PyNe

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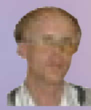
on page 5



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Vacuum Pyrolysis

- **In Canada**
  The Pyrocycling™ pilot plant represents the first phase of the industrial Pyrochem-Saquenay project, which will require a total investment of $40 million.
  See page 12.
- **In the UK**
  Border Biofuels gets permission to build a 20 MWe power station in Carlisle, Cumbria worth £35 million.
  See page 13.
- **In the Netherlands**
  Bio-oil is planned to be co-fired in a coal fired power station.
  See page 13.

The vacuum pyrolysis reactor with the oil recovery system.

SEPTEMBER 1999 **ISSUE 8**

Pyrolysis Network.

Analysis and Characterisation

A Round Robin test has been suggested to compare different test methods and their results to give a more precise specification for bio-oil and also compare procedures and techniques in different laboratories.

This was one of the items discussed at the Subject Group Workshop, which was held in Montpellier, France on 23rd and 24th April this year. Anja Oasmaa and Dietrich Meier, the convenors of the group, provide the summary of the outcome from this meeting on page 2 and Stefan Czernik provides a summary of the stabilisation and upgrading subject group workshop on page 3.

PyNe subject group Convenors: Anja Oasmaa and Dietrich Meier at the Analysis and Characterisation Workshop in Montpellier, France, April 1999.

NEW DATE

PITBC

This conference has had to be moved to **17 to 22 September 2000** but will remain at the same venue in Austria.

Further details are available on page 20.

ASTON UNIVERSITY

Comments and contributions are most welcome on any aspect of the contents.
Please contact your country representative for further details or send material to Claire Humphreys.

Contents

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Conference & Meeting Reports

Analysis and Characterisation Subject Group Workshop Montpellier, France 23rd–24th April 1999

By Anja Oasmaa, VTT, Finland and Dietrich Meier, IWC, Germany

The first meeting of this PyNe Subject Group was held in Montpellier, France in April 1999. The following topics formed the core of the workshop discussions:

- The most important characteristics of bio-oils for fuel oil applications and chemical production.
- Analytical and test methods that need to be developed.
- On-line monitoring and quality control methods.
- Round Robin analysis.

Important properties of bio-oils
For fuel oil use, the important properties for the end-users depend on the application. Chemical composition, oxygen-containing functionalities and molecular weight distribution play a major role in the instability of pyrolysis liquids.
The important properties for chemical production include flavour, odour, composition, reactivity and stability.

Method development
Gas chromatographic methods are fully developed and operable. HPLC is one of the best ways for polar and higher molecular weight compounds. However, it needs more development, especially the columns. Simple test methods for predicting the behaviour of pyrolysis liquids in fuel oil applications are needed.

On-line monitoring
On-line monitoring is particularly needed in the quality control of larger pyrolysis liquids production plants. The key parameters for control are water content and solids content. On-line analyses in toxicological compounds are also needed. The quantitative relationship between water content, pyrolytic lignin and low molecular weight amount was discussed. As a rule of thumb the ratio of water, water-solubles and pyrolytic lignin should be around 25:50:25. Other ratios may result in problems with phase stability.

Round Robin
A Round Robin will be organised later in 1999 to improve test methods and share experiences in analysing and characterising bio-oils. New feedstocks such as pine, straw and bagasse will be included as well as hardwood. Instructions for pyrolysis liquid handling and delivery have been agreed and will be circulated with instructions and guidelines. Various analytical methods from at least ten laboratories will be assessed, including fuel oil analyses, stability tests and chemical characterisations. The results will be published with recommendations for analytical procedures and preferred methods.

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Workshop on Stabilisation/ Upgrading of Bio-oils

By Stefan Czernik, NREL, USA

Summary

The workshop focused on two major topics: a quantitative measure of bio-oil stability and specifications for the PyNe Round Robin stability test.

Viscosity measurement for Viscosity Index

Instability

Instability of biomass pyrolysis liquids results from physicochemical processes and chemical reactions that occur in those liquids. These processes lead to the formation of larger molecules, which is not desirable, especially for fuel applications. The nature of molecular growth in bio-oils is very complex and difficult to describe quantitatively. However, the overall progress of the reactions can be relatively easily observed as a change in certain physical properties of bio-oils. The most obvious of those is viscosity, which for polymeric solutions is directly related to the size of molecules expressed as an average molecular weight. In addition, viscosity is a very important property for fuel applications that affects pumping and atomization of bio-oil.

It is generally agreed that the exposure of bio-oil to an extended contact with air is detrimental for fuel properties and should be avoided. It is also well known that even in a neutral atmosphere (sealed containers, nitrogen blanket) viscosity of bio-oils increases with time of storage. This increase can be measured and quantitatively expressed in different ways such as an absolute rate of change of viscosity (cP/h) a relative rate of change (h^{-1}) or a viscosity index. The viscosity changes accelerate at higher temperatures, which is in agreement with the principles of chemical reaction kinetics. However, there are many questions that still remain unanswered such as:

- What contribution to the viscosity increase is due to physicochemical processes such as micelle growth and agglomeration compared to that resulting from chemical reactions of polymerization and condensation?
- How will those two types of processes contribute to the global effect of the viscosity change at different temperatures?
- Will the chemical reaction effect be more dominant at a higher temperature?
- Can the changes observed at one temperature be used to predict those that occur at different conditions?
- Can a storage test carried out at a higher temperature for a shorter time provide any useful information on bio-oil stability at lower temperature?

Viscosity Index

Considering all the above points a viscosity index $(\mu_t-\mu_0)/\mu_0$ was agreed as a suitable measure of bio-oil stability to be reported at three specified storage conditions:

1. 50°C for one week (168 hours).
2. 80°C for 2-6 hours.
3. 80°C for 24 hours.

The bio-oil stability measure will be included in the Round Robin test being organised by the PyNe Analysis, Characterisation and Test Methods Group. It was recommended to use bio-oils generated at least ten days before the test and to report the age of tested oils.

Procedure

Bio-oil samples will be placed in sealed containers and stored ('aged') at temperatures of 50°C and 80°C maintained within ±1°C. The samples will be weighed before and after the storage to verify that volatile material has not been lost from the stored oils. The 'aging' tests should be repeated if weight losses greater than 0.5% are observed. Viscosity of fresh and 'aged' bio-oil samples will be measured at two temperatures of 25°C and 40°C using a viscometer type available in a participating laboratory.

Round Robin

Six values of the viscosity index (three storage conditions, two measurement temperatures) and the viscosimetry method used will be reported to the Round Robin organisers (Anja Oasmaa and Dietrich Meier – see page 2). Measurements of changes in other properties of bio-oils during storage such as flash point and ignitability had been suggested but were considered as less reliable (flash point) or difficult to conduct (ignitability). Besides, their relation to the changes in molecular structure of bio-oil is less obvious than that for viscosity.

Stabilisation

In addition, it was suggested that a relatively simple stabilisation method should also be included in the Round Robin. Stabilised oils would be subject to the same 'aging' test as 'crude' oils to evaluate efficiency of the selected stabilisation method. Possibilities for stabilisation include liquid filtration of the whole bio-oil and solvent addition, but agreement on procedures will need to be established before proceeding with a common exercise. This will be carried out later by recommending a stabilisation procedure and inviting interested laboratories to conduct and report on the stability test.

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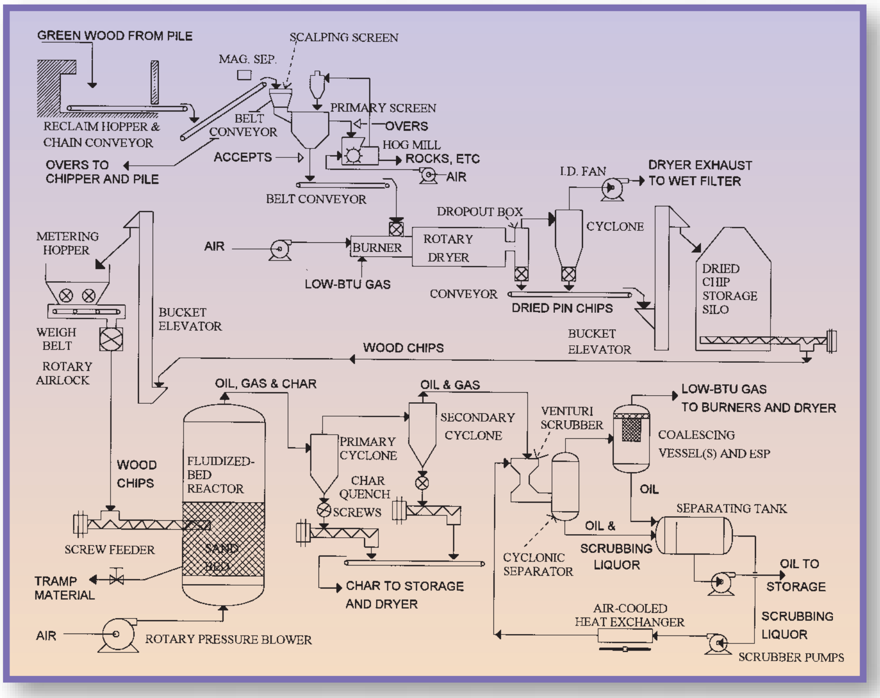
Biocarbons Corporation

By Andrew Himmelblau, Biocarbons Corporation, USA

Biocarbons Corporation is trying to commercialise the use of pyrolysis oil from biomass as a lower cost substitute for phenol in the water-resistant, phenol-formaldehyde (PF) adhesives resins used to make exterior-grade plywood and oriented strandboard, mainly in North America. The company has patented (U.S. patent 5,034,498) the use of an air-blown, bubbling fluidized bed reactor specifically to make (adhesive) resin products. To make oil samples for adhesive formulation and testing, a pilot plant is currently operated with a 7.6 cm diameter reactor (about 8 kg/hr feed), scaled down from an earlier, larger pilot facility (0.5 metres diameter, 450 kg/hr) that was operated by Energy Resources Corporation in the 1970's.



Overall process of oil production from biomass

While not competitive in terms of oil yield with respect to fast pyrolysis, an air-blown bubbling fluidized-bed reactor does not require indirect heating or heating by re-circulation to maintain reactor temperature. Temperature can be controlled rapidly over a wide range of operating conditions by adjusting the feed/air ratio. Almost all of the oxygen is consumed by combustion at the bottom of the bed. The feed near the top 'sees' mainly inert gas, and bed temperature variation is minimal – about 15ºC or less.

By operating the reactor above typical fast pyrolysis, oil-maximisation temperatures, a pyrolysis oil is produced that can be used whole in making a PF resin. Yield is about 25 weight percent, but selectivity is 100%; no product separation is required. Biocarbons Corporation's pyrolysis oil consists mainly of single ring aromatics derived from lignin plus furans and pyrans from the cellulose and hemicellulose.

A large number of compounds are present; no compound predominates. The average molecular weight is 133 Daltons. The average functionality (the number of molecular sites available for crosslinking with formaldehyde) is 2.0 versus 3 for phenol. All compounds identified to date with the exception of fatty acids from pine feedstock have at least one functional site for polymerization. About 10 mole percent of the oil consists of aldehydes, mainly benzaldehydes.

Biocarbons Corporation has had good success in substituting pyrolysis oil for 50 to 60 weight percent of the phenol in a typical adhesive resin formulation (with fillers and extenders) used for southern yellow pine plywood without odour problems and with conventional press times, i.e., throughput. The company believes it can produce biomass oil in commercial quantities at a cost of $(US) 0.23/kg from $22 per dry tonne feedstock. This translates after markup into a PF resin (solids) cost savings of 15 to 25%, depending on the amount of substitution for phenol and phenol cost. The potential savings for plywood and strandboard are $1.40 to $2.40/$m^3$, respectively, which are significant savings for commodity products. The pyrolysis oil would likely be sold as a raw material to adhesive manufacturers.

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Fineline Leads & Carbon Pigments made from Pyrolysis of Cellulose and Lignin Derivatives

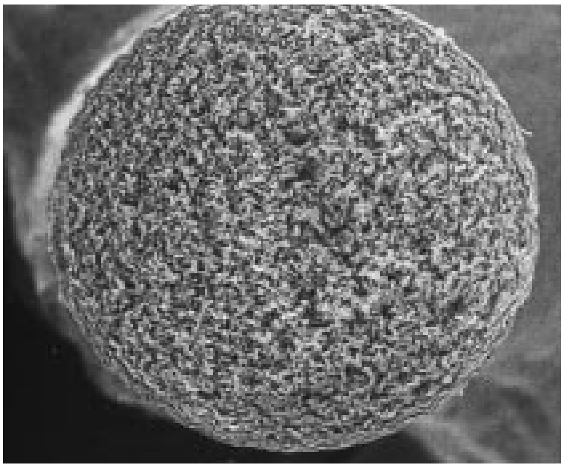
By Werner Handl, Staedtler Mars GmbH, Nuernberg, Germany.

Introduction

High-performance writing implements such as fineline leads, demand degrees of hardness and bending strengths which cannot be achieved by the usual technologies. For example, a bending strength of more than $250N/mm^2$ is needed for lead diameters of only 0.3, 0.5, 0.7 and 0.9 mm. Staedtler has been involved in the development and commercial production of carbon/graphite composite leads since 1976.

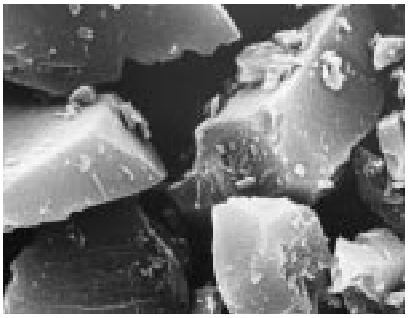
Process

The main feature of the process is the pyrolysis of water-soluble cellulose-derivatives and lignin-derivatives to carbon. Cellulose ethers such as hydroxy-methylcellulose or lignosulphonates are dissolved in water to form a highly viscous solution. Graphite is suspended in this solution. The complete mixture is then squeezed through nozzles with high pressure so that threads are produced. The speed used is greater than 2m/s to give the correct orientation of the graphite particles. The threads are then dried, cut and converted to carbon in special pyrolysis furnaces.



Scanning electron micrographs showing the morphology of lignin based carbon lead

The pyrolysis or carbonisation takes place according to a temperature programme, which is derived from the decomposition kinetics of the cellulose and lignin combinations. This reaction rate is determined by means of differential thermogravimetric analysis. The rate of heating is, for example, only 3°C/h. The temperature is increased up to a maximum of 1000°C. During this process the pyrolysis furnaces are constantly purged with nitrogen to remove the pyrolytic decomposition products and to protect the leads from oxidation. The leads consist of 99.9% carbon.



Scanning electron micrographs of typical low structure carbon pigment

Another development of Staedtler is the so-called in-situ pyrolysis. In this process polysaccharides and lignin derivates are converted to carbon pigments with special characteristics. For some applications carbon pigments with extremely low specific surface areas are required and normal carbon black cannot meet these requirements. In the in-situ pyrolysis, powdered polysaccharides such as starch or lignin derivatives are pyrolysed under an inert gas atmosphere in the above mentioned furnaces and the residual carbon is ground in a variety of grinding aggregates. In this process particle sizes of <1µm with a specific surface area (BET) of less than $10m^2/g$ can be achieved. These pigments are not only absolutel non-fading; they are also remarkable for their particular rheological behaviour.

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Hydrogen from Biomass by Catalytic Steam Reforming of Fast Pyrolysis Oil

By Stefan Czernik, NREL, USA

At present, hydrogen is produced almost entirely from fossil fuels such as natural gas, naphtha, and inexpensive coal. Renewable biomass is an attractive alternative to fossil feedstocks because of an essentially zero net CO_2 impact. Unfortunately, the hydrogen content in biomass is only 6-6.5%, compared to almost 25% in natural gas. For this reason, on a cost basis, producing hydrogen by a direct conversion process such as the biomass gasification/water-gas shift cannot economically compete with the well-developed technology for steam reforming of natural gas. However, an integrated process, in which biomass is partly used to produce more valuable materials or chemicals with only residual fractions utilised for generation of hydrogen, may be an economically viable option.

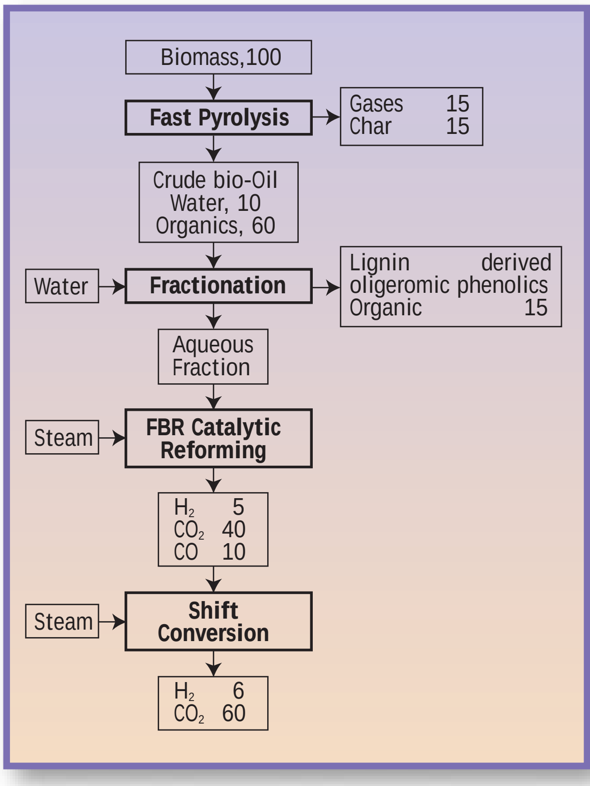

Figure 1. Outline mass balance of process for hydrogen production

The proposed method[1,2] combines two stages:

1. fast pyrolysis of biomass to generate bio-oil,
2. catalytic steam reforming of the bio-oil to hydrogen and carbon dioxide.

This concept has several advantages over the traditional gasification/water-gas shift technology.

First, bio-oil is much easier to transport than solid biomass and, therefore, the location of pyrolysis plants could be optimised considering the availability of low-cost feedstock while reforming would be carried out at a site with an existing hydrogen storage and distribution infrastructure.

The second advantage is the potential production and recovery of higher value added co-products from bio-oil that could significantly impact the economics of the entire process. In this concept, the lignin-derived fraction would be separated from bio-oil and used as a phenol substitute in phenol-formaldehyde adhesives while the carbohydrate-derived fraction would be catalytically steam reformed to produce hydrogen. Assuming that the phenolic fraction could be sold for $0.44/kg (approximately half of the price of phenol), the estimated cost of hydrogen from this conceptual process would be $7.7/GJ[3], which is at the low end of the current selling prices. An outline mass balance is shown as Figure 1.

Because biomass fast pyrolysis has almost reached commercial status, our work has focused on the catalytic steam reforming of bio-oil and its fractions. We successfully demonstrated that hydrogen could be efficiently produced by catalytic steam reforming the carbohydrate-derived bio-oil fraction using a commercial nickel-based catalyst in a fluidised bed reactor. The equipment is shown in Figure 2. Greater steam excess than that used for natural gas reforming was necessary to minimise the formation of char and coke (or to gasify these carbonaceous solids) resulting from thermal decomposition of complex carbohydrate-derived compounds.

National Renewable Energy Laboratory

At 850ºC the hydrogen yield was 90% of that possible for stoichiometric conversion during eight hours of the catalyst on-stream time. A yield graph is shown in Figure 3. This yield could be 5-7% greater if a secondary water-gas shift reactor followed the reformer.

Coke deposits were efficiently removed from the catalyst by steam and carbon dioxide gasification, which restored the initial catalytic activity.

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Figure 2. Bio-oil steam reforming unit

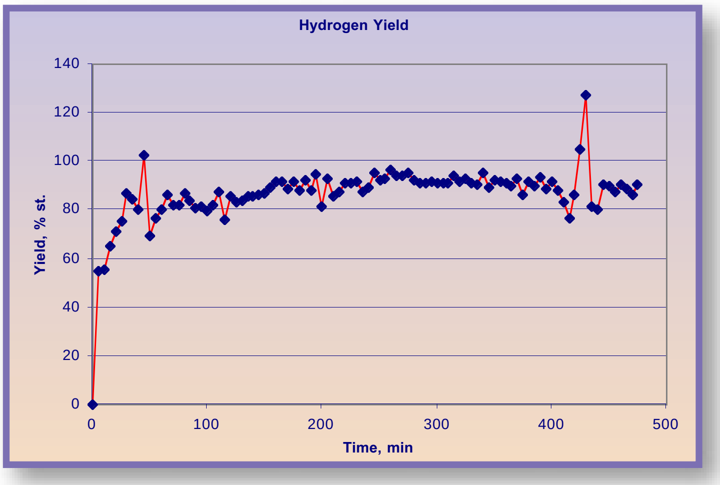

Figure 3. Hydrogen yield against time

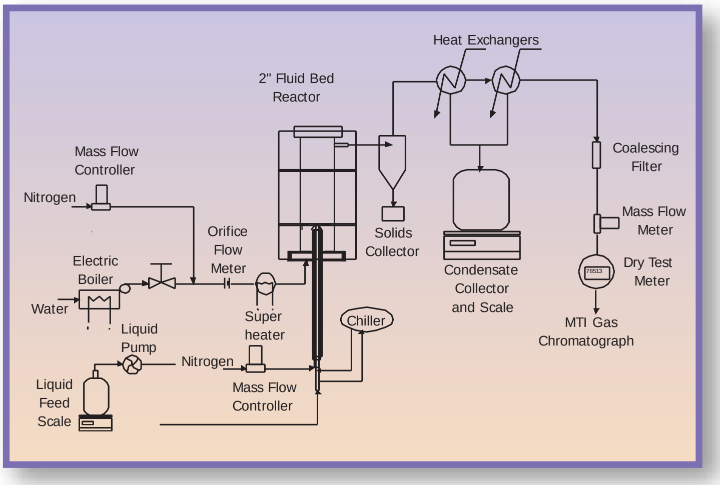

Figure 4. Flowsheet of bio-oil steam reforming unit

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2. D. Wang, S. Czernik, and E. Chornet, Energy&Fuels, 12 (1998) 19.
3. MK. Mann, P.L. Spath, K. Kadam, In Proceedings of the 1996 U.S. DOE Hydrogen Program Review, Miami, FL, May 1-2, 1996, NREL/CP-430-21968; pp. 249-272.

The importance of Bio-Energy to Ireland's future Energy Supply

By Pearse Buckley, Trinity College, Ireland

At the end of the millennium, Ireland is experiencing a period of considerable economic growth. While this is a welcome development, it is important not to lose sight of some of the concomitant dangers. Significant growth in an economy is often accompanied by increased levels of energy consumption. In this context a closer examination of the Irish situation highlights a number of worrying issues. These include a risk of failing to meet the National commitments on greenhouse gas emissions vis-à-vis the Kyoto accord and an increasing dependency on imported energy. Against this background, the development of bio-energy technologies is of great importance to Ireland in order to make the economic gains sustainable.

Current energy supply

While there has been some de-coupling of economic development and energy consumption, the recent growth in Irish economic activity has been accompanied by an expansion in energy consumption. A total primary energy requirement (TPER) of 9.7 million tonnes of oil equivalent (TOE) in 1991 has risen to 12.7 million tonnes of oil equivalent by 1998, an increase of more than 30% over the period. Figure 1 represents the breakdown by energy type of the TPER over these last eight years. It can be seen that the contribution made by oil is significant and increasing. Fossil and non-renewable energy sources account for 98% of the supply (if one accepts that peat is a non-renewable energy source – and there are arguments about this), with renewables amounting to an insignificant 2% of the total.

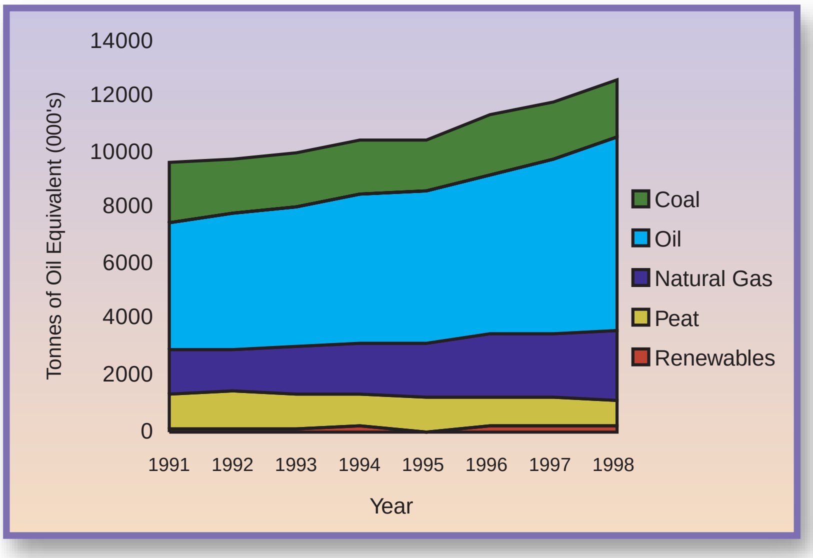

Figure 1. Make-up of Ireland's total primary energy requirement

Coal, peat and oil, which are major contributors to the energy supply, are significant producers of carbon dioxide on a per unit of useful energy basis. This aspect of these fuels is of concern in the context of the Kyoto accord, which limits Ireland to an overall increase in greenhouse gas emissions of 13% above 1990 levels, and this target to be achieved between 2008 and 2012.

The dependence on non-indigenous sources for energy supply is another characteristic of the situation in Ireland. In figure 2 it can be seen that there was an improvement in this dependency until the mid 1990s. The installation of an inter-connector gas pipeline to Britain and the approaching exhaustion of domestic natural gas supplies has resulted in a reversal of the trend since 1995. Imported energy plays a dominant role, which continues to grow in significance, and may account for greater than 90% of the total supply in the near future. In these circumstances the risks posed by political instability in distant parts are considerable and ever present.

Alternative sources of energy

An evaluation of alternative sources of energy in Ireland presents the following possibilities:

- Hydroelectricity
- Tidal energy
- Solar energy
- Wind energy
- Biomass

Of these, wind and biomass could make a significant contribution to the energy needs of the country. The technology for conversion of wind to electricity, for example, is well developed and the application is relatively straight forward. There is a down side, however, with many projects being opposed on environmental grounds, particularly related to visual intrusion. It is worth noting here that those areas of Ireland with the most favourable wind regimes for the installation of wind farms are also areas which are important tourist attractions.

Energy from biomass could make a major contribution to the energy supply through the utilisation of a variety of feedstocks. These range from wastes and residues (including municipal solid waste and agricultural wastes) to purpose grown energy crops such as short rotation forestry and specific types of grasses. The energy produced from these sources is effectively neutral in terms of greenhouse gas emissions and the production and conversion would occur within the country.

Developments in Biomass for Energy

In recognition of its potential, a number of initiatives have been taken in Ireland to develop biomass as a source of future energy supply. There is a new awareness of the value of waste for example. Forest residues, which heretofore have been left on the forest floor following thinning and clear fell, are being looked at anew as a significant resource, which could be converted to useful energy. More significantly, energy crops are being seen as having very great potential, particularly due to the likely availability of surplus land resulting from changes in the farming sector. Research into the most productive crop species and the critical factors influencing their productivity is continuing so that a sustainable and reliable fuel supply can be established.

The conversion of biomass has tended to focus on gasification with the production of electricity. The approach has been towards the development of small scale (< 0.5 MW_e), decentralised power generation units.

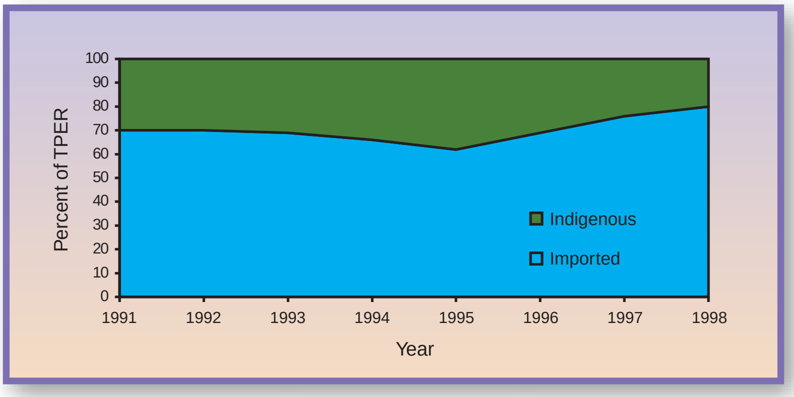

Figure 2. Indigenous/imported contribution to Ireland's energy supply

This approach is guided somewhat by the need to involve farmers in alternative activities in the exploitation of their lands. The production of power would allow a farmer to add value rather than being a producer of wood fuel for sale into an energy market where it would command a low return. To date, two pilot plants (100 kW_e and 200 kW_e capacity), converting wood to heat and power have been set up in Northern Ireland. It is hoped that these will serve as a basis for the development of niche markets for this approach to the exploitation of energy from biomass.

Pyrolysis and the production of a liquid fuel

The production of a liquid fuel from biomass by pyrolysis would be a very significant development from an Irish viewpoint.

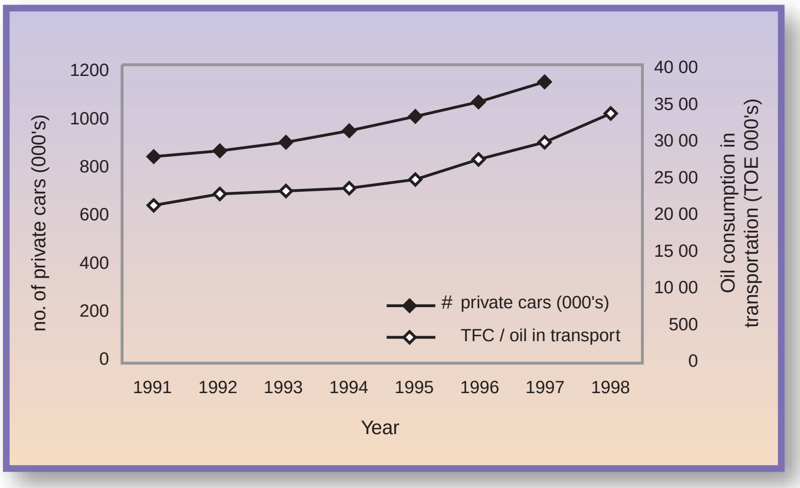

Figure 3. Private car ownership and consumption of transportation fuel

By reference to figure 3, it can be seen that the expansion in the economy has been accompanied by an increase in car ownership. This has been mirrored by a rise in the consumption of fuel in the transportation sector. The fuel to power this increased mobility has to be imported. It is clear that a reliable supply of transportation fuel is an important future consideration.

There is considerable capacity to produce biomass in Ireland, given the climate and the potential of the land. A study by Teagasc (the agriculture and forestry advisory body), for example, has indicated that more than 50% of the island is suitable for growing short rotation forestry.

Advances in fast pyrolysis are therefore of great significance. The transformation of biomass to a liquid fuel by this technology would achieve the twin goals of providing an environmentally more acceptable fuel and, at the same time, developing an indigenous source of energy for the country. Once fast pyrolysis to produce transportation fuels is developed to a commercial stage it will have a ready application in Ireland.

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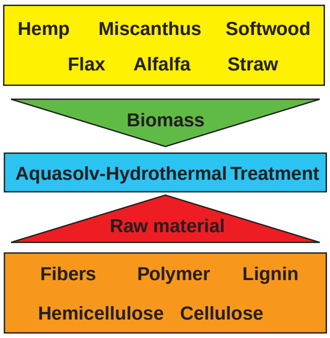
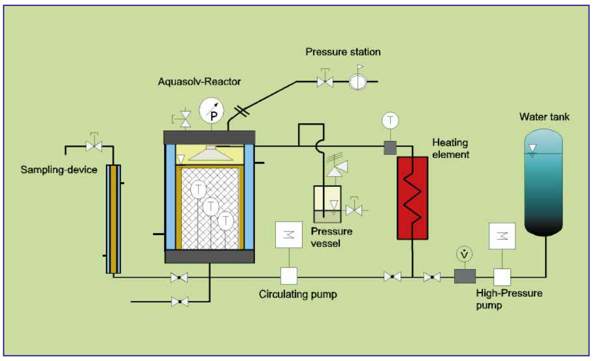


Aquasolv Technique®

A hydrothermal separation method for obtaining raw materials from biomass

By Alistair Brown, Fraunhofer ICT, United Kingdom



Aquasolv Hydrothermal System

The Aquasolv Technique® is a non-aggressive method for processing a variety of plant materials, for example wood, straw or grass, into a polymeric material with widespread applications in manufacturing. Temperatures up to 240°C and pressures up to 45 bar are sufficient to break biomass down into its component cellulose, hemi-cellulose and lignin. As the process uses only water as the solvent, it is particularly environmentally friendly. Currently a 10 litre batch reactor is in operation with a 100 litre semi-continuous reactor currently being commissioned. This will allow larger batch sizes to be produced suitable for small scale manufacturing of biomass derived polymer products.

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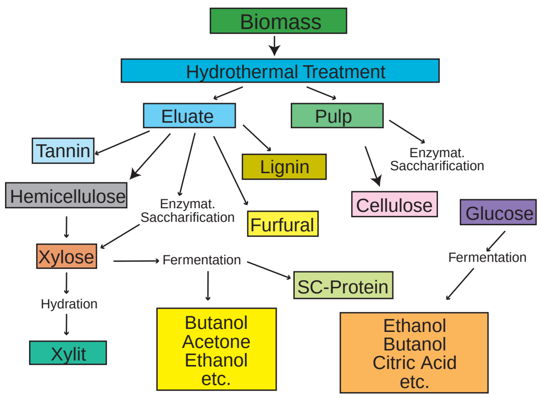

Product spectrum obtainable after hydrothermal treatment of plant biomass

PyNe Events

A regular programme of seminars, workshops and meetings is provided by PyNe. Anyone interested in attending or contributing to these meeting is most welcome. The programme of meetings is published on our **Website (http://www.pyne.co.uk)** and regularly updated. Details can also be obtained from Claire Humphreys at the address shown on page 2.

Recycling of Agricultural Materials as a Novel Slow Release Fertiliser

By Tony Bridgwater, Bio-Energy Research Group, Aston University, United Kingdom

An EC sponsored Research Contract valued at 1.55 million Euros was awarded in January 1999 and will run for three years. The contract partners are: Aston University (UK) – Co-ordinator, IWC (Germany), ADAS (UK), DIAS (Denmark), Levington Agriculture (UK).

Objectives

The overall objective of the proposed work is to recycle agricultural wastes and residues to produce a high added value slow release fertiliser for the horticultural and agricultural industries.

The Research Contract team viewing early results

This will be done by pyrolytic liquefaction with nitrogen addition through ammonoxidation and nutrient blending. The key feature is the total recycling of agricultural wastes and residues into a unique and valuable fertiliser that can be safely used in a range of agricultural and horticultural applications. This is a sustainable method of recycling agricultural materials into a useful and valuable non-food, non-fuel product. The product is flexible as a range of nutrients and additives can be included in the product as required for different applications. The pyrolysis process to be used to liquefy the agro-materials is a well-established technology. It produces no wastes as all the by-products are either used in the process as energy source, or contained as essential components of the resultant liquid.

Miscanthus used as feedstock in the process

Production of slow release nitrogenous fertiliser

Fertiliser production will be carried out by several methods including:

- Reaction of nitrogen containing compounds with pyrolysis liquid.
- Addition of the nitrogen containing compound to the biomass before pyrolysis.
- Direct reaction of nitrogen containing compounds within the pyrolysis process.

The products from the three routes will be tested and compared to determine the most effective fertiliser product and hence derive the most cost-effective process. The addition of other essential nutrients will also be investigated. Solid fertiliser products will be initially produced as a free flowing dark brown powder, but alternative product formulations will be investigated including liquid, granules and pellets. Product samples will be made from different feedstocks, under various reaction conditions and with various ammonia-oxidation reagents.

Tests of the slow release nitrogenous fertilisers

Growth trials on pot plants will be used to test the fertiliser samples in order to identify the most suitable product for growth using various criteria including nitrogen release rate, soil conditioning properties, level of application in the soil media, soil media substitution, release of micro-nutrients and toxicity. The fertiliser product will be extensively characterised. In addition, the fast pyrolysis by-product char can act as a fertiliser support media and also release the original inorganic elements present in the agro-industrial waste thereby also recycling micro-nutrients. Although the short-term focus is on the specialised slow release, higher added value fertiliser market, there are wider opportunities for general fertiliser production in the longer term.

Production and testing of larger quantities of slow release nitrogenous fertiliser

The most promising slow release fertiliser product from the evaluatory tests, as above, will be produced in quantities of 20-50 kg for larger scale field trials on suitable agricultural crops including miscanthus in Denmark and wheat in the UK.

Design, cost and evaluation of commercial-scale opportunities

The potential for the product will be evaluated for key market opportunities in Europe. Costs will be compared with those for other conventional slow release nitrogenous fertilisers and potential markets will be assessed.

Expected Results

The results will provide an assessment of the short, medium and long-term performance of the fertiliser in terms of release rate, degree of mineralisation of nitrogen, crop growth and other criteria. The project will provide a full technical and economic assessment of the process, based on specifications, designs and costs for a fully integrated demonstration/commercial plant.

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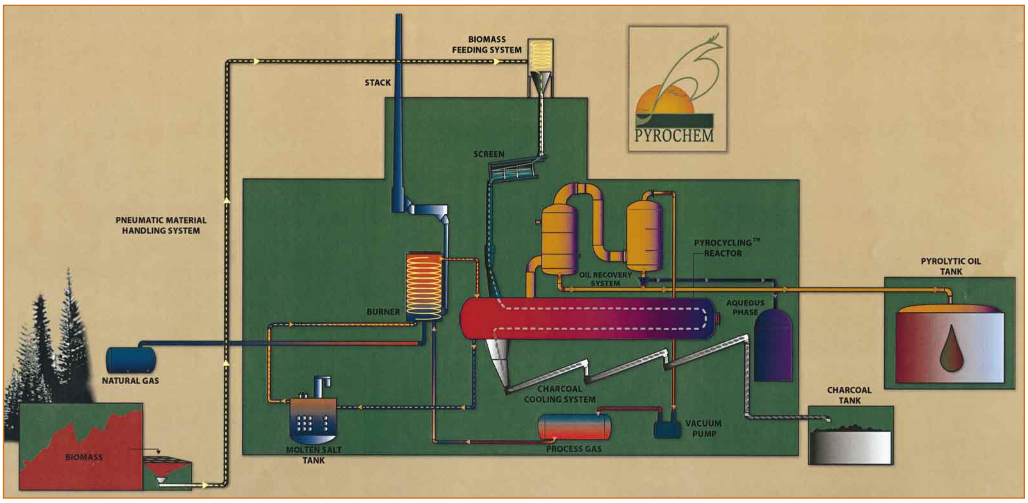
A Full Scale Pyrocycling™ Pilot Plant has been built in Jonquière, Québec

By Christian Roy, Pyrovac International Inc, Canada

Groupe Pyrovac inc. from Canada and Ecosun bv from the Netherlands have built the first Pyrocycling™ industrial scale plant in Jonquière, Province of Québec, Canada, based on vacuum pyrolysis technology. The plant which has a throughput capacity is 3.5 t/h of air-dry feedstock, has been constructed to demonstrate and further improve the technology and produce sizeable amounts of pyrolysis oils and wood charcoal. It will serve as cornerstone for the start-up of the Pyrochem-Saguenay plant, which will transform softwood bark residues into pyrolytic oil and wood charcoal. The pyrolytic oil will be used in the manufacture of phenol formaldehyde resins. The wood charcoal will be sold as a feedstock in the metallurgical and mineral industries.



The Pyrocycling™ Plant

The oil recovery system

General view of the plant

The plant has been designed and the project management done by Pyro Systems Inc., an affiliate of Groupe Pyrovac. In this pyrolysis process, the biomass is pneumatically conveyed to the vacuum feeding device and then introduced into the reactor. The pyrolysis reactor, which is 13m in length and 2.2m in diameter, operates in a continuous feed mode under vacuum using a patented feedstock moving bed transport and agitation system. The reactor heat source is process gas and natural gas. Molten salts are used as a heat carrier, which enables efficient heat transfer inside the reactor. The pyrolytic oils are recovered by means of two cooling columns, which are connected to a storage tank. The wood charcoal is cooled at the reactor outlet and conveyed to storage. The reactor is equipped with a vacuum pump to maintain the whole system under a total pressure of 10-15 kPa. Reactor safety is guaranteed by means of a nitrogen injection system in order to prevent any leakage of air into the reactor chamber. Vacuum pyrolysis of bark residues with 15% moisture yields approximately 29.5% pyrolytic oils, 29% wood charcoal, 10% gas and 31.5% water.

The plant will also enable the demonstration of a new electricity generation system. Groupe Pyrovac and Ecosun (see page 13) are developing the Integrated Pyrolysis Combined Cycle system in collaboration with Orenda Aerospace Corporation (see page 19), a Canadian company located in Mississauga, Ontario. Orenda's GT 2500 gas turbine is the first of its kind in the world to be fed with a bio-oil feedstock.

The CAN$ 9 million pilot plant was equally funded by Groupe Pyrovac and Ecosun in collaboration with Sodexfor, a limited partnership company, and SGF-Rexfor, a Québec government-owned holding society. The Pyrocycling™ pilot plant represents the first phase of the industrial Pyrochem-Saguenay project, which will require a total investment of $40 million.

For more information please contact:

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Border Biofuels

By John Seed, Border Biofuels Limited, Scotland, United Kingdom

Carlisle City Council has approved proposals promoted by Border Biofuels for a 20 MWe power station on a site near Carlisle, Cumbria, UK. The scheme will use vacuum pyrolysis (see Pyrocycling feature on page 12) to convert forestry residues and wood residues from primary forestry processing activities to liquid biofuel and char. This will fuel generation of 20 MWe at Carlisle with additional biofuel being exported to satellite facilities for the production of heat and power.

This plant will be the first of its kind in Europe using an integrated process technology incorporating, for the first time at a commercial scale, advanced technologies for fuel processing, fuel conversion, power generation and the distribution of biofuel from a central biomass processing facility to fuel satellite power generation.

The scheme has the benefit of a contract under Tranche 4 of the Non Fossil Fuels Obligation and, when operating, will contribute towards the UK Government's target of securing 10% of national electricity production from renewables by 2010. The plant will save the production of 250,000 tonnes of carbon dioxide into the environment per annum by displacement of more polluting fossil fuel generating capacity.

Growing Ambitions for Cleaner Energy

Border Biofuels was established in 1992 by a consortium of rural businessmen with a wide range of management, technical, engineering and marketing experience. The company was formed as a response to growing concerns over the environment and the decline in local economic activity in rural areas by encouraging the installation of commercially viable heat and power generation plants, using locally sourced non food crops and forestry residues as biomass fuel feedstocks.

Border Biofuels are currently developing seven co-generation projects around the UK that will have a total installed electrical capacity in excess of 70 MWe by 2002. The generation licences have been secured by Border Biofuels working in partnership with a number of major UK and European utilities, financial institutions, engineering and timber companies to develop commercially competitive biomass energy projects.

These co-generation projects will utilise advance thermal processing combined-cycle technologies to provide the highest possible levels of energy efficiency in an environmentally benign manner. They will also serve to create an annual demand for over 800,000 green tonnes of biomass that will help sustain the rural economy and serve to create and underpin the development of a UK-wide biomass energy industry for the next millennium.

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Ecosun

Bio-oil is planned to be co-fired in the Hemweg power station operated by the electricity utility UNA in the Netherlands. Pyrovac will provide vacuum pyrolysis units to process up to 123000 t/y wood and wood waste.

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IPT – The Institute for Technological Research

By Ademar Ushima, IPT, São Paulo State, Brazil

The Institute for Technological Research of São Paulo State – IPT (Instituto de Pesquisas Tecnológicas do Estado de São Paulo S. A.) – IPT, a corporation of the Government of the State of São Paulo, is one of the foremost technical research institutes in Latin America.

Figure 1. IPT's pilot plant for biomass pyrolysis

IPT started in 1899 as a Materials Strength Bureau at the Polytechnical School of São Paulo and this year is completing 100 years of existence. Nowadays, after administrative transformations occurred from then on, it is a non profit corporation linked to the Science, Technology and Economic Development Secretariat of São Paulo State.

The services IPT offers the community today can be summarised as follows: specialised technological services, which include tests, analysis and evaluations; elaboration of certificates and technical opinions; definition of standards and criteria; research, experimental development and engineering pilot-projects; manufacture of specialised equipment and components; dissemination of scientific and technical knowledge.

IPT, a pluridisciplinary institution that comprises dozens of research fields, has 72 different laboratories capable to realise more than 3,000 essays, tests and analysis. For this purpose IPT has nearly 1,300 employees, 900 of which are researchers and technicians.

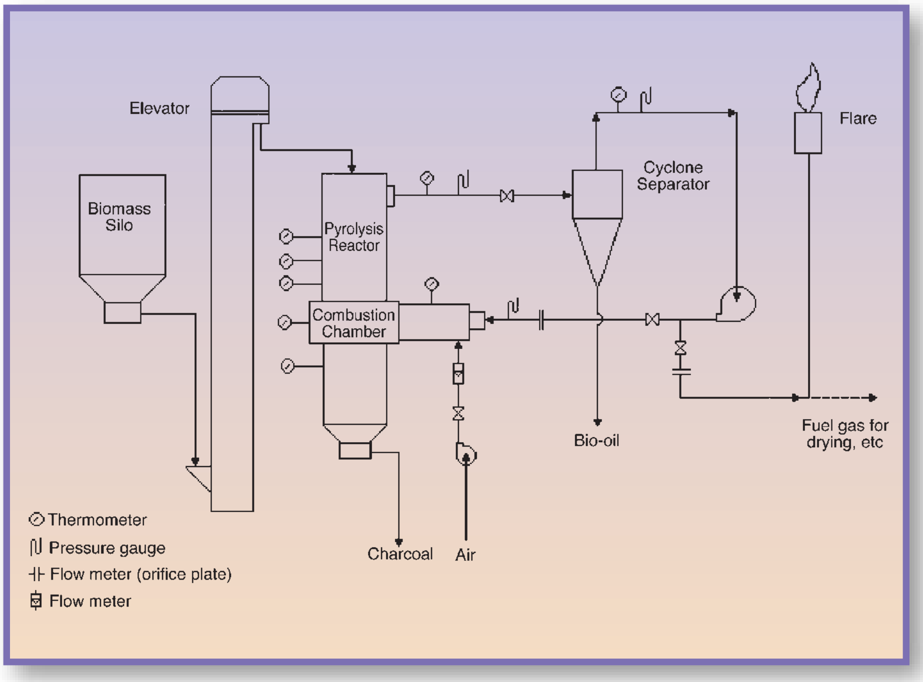

Figure 2. IPT's biomass pyrolysis process flow sheet

Figure 3. Babassu nuts

IPT is divided into 13 divisions and two of them, Mechanics and Metallurgy Divisions, have been working with biomass as an alternative fuel since the 60th decade. At the end of the 70th a continuous pyrolysis reactor pilot was built and is shown in Figure 1. A flow sheet of the process is shown in Figure 2.

Figure 4. Demonstration plant for babassu nuts pyrolysis

This reactor was planned to process 150 kg/h of wood chips or 450 kg/h of babassu nuts, which are shown in Figure 3. Based on the data acquired in this unit, a demonstration plant, with capacity for 1000 kg/h of babassu nuts was built at Teresina city (Piaui brazilian state). A picture of the installation is shown in Figure 4. It operated for two years and now is out of operation.

More recent developments in this area involve biomass pyrolysis modelling and simulation, high harvesting species ('elephant' grass) pyrolysis, biomass (sugar cane bagasse, rice husk, corn cob) bubbling fluidized bed gasification and combustion, etc.

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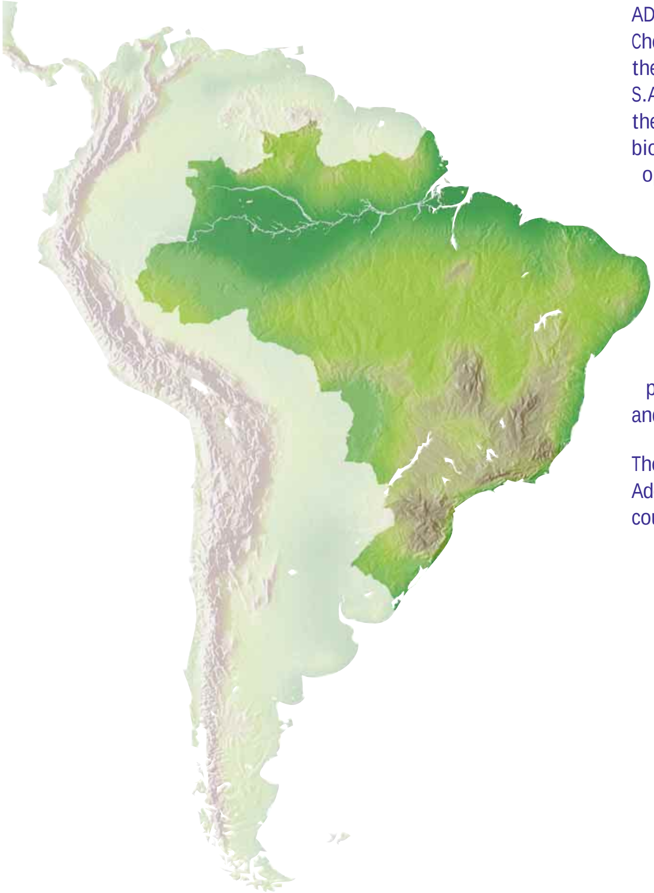
New member



ADEMAR HAKUO USHIMA graduated as a Chemical Engineer. He has been working at the Institute of Technological Researchers S.A. (IPT) since 1978. He has participated in the development of many projects involving biomass – design, construction and operation of a pilot and demonstration pyrolysis reactor for babassu nuts and wood chips; utilisation of grass as fuel in a cement kiln; burning of rice husk and corn-cob in fluidised bed; etc. More recently he developed a Thesis in the modelling and simulation of biomass pyrolysis and is presently responsible for the IPT's pyrolysis and gasification areas.

The PyNe Network would like to welcome Ademar to the group who will now be the country representative for Brazil.

Energy

By John Brammer, Bio-Energy Research Group,
Aston University, United Kingdom

Energy Prices 1998

Average prices 1/98–12/98, except *italics* part year only.

All liquid fuel prices in Euro/1000l.

All gas and electricity prices in Euro/100kWh (or Euro c/kWh).

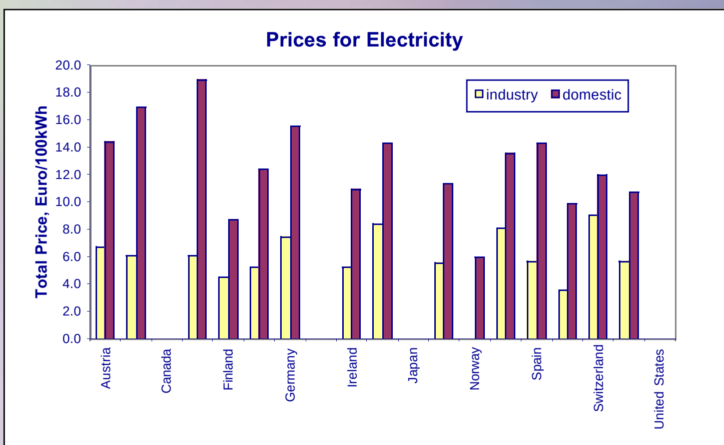
All currency conversions based on exchange rates as defined below 1 Euro = 1.122 US$, 1.973 DM.

Principal source: IEA Energy Prices and Taxes, 4th Quarter 1998 (ISBN 92-64-16197-X).

Secondary source: Erdol Energie Informationsdienst, Nos 5/99, 6/99
Brazil omitted as no 1998 data available.

Electricity

Country	***Electricity (Industry)***			***Electricity (Domestic)***		
	ex-tax	tax	total	ex-tax	tax	total
Austria	*6.73*		*6.73*			14.45
Belgium			6.06			16.94
Canada						
Denmark	5.03	1.05	6.08	7.54	11.45	19.00
Finland	4.10	0.38	4.47	6.55	2.18	8.73
France			5.24			12.44
Germany			7.46			15.63
Greece						
Ireland	5.30		5.30	9.76	1.22	10.98
Italy	*6.77*	*1.64*	*8.41*	*10.39*	*3.90*	*14.29*
Japan						
Netherlands	5.55		5.56	8.68	2.72	11.40
Norway				4.18	1.80	5.97
Portugal	8.14		8.14	12.93	0.65	13.58
Spain			5.72			14.27
Sweden			3.56			9.85
Switzerland	9.01		9.01	11.29	0.73	12.02
United Kingdom	*5.68*		*5.68*	10.26	0.52	10.77
United States	3.52			7.33		

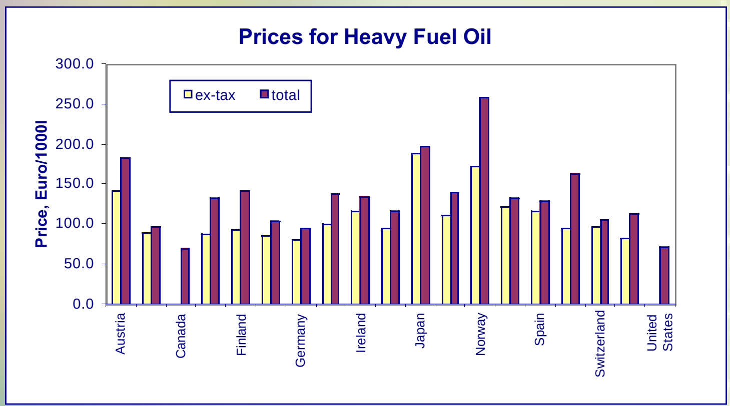


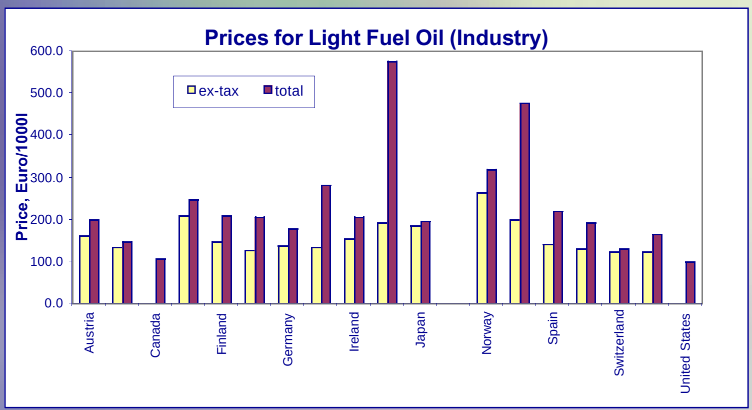
Prices & Taxes

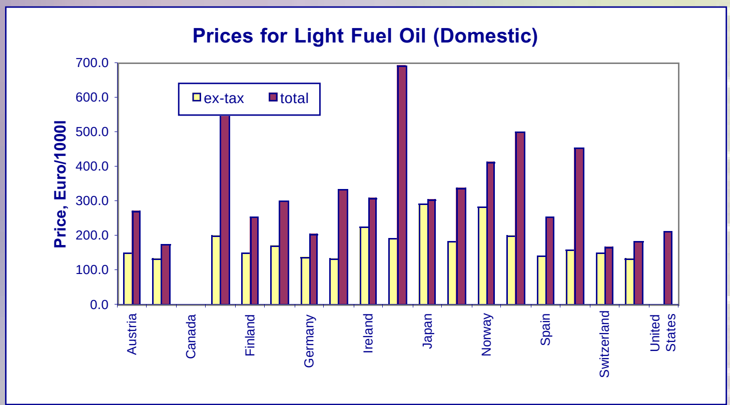
Fuel Oils

Country	***Heavy Fuel Oil***			***Light Fuel Oil (Industry)***			***Light Fuel Oil (Domestic)***		
	ex-tax	tax	total	ex-tax	tax	total	ex-tax	tax	total
Austria	*142.0*	*40.9*	*182.9*	*160.7*	*39.2*	*199.9*	148.7	120.2	269.0
Belgium	90.4	5.9	96.3	132.5	13.5	146.0	132.5	44.2	176.6
Canada			70.8			105.2			
Denmark	87.6	45.5	133.1	210.8	34.6	245.4	201.2	360.5	561.7
Finland	93.7	47.7	141.4	148.1	61.2	209.4	148.1	107.3	255.4
France	86.2	17.4	103.6	125.7	78.7	204.4	169.0	129.7	298.7
Germany	81.2	14.6	95.8	136.8	40.5	177.4	136.8	68.5	205.2
Greece	100.3	37.7	137.9	133.5	147.7	281.2	133.5	198.3	331.8
Ireland	116.9	17.7	134.6	155.3	52.0	207.3	223.6	86.5	310.1
Italy	94.5	22.2	116.7	193.7	383.8	577.5	193.7	499.3	693.0
Japan	188.8	9.4	198.3	185.5	9.3	194.7	290.1	14.5	304.6
Netherlands	110.7	28.7	139.4				183.5	152.0	335.5
Norway	172.2	85.7	257.9	265.6	52.6	318.2	282.2	129.6	411.7
Portugal	121.7	11.9	133.6	200.5	276.0	476.5	200.5	299.8	500.3
Spain	116.2	12.6	128.8	141.3	76.8	218.1	141.3	111.6	253.0
Sweden	*95.8*	*68.0*	*163.8*	131.2	59.3	190.5	159.8	292.4	452.2
Switzerland	*97.8*	*7.4*	*105.2*	122.3	8.4	130.7	149.6	18.6	168.3
United Kingdom	83.1	30.6	113.7	*121.8*	*41.7*	*163.5*	134.7	49.6	184.3
United States			72.3			99.0			213.9

Heavy fuel oil is low sulphur, except Canada, Ireland, UK and US (high sulphur)
Heavy fuel oil density 0.96 kg/l



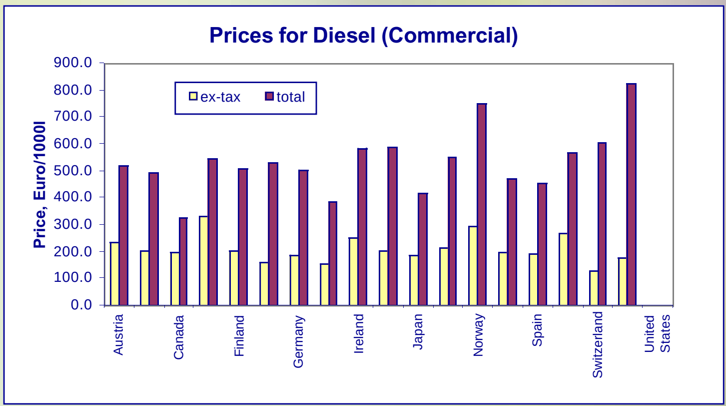


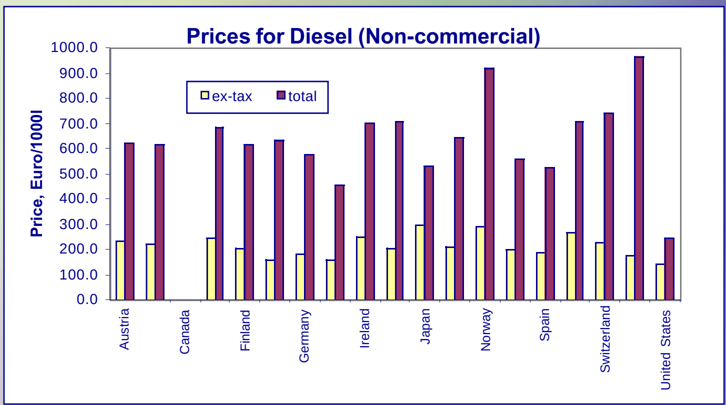


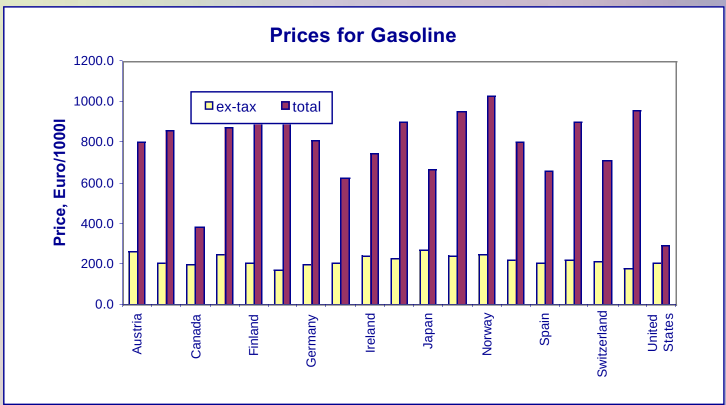
Transport Fuels

Country	Diesel (Commercial)			Diesel (Non-commercial)			Gasoline		
	ex-tax	tax	total	ex-tax	tax	total	ex-tax	tax	total
Austria	235.0	287.1	522.1	234.3	391.3	625.6	259.4	545.2	804.6
Belgium	205.9	287.3	493.3	221.1	394.1	615.2	208.0	651.6	859.6
Canada	196.5	128.0	324.6				200.7	182.1	382.9
Denmark	331.8	216.9	548.7	244.3	442.1	686.4	251.3	623.3	874.6
Finland	205.0	301.5	506.5	205.0	412.9	617.9	204.0	721.5	925.4
France	161.4	367.0	528.3	161.4	475.8	637.1	171.5	739.4	910.9
Germany	*189.0*	*314.2*	*503.2*	183.9	392.7	576.7	200.2	606.6	806.7
Greece	158.0	227.9	385.9	158.0	298.2	456.2	207.5	414.6	622.1
Ireland	252.2	329.6	581.8	252.2	451.2	703.5	238.3	507.0	745.3
Italy	204.9	383.5	588.4	204.9	501.1	706.0	229.0	675.7	904.1
Japan	189.3	228.1	417.4	296.9	233.6	530.4	266.9	398.3	665.2
Netherlands	213.8	335.9	549.7	213.8	432.0	645.8	238.9	710.4	949.3
Norway	292.5	457.7	750.2	292.5	630.2	922.8	247.0	783.2	1030.1
Portugal	200.5	273.5	474.0	200.5	357.0	557.5	219.0	584.7	803.7
Spain	190.6	263.1	453.8	190.6	335.7	526.4	206.8	453.5	660.2
Sweden	265.8	299.6	565.4	265.8	440.9	706.7	221.1	681.8	902.9
Switzerland	130.9	472.8	603.7	226.9	518.3	745.1	213.3	499.8	713.1
United Kingdom	175.9	647.3	823.2	175.9	792.1	968.0	178.8	780.3	959.1
United States				140.8	103.4	244.2	204.1	90.0	294.1

'Gasoline is premium unleaded 95 RON, except Canada (97 RON), Denmark (98 RON) and Japan (Regular)'

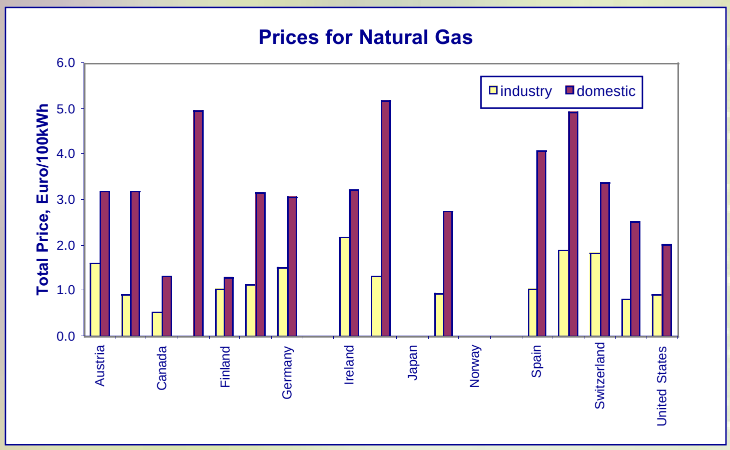






Gas

Country	Natural Gas (Industry)			Natural Gas (Domestic)		
	ex-tax	tax	total	ex-tax	tax	total
Austria			1.60	2.31	0.88	3.18
Belgium	*0.92*		*0.92*	2.51	0.67	3.18
Canada			*0.54*			*1.34*
Denmark				3.56	1.39	4.95
Finland	0.91	0.14	1.05	0.91	0.37	1.28
France			1.15			3.16
Germany			1.53			3.07
Greece						
Ireland	2.17		2.17	2.86	0.36	3.22
Italy	1.19	0.13	1.31			5.18
Japan						
Netherlands	0.88	0.06	0.94	1.96	0.78	2.74
Norway						
Portugal						
Spain	1.06		1.06	3.47	0.62	4.09
Sweden			1.89			4.92
Switzerland	1.81	0.02	1.83	3.14	0.23	3.37
United Kingdom	*0.81*		*0.81*	2.42	0.12	2.54
United States			0.92			2.02



Power Generation from bio-oil

From Ed Hogan, Natural Resources Canada, Canada

OGT2500 – 2.5MW Gas turbine engine

The Canadian Government is investing $1,167,000 in Orenda Aerospace Corporation to help develop a reliable power generating system based on firing bio-oil in a gas turbine. Orenda is the first company in the world to successfully demonstrate the feasibility of a turbine power generation system for industry, which is capable of operating on liquid bio-oil derived from feedstocks such as wood, grasses, waste paper and agricultural residues. This project will further advance the technology by:

- developing and testing commercial-scale systems for engine operation on bio-fuel;
- redesigning and refining the combustion system and;
- developing specifications for a full commercial-level power generation system.

This project furthers the development of a promising new technology to help reduce greenhouse gas emissions and allows Orenda to diversify into the fast-growing field of green power production. The technology is expected to reduce CO_2 emissions by 0.65 million tonnes per year by 2005 and 1.25 million tonnes per year by 2010, while also creating 19 new high technology jobs.

Orenda Aerospace Corporation is a Canadian-based company wholly owned by Magellan Aerospace Corporation, of Mississauga, Ontario. Orenda has an established reputation in power and propulsion technologies, with core competencies in gas turbine engine repair and overhaul, component manufacturing for turbine OEMs, reciprocating power plants, industrial power packages, and advanced energy systems. ***(see PyNe Newsletter 7, pages 5 and 6).***

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Further Complementary Publications

Bois/Holz Energie
(Quarterly newsletter in French and German)

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Fax: +33 3 84 24 17 07
Email: ajena@wanadoo.fr
Website: http://perso.wanadoo.fr/ajena/itebe

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Energy Management
(Subscription, 6 issues per year)

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Readerlink Ltd
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UNITED KINGDOM

N&RE European Briefing
(Published twice a year)

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Website: http://www.etsu.com

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Renewable Energy Report
Financial Times – Monthly analysis of global markets, finance and policy

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Website: http://www.nrcan.gxc.ca/es/etb/

A complete list of Complementary Publications can be found on the PyNe Website: http://www.pyne.co.uk/

Diary of Events

Information compiled by Claire Humphreys, Aston University, United Kingdom and Filomena Pinto, INETI, Portugal

Waste Management '99 International Conference and Exhibition

Venue: Kowloon Shangri-La Hotel, Hong Kong
Date: 20-21 September 1999
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Tel: +852 2574 9133
Fax: +852 2574 1997
Email: tracy@adal.com

3rd European Biofuels Forum International Conference and Trade Show

Venue: Palais des Congrès, Brussels, Belgium
Date: 11-13 October 1999
Contact: Conference & Exhibition Organisers, PO Box/B.P. 822, NL 3700, AV Zeist
Tel: +31 30 693 3489
Fax: +31 30 691 7394
Email: info@europoint-bv.com
Website: http://www.europoint-bv.com

Entrée 99 – Sustainable Use of Natural Resources – Co-operative Planning and Actions

Venue: Tampere, Finland
Date: 10-13 November 1999
Contact: Ms Marjukka Dyer, Tampere Polytecni, Teiskontie 33, FIN-33520, Tampere, FINLAND
Tel: +358 3 264 74 01
Fax: +358 3 264 74 47
Email: Marjukka.Dyer@tpu.fi OR EEEnetwork@netscape.net

6th Edition of the Romanian Environment Forum

Venue: International Conference Centre, Parliament Palace, Bucharest, Romania
Date: 16-19 November 1999
Contact: Adrian Relicovschi, PO Box 4-83/74126, Bucharest, ROMANIA
Tel: +40 1 320 21 39 or 320 27 24
Fax: +40 1 323 44 23
Email: gsf@ebony.ro

Millennium International Conference on Renewable Energy Technologies

Venue: Indian Institute of Technology Madras, Chennai, Tamil Nadu, India
Date: 9-11 February 2000
Contact: Dr C Palaniappan, Organising Secretary, 171/2 Madurai Kamaraj University Road, Rajambadi, Madurai Kamaraj University Post, Madurai – 625 021, INDIA.
Tel: +91 452 858607, 856020
Fax: +91 452 858607, 856020, 742886
Email: pen@vsnl.com OR pen@md3.vsnl.net.in

Renewable Energy for the New Millennium

Venue: Sydney, Australia
Date: 8-10 March 2000
Contact: The Meetings Manager Pty Ltd, PO Box N542, Grosvenor Place NSW, 1220, AUSTRALIA
Tel: +612 9241 2955
Fax: +612 9241 5354
Email: meetings@tmm.com.au
Website: http://www.esaa.com.au

Pyrolysis' 2000 – 14th International Symposium on Analytical and Applied Pyrolysis

Venue: Seville, Spain
Date: 2-6 April 2000
Contact: Secretariat general and registration, Viajes El Monte – Dpto. de Congresos C/ Santo Domingo de la Calzada, 5 –1ª , 41018 Seville – SPAIN
Tel: + 34 95 498 10 89
Fax: + 34 95 457 78 63
E-mail: congresos.itc@caymasa.es
Website: http://www.irnase.csic.es/py'2000/

5th European Conference on Industrial Furnaces and Boilers

Venue: Porto, Portugal
Date: 11-14 April 2000
Contact: INFUB, A. Reis, R. Gago Coutinho, 185-187, 4435 Rio Tinto, PORTUGAL
Tel: +351 2 973 46 24
Fax: +351 2 973 07 46
Email: conference@infub.pt
Website: http://www.infub.pt

International Exhibition on New Energy, Renewable Energy & Energy Saving 2000

Venue: Shanghai Exhibition Centre, China
Date: 18-21 April 2000
Contact: Shanghai Pudong Internation Exhibition Corporation, Coastal International Exhibition, Co, Ltd, Room 3808, China resources Building, 26 Harbour Road, Wanchai, HONG KONG, 26 38 3808
Tel: +352 2827 6766
Fax: +352 2827 6870
Email: general@coastal.com.hk
Website: www.coastal.com.hk

R'2000 – Recovery, Recycling, Re-integration

Venue: Ontario, Canada
Date: 5-9 June 2000
Contact: PEAK Ltd, Ms Maria Buhler, R'2000 Executive Director, Seefeldstrasse, 224, CH-8008, Surich, SWITZERLAND
Tel: +41 1 386 44 44
Fax: +41 1 386 44 45
Email: buehler@peak.ch

Biomass for Energy and Industry 1st World Conference and Technology Exhibition

a merger of:

11th European Biomass Conference and Technology Exhibition; 5th Biomass Conference of the Americas; Canadian Biomass Conference

Venue: Conference and Exhibition Centre, Sevilla, Spain
Date: 5-9 June 2000
Contact: EnergiaTA – Florence, Dr David Chiaramonti, Piazza Savonarola 10, I-50132, Florence, ITALY
Tel: +39 055 5002 174
Fax: +39 055 5734 425
Email: eta.fi@etaflorence.it
Website: http://www.etaflorence.it http://www.wip.tnet.de

Renewable Energy 2000

Venue: Metropole, Brighton, UK
Date: 1-3 July 2000
Contact: Reed Exhibition Companies

ISWA 2000 8th World Congress of ISWA

Venue: Paris, FRANCE
Date: 3-7 July 2000
Contact: Secrétariat pour le 8e Congrès Mondial de l'ISWA c/o AGHTM 83, Avenue Foch – BP 39 16 75761, Paris Cedex16, FRANCE
Tel: +33 1 53 70 13 53
Fax: +33 1 53 70 13 40

ENERGEX 2000 8th International Energy Forum

Venue: Las Vegas, USA
Date: 23-28 July 2000
Contact: Dr. Chenn Q. Zhou, Purdue University Calument, Department of Engineering, Hammond IN 46323, USA
Tel: +1 219 989 2665
Fax: +1 210 989 2898
Email: qzhou@calument.purdue.edu
Website: http://www2.regina.ism.ca/ief/index.htm http://www.energysource.com/ief/updates/

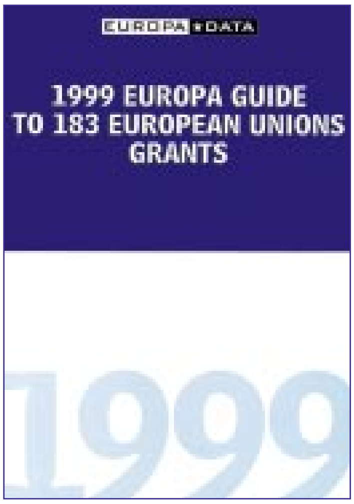
Progress in Thermochemical Biomass Conversion

Venue: Tyrol, AUSTRIA
Date: 17-22 September 2000
Contact: Prof. Tony Bridgwater or Miss Nina Ahrendt Bio-Energy Research Group, Aston University, Birmingham, B4 7ET, UNITED KINGDOM
Tel: +44 121 359 3611 (Ext. 4647 or 4633)
Fax: +44 121 359 6814
Email: a.v.bridgwater@aston.ac.uk ahrendtn@aston.ac.uk
Website: http://www.pyne.co.uk

Bioenergy for mitigation of CO^2 emissions: the power, transportation, and industrial sectors

Venue: Gatlinburg, Tennessee, USA
Date: 27-30 September 1999
Website: www.joanneum.ac.at/iea-bioenergy-task25

Book News



1999 Europa Guide to 183 European Union Grants

This has been devised as the comprehensive reference to European Community subsidies and grant funding programmes. The 1999 Europa Guide provides complete background information for all 183 of the European Union's funding programmes as well as practical advice and assistance on obtaining subsidies for your project proposals.

It includes 3 main parts which are:-

- **Guide to 183 European Union Subsidies**

  183 entries for 183 European Union subsidies, all updated and classified by theme. Provides contact information for programme supervisors, including 5th Framework programmes.

- **Directories of European Commission Civil Servants**

  From programme directors through to unit heads, complete contact information for all European Commission civil servants with power of approval for EU subsidies.

- **Guide to European Union Institutions and Policy**

  A comprehensive introduction to each of the various EU institutions and funding programmes; includes a practical guide to optimising your chances of obtaining funding.

Price: 160 Euros or FRF 1049.53

For further information please contact:

Europa Data
38 Rue de Bassano
F – 75008 Paris
FRANCE

Tel: +33 1 4431 2055
Fax: +33 1 4070 0130
Email: contact@europa-data.com
Website: www.europa-data.com

Free Renewable Energy Software available

Natural Resources Canada are pleased to inform you about the availability of a new software tool for evaluating renewable energy technology projects. This software, called RETScreen™, can be downloaded FREE OF CHARGE at the following web site:

http://cedrl.mets.nrcan.gc.ca/retscreen/

RETScreen™ is a standardised project pre-feasibility assessment software that facilitates the identification of cost-effective deployment opportunities for renewable energy technologies. The following models are currently available:

1. Wind energy
2. Small hydro
3. Photovoltaics
4. Solar ventilation air heating
5. Biomass heating

For further information please contact:

Tel: +1 450 652 4621
Fax: +1 450 652 5177
Email: rets@nrcan.gc.ca

European Financial Resources Guide

Renewable Energy Focus on Biomass Over 200 ways to finance renewable energy projects.

The aim of the guide is to help finance renewable energy projects in Europe. Renewable energy plays a key role in sustainable development targets of the EU and its member countries. As renewable energy is more expensive than traditional energy, financial incentives are brought into action. The European financial guide provides a clear and easy accessible overview of all these incentives.
Project developers can improve the economic feasibility of their initiatives assisted by the guide.

Price: 160 ECUs

For further information please contact:

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Schapenlaan 136
NL-2512 HX The Hague

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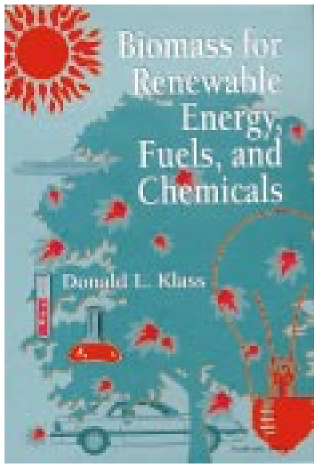

Biomass for Renewable Energy, Fuels, and Chemicals

D L Klass, Entech International Inc, Barrington, Illinois

Biomass for Renewable Energy, Fuels and Chemicals is an invaluable reference for researchers, who are interested in the technical details of biomass energy production, and also serves as a comprehensive introduction to the subject for the student and educator. The coverage and discussion are multi-disciplinary, reflecting the many scientific and engineering disciplines involved.

July 1998, 500pp
Price: £69.95
ISBN: 0-12-410950-0

Biofuels and Industrial Products from Jatropha Curcas

Proceedings from the Jatropha 97 Conference Edited by G M Gübitz, M Mittelbach and M Trabi

Jatropha Curcas (common name 'physic nut') is a drought resistant shrub or tree growing in many tropical and sub–tropical countries. Its seeds, toxic to humans and many animals contain a high percentage of oil used for candles, soap or biodiesel production.
In the book 'Biofuels and Industrial Products from Jotropha Curcas and other Tropical Oil Seed Plants' over 40 scientific contributions from both research institutes and the industry demonstrate the potential of under-utilised and neglected plants for example for biodiesel production, human and animal nutrition, pest control or fertilisers.

ISBN: 3-7041-0242-3

For further information please contact:

University of Technology
Graz
AUSTRIA

Website: www.cis.tu-graz.ac.at/biote/jatropha/proceedings.htm

OR

Proyecto Biomasa
Managua
NICARAGUA

Website: www.ibw.com.ni/~biomasa/

Book News continued...

Thermal Data for Natural and Synthetic Fuels

S Gaur, VSLR Sciences, Arvada, Colorado and T Reed, Colorado School of Mines, Golden, Colorado

100 samples of organic substances have been characterised under identical conditions by thermogravimetry and differential thermal analysis in addition to proximate analysis – providing accurate information essential in research and engineering applications related to fuel preparation.

The book discusses non-isothermal kinetic techniques, mathematical models, and other parameter estimation procedures that facilitate the extrapolation of results obtained under various conditions.

Price: **$150.00, 280 pp.,**
ISBN: 0-8247-0070-8
Marcel Dekker

Fast Pyrolysis of Biomass: A Handbook

A Bridgwater, S Czernik, J Diebold, D Meier, A Oasmaa, C Peacocke, J Piskorz, D Radkin

This handbook is an edited and updated version of the final report of the IEA Bioenergy sponsored Pyrolysis Activity – PYRA – that officially finished in 1998 and accomplished many valuable contributions to the science and technology of fast pyrolysis. It is intended that this handbook will provide a useful guide both to newcomers to the subject area as well as those already involved in research, development and implementation.

Published in the UK by CPL Press©
Aston University,
Bio-Energy Research Group, UK

Price: **£35**
ISBN: 1 872691 07 2
May 1999

Waste-to-Energy Trends in Europe

This report provides the findings of Juniper's 3rd Biennial Survey of the Municipal Solid Waste Incineration (MSWI) industry.
This survey is designed as a follow-up study to two earlier surveys carried out by Juniper in 1994 and 1996. The survey was sent to 274 MSQI sites across Europe – more than 90% of active sites in Western Europe.
Waste-to-Energy Trends in Europe: will provide you with the very latest information on MSW incineration today and an analysis of future trends – including operating practices, costs, recycling, residue management and capacity trends. This latest edition is an invaluable reference document for all those involved in waste management, environmental technology or alternative energy.

Price: **£150.00**
ISBN: 0 9534305 0 2

For future information please contact:

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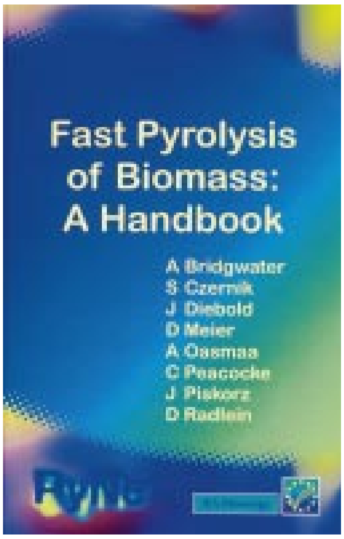
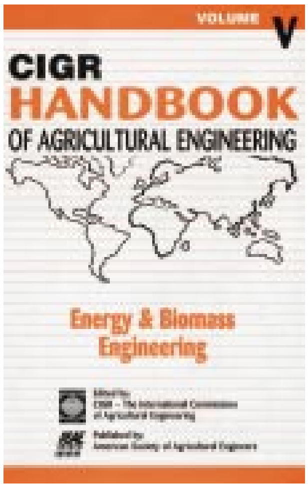


CIGR Handbook of Agricultural Engineering Volume V-Energy & Biomass Engineering

This handbook is designed to cover the major fields of agricultural engineering such as soil and water, machinery and its management, farm structures and processing agricultural, as well as other emerging fields. Information on technology for rural planning and farming systems, aquaculture, environmental technology for plant and animal production, energy and biomass engineering is also incorporated in this handbook.

Edited by: CIGR-The International Commission of Agricultural Engineering
Published by: American Society of Agricultural Engineers
ISBN: 0-929355-97-0



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PyNe Group in Montpellier,France,April 1999.

IEA Bioenergy

The PyNE newsletter is published by the Bio-Energy Research Group, Aston University, United Kingdom and is sponsored by the FAIR Programme of the European Commission DGXII and IEA Bioenergy.

For further details or offers to contribute, please contact Claire Humphreys (see inside front cover for details).