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The Ecological Aspects of Rotary Hydrodynamic Steam Generators with Vapour Phase Internal Separation

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The designs and operating modes of existing steam generators of hydrodynamic heating with vapour phase internal separation is presented. The simplest hydrodynamic and thermal models of liquids evaporation in them are proposed. The possibility of effective and economic low power heat sources development based on renewable energy direct conversion of water flows is displayed. The expediency of application of hydrodynamic steam generators with electric drive for heat supply of uninterrupted chemical plants alternately with cogeneration units in daily electricity consumption drop hours is proved.

Key words: steam generator, rotor, hydrodynamic heating, cavitational thermal emissions, rotating liquid annulus, renewable energy.

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Biofuel as Alternative Energy Carrier : Current Status, European Policies, Market and Production Level

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Biofuels could be an appropriate way to reduce green house gas (GHG) emissions and to reduce the amount of fossil fuels burned. Two most common types of biofuels which are being developed and presently available on a commercial basis, are Ethanol and Biodiesel along with their derivatives. Biodiesel is the biofuel with the most rapid rate of market growth. European biodiesel industry is well established with a significant continuous increase in its production. In order to support the use of biodiesel and biofuel World-wide, especially, in developing countries where fossil energy use GHG emission will rise exponentially, there is a utmost necessity for international co-operation. The questions of biofuel industrial production, financial incentives, legislation, investment potential et. al. will be discussed in this publication.

Key words: ethanol, biodiesel.

Використання біопалива може істотно знизити емісію парникових газів та скоротити кількість викопного палива, що спалюється. Найбільш поширеними та такими, що знайшли комерційне застосування, видами біопалива є біоетанол та біодизель з їх похідними. Застосування біодизеля характеризується найбільш активно зростаючим ринковим попитом, а Європейська біодизельна індустрія є стабільною з суттєвим постійним зростанням виробництва. Для забезпечення широкомасштабного, на світовому рівні, застосування біопалив, особливо в країнах, що розвиваються, де емісія парникових газів внаслідок використання викопних палив експоненційно зростає, вкрай необхідним є міжнародне співробітництво. У статті обговорюються питання промислового виробництва біопалива, фінансового стимулювання, законодавчої діяльності, інвестиційного потенціалу та ін.

Ключові слова: біоетанол, біодизель.

Introduction

Soaring oil prices have encouraged major consumers worldwide to sharply increase their use of «green» biofuels. The use of biofuels is increasing in many regions throughout the world.

It is worth to note that to meet the ever growing energy demand, biofuels appears to be one of the potential energy technologies that can help to resolve the energy problem as well as reduce the amount of carbon dioxide emission in the atmosphere. Two most common types of biofuels which are being developed are bioethanol and biodiesel.

Ethanol is alcohol produced from fermentation of biomass. A renewable fuel, ethanol is known as an «oxygenate» because it contains 35% oxygen by weight. Oxygen creates a more efficient burn thus enhancing the combustion of petrol in engines, and reducing exhaust emissions such as carbon monoxide (up to 33% depending on the age of the vehicle) and toxic hydrocarbon compounds. ***Methanol*** (though largely been replaced by ethanol in reformulated fuels) made from fossil fuels, is other well known oxygenate fuel.

Oxygenates thus reduce both regulated emissions and air toxins from motor vehicles as well as reducing emissions from motor vehicles which form ozone - exhaust and evaporative hydrocarbons. Ethanol contributes little to no net carbon dioxide to the atmosphere, thus contributing to a reduction in overall greenhouse gas emissions and global warming.

Biodiesel (or biofuel) is the name for a variety of ester-based fuels (fatty esters) generally defined as the monoalkyl esters made from several different types of vegetable oils, such as soybean oil, canola or hemp oil, or sometimes from animal fats through a simple transesterification process. Organically derived oils are combined with alcohol (ethanol or methanol) and chemically altered to form fatty esters such as ethyl or methyl ester. Ethyl or methyl ester can be blended with conventional diesel fuel or used as a neat fuel (100 % biodiesel). Biodiesel is the biofuel with the most rapid rate of market growth [1]. This renewable source is as efficient as petroleum diesel in powering unmodified diesel engine.

Ethanol and biodiesel are the only biofuels presently available on a commercial basis. There is no doubt that in most parts of the world the additional costs for producing biofuels make the fuel un-competitive without hefty tax rebates from governments but in view of the last year all-time highs crude oil prices beyond $ 145, biofuels certainly appears to be competitive.

The World biofuels production continues to grow at a rapid rate, with climate change back on the political agenda, investment pouring into the sector and sensitivity to issues of energy security more acute than ever before. According to IEA renewed estimation all biofuels, ethanol and biodiesel, had the potential to reach 10 percent of world fuel use for transport by 2025. The United States, the World's top oil consumer and No. 2 biofuel producer, set a target of doubling ethanol production to 8 billion gallons by 2012 whereas The European Union set a non-binding target of 5.75 percent biofuel content by 2010.

The challenge which now faces biodiesel and bioethanol producers is to move forward and take a share of the mainstream fuels market. In view of the facts stated above, the main objectives of this communication is to overview of R&D activities on biofuel in progress at Biomass laboratory at ENEA CR Trisaia along with other concepts such like financial incentives, legislation, industry, investment potential, etc., in Italy, will be presented.

Biodiesel in Europe: Current Production

Biodiesel has been produced on an industrial scale in the European Union since 1992, largely in response to positive signals from the EU institutions. European production level of biodiesel increased from 80,000 tonnes in 1993 to approxi-

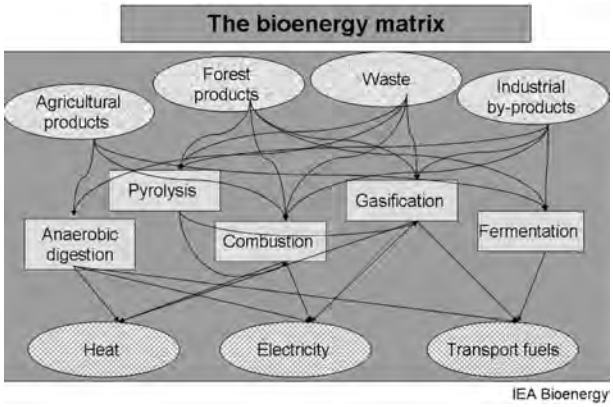

Fig. 1 Biomass conversion pathways to energy and fuels

mately 9,570 Kilo tonnes in 2010; about 5,5 % increase compared to the year 2009 [2]. For the production of biodiesel, the biomass feedstock (e.g. rapeseed, sunflowers) is processed at different specified sites. The: Rapeseed oil (84 %), sunflower (13 %), soybean oil (1 %), palm oil (1 %), and others (1 %) were the main World biodiesel sources in 2002. The European production of ethanol for application as an automotive fuel also grew significantly over the last decade or so. Today, there are numerous plants in the EU located in Germany, Italy, Austria, France and Sweden.

Main Players on the European Market

Germany, France, Austria, Sweden, Italy and Spain are the most important biofuel countries whereas Belgium, Denmark, Finland, Greece, Ireland, Luxembourg, The Netherlands, Portugal and the United Kingdom are countries where the production and application of biofuels is less developed. For detailed information on national market for biofuels for each of the above-mentioned country, please refer to [3–10].

Current Status of Biomass Technology

A simplified generalised bio-energy scheme indicating various pathways as well as competing applications of biofuels is shown in Fig. 1 while Fig. 2 shows a matrix of the various competing pathways. It can be stated that the bio-energy research community and the related industry have developed technologies that practically any type of biomass can be used for more than one type of conversion technologies after pre-treatment and upgrading to a fuel quality.

The EU — Biodiesel Industry (see Table 1):

— statistics (2009/2010 Production by Country). In 2009 production was increased by 16.6 % compared to 2008. In 2010 production was increased by 5.5 % compared to 2009. Subject to a +/− 5 % margin of error.

— production capacity during the year 2011 (Calculation based on 330 working days per year, per plant. The above figures represent an overall picture of the EU-27 biodiesel capacity on July 1, 2010). In 2010, the EBB indicates a production capacity of the order of 21,904 million liters/year (on the basis of 330 operating days per year) for a total of 276 plants (as of July 2010).

Table 1. Biodisel production in EU (2009/2010/2011)

Country	Biodiesel Production (1000 tonnes)			Country	Biodiesel Production (1000 tonnes)		
	2009	2010	2011		2009	2010	2011
Austria	310	289	560	Latvia	44	43	156
Belgium	416	435	710	Lithuania	98	85	147
Bulgaria	25	30	348	Luxemburg	0	0	0
Cyprus	9	6	20	Malta	1	0	5
Czech Rep.	164	181	427	The Netherlands	323	368	1452
Denmark/Sweden	233	246	250	Poland	332	370	864
Estonia	24	3	135	Portugal	250	289	468
Finnland*	220	288	340	Romania	29	70	277
France	1959	1910	2505	Slovakia	101	88	156
Germany	2539	2861	4932	Slovenia	9	22	113
Greece	77	33	802	Spain	859	925	4410
Hungary	133	149	158	Sweden	–	–	277
Ireland*	17	28	76	United Kingdom	137	145	404
Italy	737	706	2265	Total	9,046	9,570	22,117

* Data include hydro-diesel production.

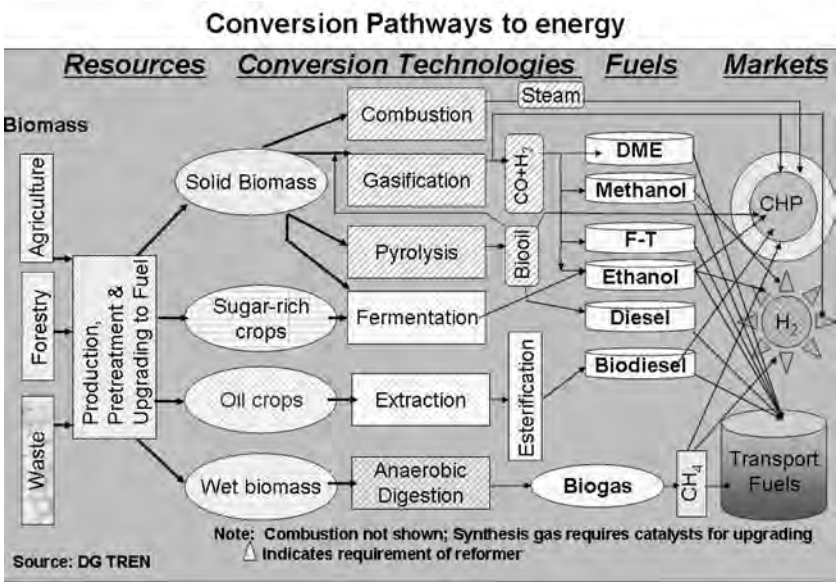

Fig.2. Simplified bio-energy matrix (IEA Bioenergy 2004).

Bio-energy technologies have achieved significant cost reductions during the past decade in areas such as combustion, co firing with coal, incineration of municipal solid waste, biogas generation via anaerobic digestion, and in certain geographical areas liquid biofuels such as ethanol and biodiesel. However, mainly due to many factors involved, it is simply not possible to generalise the production costs of biomass or biomass fuels delivered to the gate of a conversion plant and consequently the production cost of energy generated from biomass sources.

Some of the pathways shown in Fig.1, such as pyrolysis and the synthesis gas route for liquid biofuels, are still in the development and require 5–10 years further development work before they can be considered as commercial technologies.

Table 2 give the costs for liquid biofuels (2005a, IEA Bioenergy). As is evident from the table, the costs for bioethanol can vary between 0.17 to 0.67 Euro/litre, subject to the location and the crop/resource used to produce the biofuel. The cost for producing biodiesel can vary from 0.34 to 0.67 Euro/litre. For both biofuels there is potential to decrease the production costs further especially in Europe and the US with innovative combinations of technologies and utilisation of the process residues.

The gasification technologies are still in the development stage and very few reference operating plants exist, however, due to its flexibility in terms of final use of the fuel gas produced gasification may offer significant opportunities once the remaining technical barriers are overcome, reliability is demonstrated and the costs are reduced further.

European Market and Policies

Biodiesel is presently available on a commercial basis. The biomass feed-stock includes residuals from agriculture, forestry and cattle farming and so-called energy crops. Residuals are, for example, straw from cereals, plant residuals from the flower sector, wood residuals from forestry, fertilisers and animal waste. But organic fractions from municipal and industrial wastes can serve as resources for biofuel production as well. Furthermore, energy crops that are grown especially for bio-energy purposes can be applied for both biofuels production and electricity and heat generation. These crops include perennial plants, such as trees (e.g. willow, poplar) and grasses (e.g. miscanthus). So producers of biomass can be found in a broad range from cattle farmers to wood companies, from households to industries, from flower producers to specialised crop farmers.

The commercial marketing of rapeseed oil methyl ester as a fuel for use in diesel vehicles began about ten years ago. With regards to the produced quality and sales, the beginnings were initially very modest. Particularly, in countries where the marketing of pure biodiesel was intended from the beginning, this development was borne initially by a few idealists, who preserved their courage despite setbacks. The entry to the market was extremely difficult due to lacking ap-

Table 2. Costs for liquid biofuels

Country	Resource/Crop	Reference year	Production cost (Euro/litre)
Bioethanol			
US	Corn	2004	0,27–0,46
France	Sugar beet	2001	0,52
Brazil	Sugarcane	2003	0,17
UK	Sugarcane	2003	0,67
US	Wood	2004	0,33–0,42 *
Sweden	Wood	2002	0,51
Sweden	Straw	2003	0,63
Biodiesel			
US	Oilseed	2003	0,52
US	Oilseed	2004	0,52–0,67
EU	Oilseed	2003	0,64
Germany	Oilseed	2004	0,55–0,64
North America	Used oils/fat	2004	0,34–0,50

* Estimate.

provals and a price relatively high in comparison with diesel fuel. Two factors have significantly determined the further penetration of the market.

The European policy affects the national governments of the EU Member States, which have to develop national policies in order to realise the European targets. These policies influence the whole market from biomass producer, to biodiesel producer, to the seller.

The European and national policies also provide incentives for research institutes to investigate the recent and future developments in the market of biodiesel. Oil companies also do this to find out what their opportunities are in this new fuel market. These companies take care of the marketing of this fuel to their customers at their service stations. Besides this, they are in contact with car and engine manufacturers. This collaboration is very important since the engine and the fuel used in the engines have to be compatible. The car manufacturers have to communicate the use of cars with these engines to their customers.

Legislation at the European Level

Directive on the promotion of the use of biofuels or other renewable fuels for transport (Directive 2009/28/ec of the european parliament and of the council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC Directive 2003/30/EC)

The transport sector with more than 30 % of final energy consumption in the Community is certainly bound to increase with subsequent enormous carbon dioxide emissions. The Commission White Paper «European transport policy for 2010 » expects CO_2 emissions from transport to rise by 50 % between 1990 and 2010, to around 1113 million tonnes, the main responsibility resting with road transport, which accounts for 84 % of transported related CO_2 emission. EUROPEAN UNION, White Paper therefore calls for dependence on oil (currently 98 %) in the transport sector to be reduced by using alternative fuels such as biofuels.

The use of biodiesel is affected by legislation and regulations in all countries. Draft European Parliament and Council Directives aims at promoting the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes in each member state, with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources.

In the Explanatory Memorandum of the directive proposal on the promotion of the use of biological fuels in transport, the objective and the scope of the directive are illustrated. Moreover, the production costs and benefits in terms of CO_2 emission avoidance and increased security of supply are discussed and quantified. Also, it sets a minimum percentage of biofuel to replace diesel or gasoline for transport purposes in each member state.

Directive 2009/30/ec of the european parliament and of the council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.

Directive for a Reduced Rate of Excise Duty on Biofuels

This proposal for a Council Directive sets out a new framework of taxation for biofuels. It is explained that within the taxation framework on energy products, automotive fuels are taxed in three ways: excise duties (proportional to the physical quantity of the product), dedicated taxes and duties and VAT (proportional to the selling price of the product). Two other EU Directives, one on the harmonisation of the structures of excise duties (92/81/EEC) and the other on the approximation of the rates of excise duties (92/82/EEC) set a minimum rate of tax for each mineral oil.

Reduction of excise duties should be proportional to the percentage of biofuel incorporated in the fuel or end product. Member States are asked to set up excise reduction mechanisms, which take account of changes in raw material prices in order to prevent over-compensation for the extra cost of manufacturing biofuels. In this way, competition is guaranteed, as is the incentive of a reduction in costs for producers and distributors of biofuels. The proper functioning of the internal market and the achievement of the objectives of other Community policies require minimum levels of taxation to be laid down at Community level for most energy products, including electricity, natural gas and coal (taxation of energy products and electricity; DIRECTIVE 2003/96/EC).

Investment potential

A pre-set target share of 12 % from renewables in total energy consumption by 2010 will have economic opportunities for new industries and new industrial and craft jobs through production, installation and maintenance of such energy systems. To reach both the overall target and the sector targets, which is feasible, specific support actions for some technologies such as biomass to be taken soon. Using biological fuels or other renewable fuels to replace diesel or petrol for transport purposes in each member state can guide policy-makers and send important signals to the investors. Moreover, the implementation of proposed biofuels directives described above «without any delay» will certainly needs a considerable amount of investments in this sector.

Given the present state of market progress and a strong political support, it is worth mentioning that concrete steps needs to be taken to achieve significant contribution from biofuels toward energy consumption in the transport sector. By 2020, the CO_2 reduction from renewables will be 728 Mt, which represents a decrease of 17,3 % of the total GHG emissions in 1990 in the EU-15. It is emphasised that the objective of the entire strategy is the achievement of a low-to zero-emission transport sector.

Legislative resolution on the Commission communication on alternative fuels for road transportation and on a set of measure to promote the use of biofuels has already been forwarded to the Council and the Commission of the European Union.

Moreover, to meet its targets for renewable energies, a marketing report produced by the European Renewable Energy Council has predicted an overall investment of Euro 443 billion (by the year 2020), in Europe.

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Биотопливо как альтернативный энергоноситель : Современное состояние, европейская стратегия, рынок и уровень производства

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Использование биотоплива может существенно снизить эмиссию парниковых газов и сократить количество сжигаемых ископаемых топлив. Наиболее распространенными и нашедшими коммерческое применение видами биотоплива являются биоэтанол и биодизель наряду с их производными. Применение биодизеля характеризуется наиболее активно растущим рыночным спросом, а Европейская биодизельная индустрия является стабильной с существенным постоянным ростом производства. Для обеспечения широкомасштабного, на мировом уровне, применения биотоплив, особенно в развивающихся странах, где эмиссия парниковых газов вследствие использования ископаемых топлив экспоненциально возрастает, крайне необходимым является международное сотрудничество. В статье обсуждаются вопросы промышленного производства биотоплива, финансового стимулирования, законодательной деятельности, инвестиционного потенциала и др.

Key words: биоэтанол, биодизель.

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