NextGenBioWaste

No 1 - 2009

NextGenBioWaste is a huge and complex project with challenging targets to be reached by the end of the project in 2010. NextGenBioWaste has 17 partners from 7 countries working together to reach these targets.

The project comprises demonstration of new technology at several plants supported by research activities. By now several demonstration facilities have been planned, engineered and built, and they are also producing their first results. A comprehensive presentation of project results was given at the conference in Milan in October 2008. Some recent news are presented in this newsletter.

Successful bioenergy conference

The International Conference on Waste and Biomass Combustion was arranged in Milan, Italy 8-10 October 2008. Excellent speakers and more than 70 participants from 14 countries made the conference a success. The conference was arranged to present NextGenBioWaste results midway in the project period and also to discuss the technological development in Europe within combustion of biomass and waste.

Technical aspects of biomass and waste combustion

Lars Sørum, SINTEF Energiforskning, opened the conference, and the local host Antonio Bonomo, A2A, welcomed all participants to Milan. The latest EU policy and framework developments for energy from biomass and waste were presented by Jean-Pierre Schosger from the EU Commission.

Keynote lectures on combustion of biomass and waste were given by Professor Ingwald Obernberger, University of Eindhoven, and Professor Gerrit Brem, Universitety of Twente, respectively.

The conference focussed on the technical aspects of biomass and waste combustion, and technical innovations were presented in front of an interested auditorium. Presentations from NextGenBioWaste activities were given, as well as presentations by other invited speakers. The conference sessions included sub-themes like fuel preparation and handling, combustion processes, system design, corrosion and fouling, ash handling and emissions.

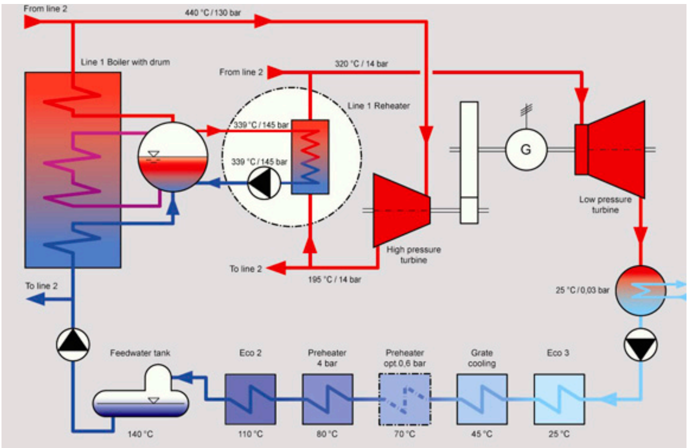
Conference participants in front of A2A's plant in Brescia, Italy

City of Amsterdam Waste and Energy Company

One of the 17 partners of NextGenBioWaste is the City of Amsterdam Waste and Energy Company (AEB). AEB has 85 years of experience in waste to energy as a source for clean renewable energy and secondary materials. In 1993 AEB opened its Waste to Energy plant in the Westport Area. Since then activities expanded with the co-operation with the neighbouring municipal waste water treatment plant for biogas utilisation and sludge processing, and the start of operation in 2007 of the new high efficiency Waste Fired Power Plant (WFPP). The development of the WFPP is the reason that AEB participates in NextGenBioWaste because the project enables AEB to closely monitor the performance of the WFPP and to develop new solutions for high efficient waste incineration.

The Waste Fired Power Plant: innovation at the highest level

More energy and products from waste. Fewer burdens on the environment. No other facility in the world complies better with these social needs than the Waste Fired Power Plant of AEB. With its development AEB has not only raised the bar on electrical efficiency, but also the on the amount and number of products recovered from the bottom ash and flue gas. By the innovative application of a steam reheater, steam



Reheating-scheme. (© City of Amsterdam Waste and Energy Company)

is extracted from the turbine halfway in the process, to be heated for a second time. This produces an even higher pressure and temperature, making it possible to reach 30 % electrical efficiency!

Metal recovery from bottom ash

Not all the waste is incinerated. Bottom ash is the material that remains. Bottom ash consists of cinders, granulates, glass and metals. Obviously AEB aims to recover the maximum amount of materials from the bottom ash. To realize this goal AEB, in cooperation with Delft Technical University, built a pilot plant which recovers three times the amount of (precious) metals including aluminium, iron and copper from the bottom ash. This was not possible before. An interesting development, given the great demand in the world for these metals. From the bottom ash residue we produce granulate and artificial sand for use in the construction of roads and buildings.

Production location of AEB, the stack of the Waste Fired Power Plant is on the right (© City of Amsterdam Waste and Energy Company)

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Co-funded by the European Commission under the Sixth Framework Programme
Integrated project; research and demonstration - Contract No: TREN/05/FP6EN/S07. 56773/019809

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The largest WtE plant in Italy

A site visit to the A2A plant in Brescia, the largest in Italy, was arranged. This plant has two lines for incineration of waste and one for biomass. The annual production is 568 GWh electricity and 526 GWh heat.

The main contribution of A2A to the NextGenBioWaste project is the installation and subsequent testing of an innovative system for NOx abatement in a WTE boiler. The new implementation at A2A is a high-dust Selective Catalytic Reduction (SCR) system. The catalyst is installed along the gas path where the temperature is already suitable for operation and reheating is not needed. The risks are mainly the possibility for catalyst clogging and poisoning because of the sulphates content of the gases not yet treated with lime. Results and experiences for the first two years of operation were presented at the conference.

A2A, Keppel Seghers Belgium, Vattenfall, Visser & Smit Hanab and Von Roll Inova was conference sponsors. A second conference is planned in February 2010 to present the NextGenBioWaste results by the end of the project. More information on the project website.

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Monitoring the combustion process directly on the grate

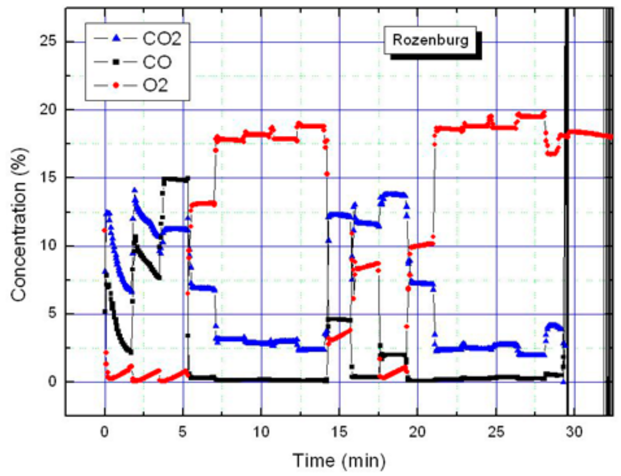
The waste incineration process on the grate can be monitored by a specific instrument called the combustion layer sensor which has been developed within the NextGenBioWaste project. This sensor is applied especially for flue gases monitoring together with temperature measurement on the grate in the burning waste layer. The monitoring process is not the typical on-line and constantly running procedure. The instrument is introduced to the combustion chamber through the feeding point within the waste batch. It observes the identical conditions as its surroundings under the combustion process and at the end of the grate it leaves the combustion chamber.

The thermal protection of the instrument, precisely the innermost part containing the measuring system, is secured by a system of specific insulation layers. The external layer made from ceramic fibre blankets is in direct contact with the burning waste. This layer observes temperatures higher than 1200 °C. The second layer made from fully water saturated balsam boards is applied to ensure for a certain period the active thermal protection keeping constant temperature of 100 °C, while the evaporation process of contained water volume occurs. The third insulation layer is the combination of the material with very low thermal conductivity and the phase changing material absorbed by wooden chips. The phase changing material based on the solid paraffin provides, similarly to the evaporation water, the constant temperature of the phase change. The temperature of the phase change between solid and liquid stage is defined by the type of used material. By application of the sufficient insulation layers the inner temperature close to the sensitive parts of the measuring system stays almost unchanged during the period of 3 hours starting from the moment when the instrument enters the combustion chamber. The final increase of the inner temperature usually does not overreach 10 °C.

Until now there were performed 4 experimental measurements exploring the combustion process in the real waste incinerators. Two experiments passed in Rozenburg, the Netherlands, one in Schweinfurt, Germany, and one in Prague, the Czech Republic. The combustion layer sensor during these experiments explored different combustion conditions and survived very high temperatures on the grates, such as in the incinerator in Schweinfurt, where the average temperature over a three-hour period never dropped below 1000 °C.

The external frame of the combustion layer sensor

The application of the combustion layer sensor may help to understand the processes occurring on the grate, and measured data concerning temperature profiles and flue gases concentrations may simplify computational modeling approach, when real input variables are considerably needed.



Concentration profiles of carbon monoxide, carbon dioxide and oxygen as a result of the experimental measurement in Rozenburg

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Rebuilding the reactor bed bottom

A major task to be accomplished by Vattenfall Nordic Heat in the NextGenBioWaste project was to rebuild the bed bottom design of the Idbäcken fluidized bed (FB) boiler in Nyköping. In the old construction, there were problems with e. g. metal parts that clogged the nozzles and caused sintering of the bed. This resulted in extra, unwanted stops in the operation.

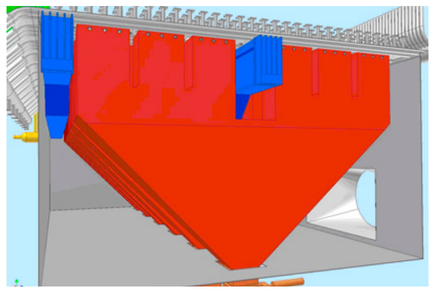
The metal parts enter the bed together with the demolition waste wood fuel that is used in the boiler. Since the wish is to increase the part of waste wood, something had to be done to manage the problems. In the project, different types of nozzles and different bed bottom designs have been studied. If the new bed bottom design works as expected, a yearly cost reduction of 1 M€ is possible.

Clogged nozzles

A new bed bottom design was installed during 2007. There were, however, still some problems with defluidisation of the bed and plugging of nozzles. A new sand hopper design and modifications of the nozzles were then proposed and installed in the boiler. The boiler was restarted in August 2008 and has worked well since then.

New nozzles

New bed bottom design



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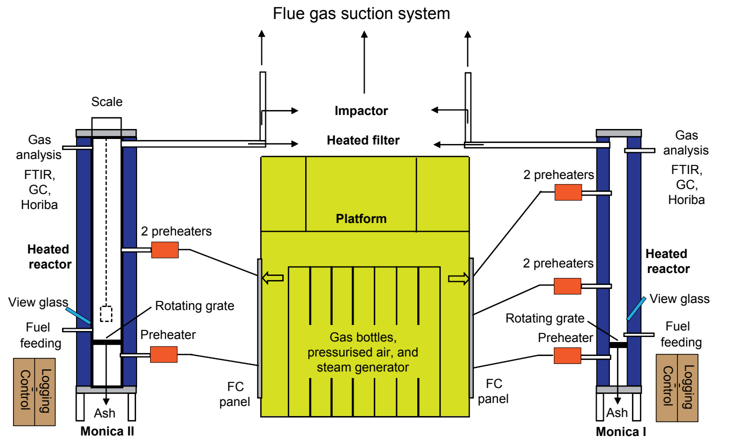
The multi-fuel reactors at SINTEF

A new, high temperature multi-fuel reactor was set up in the laboratory of SINTEF Energiforskning in Trondheim, Norway, in 2008. The multi-fuel reactor will be fed continuously with different solid fuels, through a feeding tube, being converted on a fixed grate. The reactor design is a 2 m total long vertical tube with an inner diameter of 0.10 m. The section above the grate, the reaction section, is 1.6 m long, while the ash bin section below the grate is 0.4 m long.



The two multi-fuel reactors at SINTEF

The reactor preheating temperature is up to 1300 °C. The high temperature preheating will give an opportunity to study high temperature NOx formation. The oxidant for the solid fuels will be preheated up to the reactor temperature in an external preheater and fed to the reactor through a tube in the ash bin section. Addition of preheated secondary and tertiary air is possible which will give an opportunity to study staged combustion. SINTEF Energiforskning has an another, similar reactor with a pre-heating temperature up to 1100 °C. This reactor has an additional macro-TGA function and a larger core diameter of 0.19 m. In this reactor, addition of preheated secondary air is possible.

The fuel-feeding system of both the reactors is based on a water-cooled piston. The fuel is fed from a rotating battery of fuel containers to the piston through a slot. The piston is pneumatically driven fast into the reactor where the fuel falls onto the grate. After feeding the reactor, the piston quickly returns to its previous position and the same process starts again. The fuel that is fed onto a grate that has two levels. The fuel is primarily combusted on the upper level. The fuel is gradually moved from the fuel-feeding inlet to a slot leading to the second level by rotating blades. Final burnout takes place on the second grate level before the ash is moved by rotating blades to a slot from where it falls to the ash bin.

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