumn 2006 meeting will however be held in Glasgow, in conjunction with a workshop on corrosion and deposit formation.

Field trip part 2/2, Thursday 17 March, 2005

Biomass-fired CHP plant based on ORC, in Leoben

A visit was made to the biomass CHP plant in Leoben, which was erected and operated by “Biomasse-KWK Leoben Betriebsgesellschaft m. b. H” (BKL) which is a cooperation between “Mayr-Melnhof Holz GmbH” (with a share of 5 %) and “Steirische Gas-Wärme GmbH” (with a share of 95 %). With a production capacity of about 1.2 million dense m³ p.a., MM has the largest wood processing facilities in Austria. The production of bark at this facility amounts to some 370.000 m³ per year, and is used in the new situation to generate approx. 4.5 MW_e in three parallel ORC units (each generating approx 1.47 MW_e from 8.7 MW of heat transferred in the boiler from the fuel onto the thermal oil system), while up to a total of 190 GWh/a of remaining heat from the ORC units can be delivered as process heat for pellet production, wood drying and district heating.

More details of this plant can be found in Annex 8, information about other ORC projects in Austria is enclosed in Annex 9 and Annex 10.

Seminar on Aerosols from Biomass Combustion, Friday March 18, 2005

The third workshop of Task 32 in this triennium was organised by Ingwald Obernberger of the Institute for Resource Efficient and Sustainable Systems, TU Graz, Austria on March 18, 2005. The topic was Aerosols from Biomass Combustion. The workshop was organised with support of Task 32 of the IEA Bioenergy Agreement and the Austrian Bioenergy Centre GmbH. This was the second workshop on aerosols from biomass combustion, organised by Task 32¹. It was well visited with approx 75 participants.

The presentations are available from the Task 32 website, the proceedings of the Aerosol Workshop are available as a separate book (Volume 6) in the Thermal Biomass Utilization book series of BIOS BIOENERGIESYSTEME, see www.ieabcc.nl for information how to order this publication. The summary and conclusions, prepared by Ingwald Obernberger, follow below.

Summary and conclusions

One should clearly distinguish between old and new biomass combustion devices. This is of special importance if small-scale units are considered because new biomass furnaces achieve an almost complete burn-out, which substantially reduces the amount of organic aerosols formed.

Due to the fact that old small-scale biomass combustion plants emit significantly larger amounts of aerosols (due to incomplete combustion) than new systems, aerosol emissions from biomass combustion could be substantially reduced by replacing old with new automatically operated small-scale biomass combustion devices or at least by improving the operation of old systems (e.g. by the installation of storage tanks).

Inventories concerning aerosol emissions and immissions need actual and secured data. New data concerning aerosol emissions from biomass combustion (based on measurements performed within ongoing R&D projects) should therefore be supplied for new as well as old combustion devices as well as concerning the actual ratio between old and new systems installed in a certain country. These data are of great relevance in order to achieve correct calculations and evaluations regarding the influence of aerosols from biomass combustion on the overall emission and immission situation.

Regarding health effects of aerosols from biomass combustion, first studies are ongoing but there is still a long way to go in order to understand which influencing variables are of relevance (e.g. particle size, chemical composition). Besides cell tests also inhalation tests will be necessary to evaluate health effects properly.

First sets of release data, describing the amount of aerosol forming species released to the gas phase during combustion, are available for pulverised biomass fuels as well as for grate combustion systems and will also be further investigated. These data are of great relevance for aerosol formation as well as for subsequent deposit formation modelling.

¹ The first one took place June 2001 in Zürich, and was organised by Thomas Nussbaumer, Verenum (minutes can be found on www.ieabcc.nl).

Aerosol formation models for biomass combustion systems have already achieved a high level of development and will be further improved within the next years. These models are of great relevance to understand aerosol formation pathways as well as relevant influencing variables.

Moreover, relevant investigations regarding the influence of aerosols on deposit formation have been performed and have shown that aerosols can strongly influence the ash melting behaviour of deposits due to the formation of salt mixtures with low melting points.

New small-scale aerosol precipitation devices are under development. Tests with prototypes have started but these technologies are not yet commercially available.

Medium and large-scale biomass combustion plants (nominal boiler capacity $> 500 \text{ kW}_{\text{th}}$) can precipitate aerosols well if appropriate filters are installed. An efficient aerosol precipitation can be achieved by electrostatic precipitators as well as by baghouse filters.

Future actions of Task 32

- Production of chapters for revised handbook by authors (Until October 2005)
- Discussion of first draft of revised chapters of new edition (Task meeting, Autumn 2005)
- Editing of the revised handbook to a revised draft (October 2005 – Spring 2005)
- Discussion of edited draft (Spring 2006 Task meeting)
- Finalization and printing of the revised handbook (Summer 2006)
- The next meeting of Task 32 will be held in Paris, in the week of 17-21 Oct, 2005.
- A workshop on small scale combustion systems will be organised by Netherlands and Denmark at the same conference.
- A workshop on corrosion and deposit formation will be organised by Bill Livingston, Autumn 2006 in Glasgow
- A workshop on fuel flexibility is planned for Spring 2005 and will be organised by Claes Tullin, date and venue yet unknown.
- The combined statement on biomass cofiring will be further discussed at the ExCo55 meeting, TNO will provide inputs into the discussion on the finalisation of the statement by the ExCo
- All are again requested to forward data on national research programmes or major projects related to the interest of Task 32 to the Task Leader, in order to facilitate knowledge exchange in accordance with the priorities of Task 32.

**Annex 1. Small scale CHP plants based on hermetic Stirling engines for biomass fuels – State of the Art, technology, Development and Operational Experience
BIOS Energiesysteme GmbH**

**Annex 2. Small-scale CHP plant based on a 70 kWel hermetic
eight cylinder Stirling engine for biomass fuels
Friedrich Biedermann, Henrik Carlsen, Ingwald
Oberberger, Martin Schöch**

Annex 3. Demonstration and evaluation of an innovative small-scale biomass CHP module based on a 730 kWe screw type steam engine
A. Hammerschmid, A. Stallinger, I. Obernberger, R. Piatkowski

**Annex 4. Innovative small-scale biomass CHP module based on
a 730 kWe screw type steam engine
A. Hammerschmid, A. Stallinger, I. Obernberger, R.
Piatkowski**

Annex 5. Overhead sheets presented by Sjaak van Loo

**Annex 6. Country presentation for Switzerland, Thomas
Nussbaumer**

Annex 7. Country presentation for Sweden, Claes Tullin

Annex 8. Biomass CHP plant Leoben – project overview

**Annex 9. Demonstration of an innovative biomass CHP plant
based on a 1,000 kW_e Organic Rankine Cycle - EU
Demonstration Project Lienz (A)
Peter Thonhofer, Erwin Reisenhofer, Ingwald
Oberberger, Mario Gaia**

Annex 10. Fuzzy logic controlled CHP plant for biomass fuels based on a highly efficient ORC process- contract No. NNE5/2000/475, final publishable report, Stadtwaerme Lienz, BIOS Bioeenergiesysteme GmbH, 2003