BIOENERGY KNOWLEDGE CENTRE

Bioenergy Update JUNE 2007

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This issue of the Bioenergy Update has focused on policy and wood pellets as being two specific topics of interest at present. With the expected release in November of the New Zealand Energy Strategy and New Zealand Energy Efficiency and Conservation Strategy it is timely to ensure that bioenergy policy is closely promoted. If you would like specific topics to be researched for the next issue of Bioenergy Update please let us know.

Articles and Reports

Hotting up: The wood pellet heating market. Rakos, C. *Renewable Energy World*; Vol 7(4) July-August 2004 p152-161
Discusses the biomass heating market boom resulting from the introduction of wood pellet systems. Factors contributing to this success are discussed. Topics include: barriers and solutions faced by this market, cost comparisons, international developments and supportive policies to market development.
(To request email library@energylibrary.org.nz and quote **Bio3Rakos**)

Burning a path to the future. Atkins, J. *Environmental Finance*; Feb 2006 p22-25
Could biomass really solve Europe's supply and climate change problems? Atkins examines how government, farmers and the energy industry could construct an alternative energy future.
(To request email library@energylibrary.org.nz and quote **Bio3Atkins**)

Power generation using fast pyrolysis liquids biomass. Chiaramotia et al. *Renewable and Sustainable Energy Reviews*; V 11(6) 2007 p1056-1086
Power production from biomass derived pyrolysis liquids has been under development for the past few years. If technically successful, it would make decentralized bio-energy production possible. Several technologies and system components have been developed by academia, R&D organizations, and industrial companies in many countries. Much experience has been gained and many useful results published. The present work aims at reviewing the most significant experience in power generation from biomass liquids produced by fast pyrolysis processes. Power plant technologies addressed are diesel engines, gas turbines, and natural gas/steam power plants. Main results are reviewed and R&D needs identified for each technology. The analysis shows that even for the most promising solutions long-term demonstration has not yet been achieved. Pyrolysis liquid use in gas turbine plants and in co-firing mode in large power stations are technically most advanced. Recent work with diesel engines also appears quite promising.
(To request email library@energylibrary.org.nz and quote **Bio3David**)

Test of a small domestic boiler using different pellets. Dias et al. *Biomass and Bioenergy*; Vol 27(6) 2004 p531-539
This paper presents results from an experimental study performed on a 13 kWth commercial domestic boiler using pellets as fuel. Four different types of pellets were used and, for each one, the boiler was tested as a function of its capacity and the fan regulation affecting excess air. Measurements were performed for boiler heat load, pellets consumption rate, flue-gas temperature and composition. Mass balances allowed the calculation of the flue-gas flow rate and associated heat losses. Losses from incomplete combustion have also been quantified. Under boiler steady-state conditions the flue-gas O2 concentration changes with boiler load and ventilation due to the regulation scheme of the boiler. Flue-gas CO shows a minimum for values of O2 in the flue-gases of about 13%. NOx emissions are independent of excess air for low values of nitrogen in the fuel whereas, for larger values, NOx emissions increase with the O2 present in the combustion products. The fractional conversion of the pellets nitrogen into NOx is in line with literature data. The boiler start-up was characterised by the temperature evolution inside and above the bed showing the propagation of combustion in the bed during about 10 min. During boiler start-up, a maximum in CO emissions was observed which is associated with the maximum combustion intensity, as typified by the flue-gas O2 concentration and temperature, regardless the pellets type.
(To request email library@energylibrary.org.nz and quote **Bio3Dias**)

EN 303-5 Heating boilers. Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300kW Terminology, Requirements, Testing and Marking.
(To request this standard email library@energylibrary.org.nz and quote **Bio3-EN303**)

Tendency of wood fuels from whole trees, logging residues and round wood to bridge over openings. Jensen et al. *Biomass and Bioenergy*; Vol 26 2004 p107-113
Bridging occurs when solid biofuels such as wood chips form a stable structure across openings. This may cause a blockage to the fuel flow in feeding system of heating plants. This study investigated the bridging tendencies of a variety of wood fuel particles. Findings indicated that the proportion of particles longer than 100mm increased the tendency to bridge whilst a correlation between moisture content did not occur. Adaptations to the fuel preparations can be made to reduce and avoid bridging problems.
(To request email library@energylibrary.org.nz and quote **Bio3Jenson**)

Experimental modelling of a pilot lignocellulosic pellets stove plant. Moran et al. *Biomass and Bioenergy*; Vol 27 (6) 2004 p577-583
Small-scale stoves, producing heat and hot water, are suited for domestic purposes. In order to optimise their efficiency when using lignocellulosic pellets, an important task is to do research on their real performance. The general behaviour depends on many operational factors (air flow and humidity, pressure,…), dimension and pellets characteristics (moisture, size, raw material, density, friability,…). In this paper, the first results and general performance of a 24 kW pellet fixed bed stove pilot plant are presented. The plant has been designed to study pellet combustion in the laboratory. The main targets are to reduce emissions of pollutants and to improve energy efficiency. Different situations can be simulated and tested due to its flexible design. Temperatures, pressures, flows and emissions are measured and analysed. An extensive study of different load conditions is presented through the application of both an experiment design technique and the later statistical analysis of the results. Fuel characterisation is also presented.
(To request email library@energylibrary.org.nz and quote **Bio3Moran**)

A Woodfuel Strategy for England. *Forestry Commission England*; 2007
With a target to bring an additional 2 million tonnes to market annually by 2020 - which represents 50% of the estimated un-harvested available material in English woodlands - the following strategy was proposed. Topics covered include: Delivery of Government objectives, extracting the material for use in a sustainable market, an implementation plan to increase the amount of biomass available through the woodfuel supply chain, cost/benefit analysis.
(To request email library@energylibrary.org.nz and quote **Bio3ENGLAND**)

UK Biomass Strategy.
Published in conjunction with the Government's Energy White Paper to meet the commitment made in the 2006 Energy Review, this strategy brings together together current UK Government policies on biomass for energy, transport and industry and acknowledges the importance of fuels sourced from biomass in tackling climate change.
(To request email library@energylibrary.org.nz and quote **Bio3-UK**)

Special. Renewable energies. Hannover municipal services push biomass sales. Growth market on the offensive. (No author available) *BWK-Energie-Fachmagazin*; Vol 57(5) 2005 p8-9
(To request email library@energylibrary.org.nz and quote **Bio3Special**)

Industrial processes for biomass drying and their effects on the quality properties of wood pellets. Stahl et al. *Biomass and Bioenergy*; Vol 27(6) 2004 P 621
This paper contributes to the discussion of how different kinds of industrial scale dryers for biomass influence the quality properties of wood pellets. It also discusses how the drying technique can affect the environment. The most common biomass drying processes in use, i.e., convection dryers are discussed. The discussion of drying techniques is based on advantages and disadvantages with a focus on the drying medium, temperature and residence time. The choice of drying technique is particularly important if the end-user's choice of pellets is made due to the specific requirements for the heating system used. Some specific parameters were tested in order to investigate how the choice of drying technique affects the pellet quality. The parameters tested were moisture content and the emissions of volatile hydrocarbons. Pellets available on the market were chosen for the tests. The amount of volatile hydrocarbons left in sawdust after drying vary with drying technique, as emissions of terpenes are larger in dryers with long residence times. Low emissions of volatile hydrocarbons would improve the energy content of the sawdust, and by decreasing air pollution improve the work environment and the environment in the surroundings of the dryers.
(To request email library@energylibrary.org.nz and quote **Bio3Stahl**)

Co-firing drives European biopower. Klein and Spillati. *Environmental Finance*; February 2006
The authors examine how Europe's utilities are approaching biopower investment – and find a complex, fragmented, and slow-growing market plagued by regulatory and fuel supply issues.
(To request email library@energylibrary.org.nz and quote **Bio3Klein**)

IEA bioenergy: Bioenergy in Ireland. (No author available) *Biomass and Bioenergy*; Vol 30(3) 2006 IV-V
Current trends of renewable energy supply in Ireland are reviewed. Findings show that the major source for renewable energy is bioenergy, which is primarily in the form of wood residues. In addition, Co-firing of wood residues with peat for electricity generation and use of wood chips and pellets for heating are seen as important technologies. Developments in the liquid biofuels market are also discussed.
(To request email library@energylibrary.org.nz and quote **Bio3Ireland**)

Compressed, but expanding fast: An update on pellets. Jones. *Renewable Energy World*; May 2007
Reporting from discussion at the 2005 European Pellets conference, Jones talks about the pellet market which has had a worldwide increased in production by 40%.
(To request email library@energylibrary.org.nz and quote **Bio3Jones**)

Reasons for slagging during stemwood pellet combustion and some measures for prevention. Ohman et al. *Biomass and Bioenergy*; Vol 27(6) p513-520
Ash related problems have more than occasionally been observed in pellet burners during the last years. These problems lead to reduced accessibility of the appliances and also bad publicity for the pellet market. The objectives of the present work were therefore to: (i) determine the critical levels of the problematic ash components in stemwood pellets regarding slagging, (ii) document the variations of these problematic elements in the outgoing pellets from two pellet-mills during one operational season,

(iii) determine how frequently these elements exceed the critical levels, (iv) determine how different sub-processes in the pelletising process (especially the dryer) effect the slagging properties of the pellet, and if possible (v) suggest some measures for prevention. A significant number of wood pellets reported to be problematic and problem-free, regarding slagging in ordinary residential pellet burners, were collected from the Swedish market. The ash compositions of these fuels were analysed and the results compiled in a database. Partial Least-Squares Discriminant Analysis (PLS-DA) and *F*-tests were used to statistically identify both the critical ash components and the critical levels of these components that separated the two reported classes. In addition, chemical equilibrium model calculations were used to interpret the findings. The variations of these elements in the in-going raw material and in the produced pellets were determined during one season in two pellet mills equipped with exhaust gas dryers. The results showed that the problematic wood-pellets had a significantly higher amount of Si, but also Al and Fe, in the fuel ash. The critical level of Si (given as SiO_2) was about 20–25 wt% of the fuel ash, i.e. pellets with levels in or over this range resulted in slagging problems in residential burners. This critical Si content was exceeded once and twice for the analysed samples in the two studied pellet mills. In one of the studied mills, this was because of contamination by sand of the raw material during storage and handling, and in the other mill the reason was found to be contamination of the raw material by elutriated particles from the dryer fuel. The major conclusion of the work is that both raw materials and drying fuels/processes should be carefully treated to avoid mineral contamination, and an additional cyclone separator could potentially also be used to improve the pellet quality.
(To request email library@energylibrary.org.nz and quote **Bio3Ohman**)

Design and operation of an air-conditiong system fuelled by wood pellets. Kai et al. *Renewable Energy*; Article in press May 2007
(To request email library@energylibrary.org.nz and quote **Bio3Kai**)

Biomass Pyrolysis. Bridgewater. *Bioenergy Research Group*, IEA Bioenergy T34 2007.
Covers topics such as: Fast pyrolysis, reactors, by-products, pyrolysis liquid bio-oil applications of Bio-oil, transport fuels, and cofiring.
(To request email library@energylibrary.org.nz and quote **Bio3Bridgewater**)

Slagging tendencies of wood pellet ash during combustion in residential pellet burners. Öhman. *Biomass and Bioenergy*; Vol 27(6) M. 2004 p585-596
Ash related problems have more than occasionally been observed in pellet burners during the last years. These problems can lead to reduced accessibility of the combustion systems as well as bad publicity for the market. The objectives of the present work were to; (i) evaluate how different raw materials for pellets affect the accessibility of the existing burner equipment, (ii) determine which of the ash forming element(s) that could be responsible for the deposit/slagg formation and, (iii) estimate the critical slagging temperature for the different raw materials. Stored and fresh materials from sawdust, logging residues and bark were used as raw material in three different pellet burners. The results showed that the slagging properties were relatively sensitive to the variations in total ash content and ash forming elements of the fuel. It is therefore recommended that ash rich fuels like bark and logging residues should not be used in the existing residential pellet burners. Both fuel and burner type affected the amounts of ash deposit produced. The degree of sintering (i.e. the strength of the deposits) was mostly affected by the fuel composition. Subsequent controlled sintering

test of the produced deposits/slags showed critical slagging temperatures of about 850–900 °C for stored bark and about 1000 °C for fresh bark and stored and fresh materials from sawdust and logging residues. The results further indicated that the Si-content in the fuel correlated (relatively) well to the sintering tendencies in the burners. Chemical equilibrium models were used to interpret the experimental findings, and good quantitative agreements between modelling and experimental results were generally obtained.
(To request email library@energylibrary.org.nz and quote **Bio3Öhman**)

Status and perspectives of biomass-to–liquid fuels in the European Union. Kavalov and Peteces. *European Commission,* 2005
A technical and financial perspective on the viability of biomass to liquid fuels production for automotive applications in the EU.
(To request email library@energylibrary.org.nz and quote **Bio3Kavalov**)

Pellets to the rescue? New England Wood Pellet offers relief to nearly everyone. Therrien N, *Nothern Logger and Timber Processor*; Vol 54(11) May 2006, p12-14
(To request email library@energylibrary.org.nz and quote **Bio3Therrien**)

Comparison of different methods for the determination of moisture content in biomass. Samuelsson et al. *Biomass and Bioenergy*; Vol 30(11) 2006 p 929
The purpose of this study was to compare different methods for the determination of moisture in biomass. Twenty different biomass materials from various places in Europe were investigated for total moisture using oven drying in air at three different temperatures (80, 105 and 130 °C), distillation with xylene, and freeze drying. In addition, the materials were used for the comparison of different methods for the determination of moisture in the analysis sample. In all cases CEN TC335 Solid Biofuels—Methods for determination of moisture content—Oven dry method was used as the reference method.
(To request email library@energylibrary.org.nz and quote **Bio3Samuelsson**)

Economics and a policy option on wood pellet fuel in Japan. Yagi, K and Nakata, T. *Nihon Enerugi Gakkaishi*; Vol 85(6) June 2006, p451-460
(To request email library@energylibrary.org.nz and quote **Bio3Yagi**)

An economic analysis of bio-energy options using thinnings from overstocked forests. Polagye et al. *Biomass and Bioenergy*; Vol 31 (2-3) 2007 p105-125
The economic feasibility of producing bio-fuels and ultimately bio-energy by utilizing thinnings from overstocked forests is examined. Large areas of forest in the western US are severely overstocked with small diameter trees, and pose extreme risk for catastrophic wildfires. Physical removal ("thinning") of such small diameter trees is the best solution to the wildfire problem, and represents a potential raw material for the production of bio-fuels. Production of (1) wood pellets, (2) bio-oil, and (3) methanol all represent potential conversion pathways which would utilize unmerchantable forest thinnings as the feedstock. Wood can also be directly combusted, either in conjunction with another fuel such as coal or on its own to generate steam and electricity. This study examines the potential for accomplishing both forest wildfire reduction and the generation of energy using a single integrated pathway. The economic effects of thinning scale, thinning duration, and distance to end-use markets are quantified. Co-

firing of thinnings with coal is currently found to be the most viable option for transportation distances of less than 500 km. Beyond 300 km transportation distance, pelletization, fast pyrolysis, and methanol synthesis become increasingly cost competitive for different ranges of thinning yield and duration. Bio-energy options are economically preferable to landfill or open burning disposal of thinned biomass; however, revenue from bio-fuels will not cover the cost of thinning. Results for a range of thinning scenarios are visualized using technology maps.
(To request email library@energylibrary.org.nz and quote **Bio3Polagye**)

Existing Guidelines and Quality Assurance for Fuel Pellets; PELLETS FOR EUROPE. Hahn. UMBERA, 2004
(To request email library@energylibrary.org.nz and quote **Bio3Hahn**)

Web links

Avon and Somerset Biomass Heating Feasibility Study for the Innovations Programme. *CENTRE FOR SUSTAINABLE ENERGY,* June 2003
Click here to open link.

Bristol's biomass boiler project awarded for tackling climate change.
Click here to open link

The effect of Location and Facility Demand on the Marginal Coast of Delivered Wood Chips from Energy Crops: A Case Study of the State of Tennessee. Graham et al. *Proceedings, Second Biomass Conference of the Americas: Energy, Environment, Agriculture, and Industry;* 1995 p1324. **Click here** to access paper.

PELLET HEATING SYSTEMS for larger buildings. **Click here** to access article.

The Biorefinery Concept May 2007 IEA Bioenergy workshop.
This link provides nine power point presentations on relevant technologies and commercialisation processes. **Click here** to access webpage.

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