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BIOMASS – AN IMPORTANT RENEWABLE SOURCE OF ENERGY IN ROMANIA

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Abstract

At the beginning of 3rd century the humankind finds at a crossroads. Daily, people assist at miracles, live in a time of change, both in economical and rational areas. Energy demand is expected to increase steadily over the next couple of decades, as income levels and economic output expand, especially in the new democratic states after '90th.
Renewable energy resources represent a new opportunity in Romania, with less participation in the market than those forums outside of the country borders, but with developing perspectives in the future. In present in Romania it doesn't exist a very well established renewable resources industry, but only small scale projects or developing pilot projects of some developing institutes or small companies could be mentioned. Energy renewable resources capitalization could contribute to achieve some strategic objectives regarding increasing security of energy supplying by diversifying energy resources and reducing of imports, and for a sustainable developing of energetic sector and environment protection. Renewable energy resources from biomass could be o good solution for heating in rural zones. Biomass potential in Romania is expecting to increase in 2005-2010 trough re-forestations with various trees species and short term re-afforestation. In this paper the advantages of using biomass for energetical purposes and the technological level achieved by conversion processes of biomass in energetical products are presented.

Keywords: biomass, conversion, environment, renewable resources, sustainable development

1. Introduction

The interest in using renewable energy resources increases more and more in the past decades. Because the known fossil resources (oil, natural gasses and others) are considered almost exhausted, the only chance of human kind for the near future remains the renewable resources. Even if governments adopt dynamic policies to conserve energy, the demand continues to increase.

Energy problems are today so acute at the international level that it is no longer possible to satisfy the world's constantly growing needs by continuing to exploit, as before, too limited a range of resources. This growth of energy demand must be increasingly satisfied by diversified energy resources, including sustainable and renewable sources (Tripsa, 2006; Buzdugan and Tripsa, 2006; Gavrilescu and Chisti, 2005).

Another phenomenon, which threats the whole humankind is the climate change and global warming of Earth due to greenhouse effect, determined by increasing the content of the so named greenhouse gases (CO_2, CH_4, NO_x) in the upper layers of atmosphere. Earth global warming determines the appearence of some dangerous meteorological phenomenons: hurricanes, tornados, higher and unexpected floods, El Niňo phenomenon

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of which dimension is higher every passing year, giving rise of huge damages, agricultural fields emptiness on higher altitudes.

Biomass resources include wood and wood wastes, agricultural crops and their waste byproducts, municipal solid waste, animal wastes, waste from food processing, aquatic plants and algae (Gavrilescu and Chisti, 2005;Demirbas, 2001).

Biomass is the plant material derived from the reaction between CO_2 in the air, water and sunlight, *via* photosynthesis, to produce carbohydrates that form the building blocks of biomass. Typically photosynthesis converts less than 1% of the available sunlight to stored, chemical energy. The solar energy driving photosynthesis is stored in the chemical bonds of the structural components of biomass. If biomass is efficiently processed, either chemically or biologically, by extracting the energy stored in the chemical bonds and the subsequent 'energy' product combined with oxygen, the carbon is oxidized to produce CO_2 and water. The process is cyclic, as the CO_2 is then available to produce new biomass (Fig. 1) (McKendry, 2001).

Biomass is being used as a source of primary energy all over the world since ancient times. The use of biomass to produce energy is only one form of renewable energy that can be utilized to reduce the impact of energy production and use on the global environment, in contrast to fossil fuels.

As with any energy rears limitation on the use and applicability source there are limitation on the use and applicability of biomass and it must compete not only with fossil fuels but with other renewable energy sources such as wind, solar and wave power (McKendry, 2002a, b).

Energy sources will play an important role in the world's future. They have been grouped into three categories: fossil fuels (coal, petroleum and natural gas), renewable sources and nuclear sources (Demirbas, 2000a, b; Parikka, 2004).

Biomass is used to meet a variety of energy needs, including generating electricity, heating homes, fueling vehicles and providing process heat for industrial facilities. It can be converted into useful forms of energy using a number of different processes (McKendry, 2001, 2002a).

2. Resources of biomass

Biomass differs from other alternative energy sources in that the resource is variable, and it can be converted to energy through many conversion processes. Biomass resources can be divided into four general categories:

Wastes: agricultural production wastes, agricultural processing wastes, crop residues, mill wood wastes, urban wood wastes, and urban organic wastes;

Forest products: wood, logging residues, trees, shrubs and wood residues, sawdust, bark etc. from forest clearings;

Energy crops: short rotation woody crops, herbaceous woody crops, grasses, starch crops (corn, wheat and barley), sugar crops (cane and beet), forage crops (grasses, alfalfa and clover), oilseed crops (soybean, sunflower, safflower);

Aquatic plants: algae, water weeds, water hyacinth, reed and rushes.

Biomass contributes about 12% of today's world primary energy supply, while in many developing countries, its contribution ranges from 40% to 50% (Buzdugan and Tripsa, 2006). World production of biomass is estimated at 146 billion metric tons a year, mostly wild plant growth. Some farm crops and trees can produce up to 20 metric tons per acre of biomass a year. Types of algae and grasses may produce 50 metric tons per year (Demirbas, 2001). Conversion of biomass to energy is undertaken using two main process technologies: thermo-chemical and bio-chemical/biological.

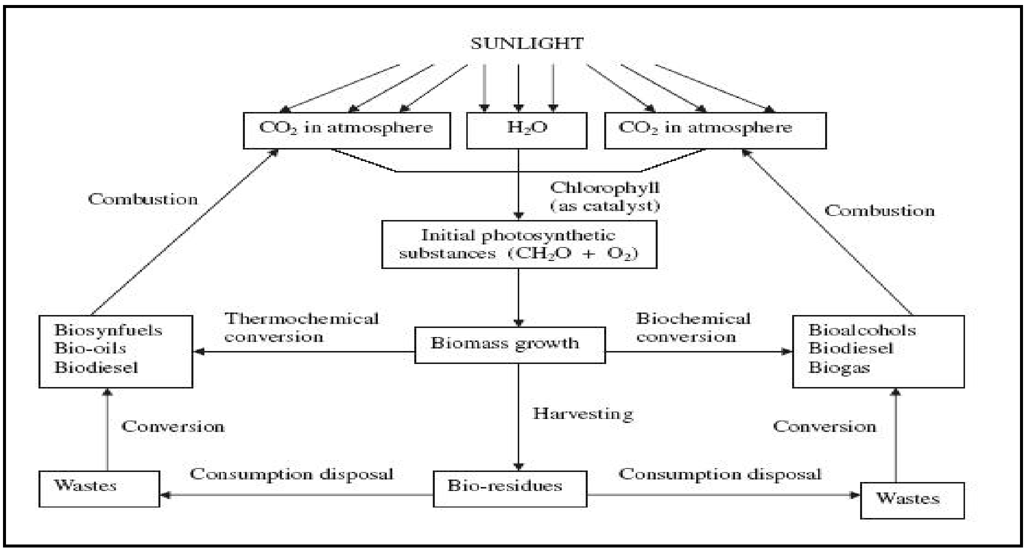

Fig 1. Main steps of biomass technology

3. Energetic potential of biomass in Romania

Romania has a considerable energetic potential of biomass, evaluated at 7594 tap/year ($318x10^9$ MJ/an) representing almost 19% from the total primary energy resources in the year 2004. This potential leads to the following biomass fuel category:

- wood wastes from woods and wood for fire, 1175 x 10^3 tap/an (49.2 PJ/an)**;**
- sawdust and others wood wastes, 487 x 10^3 tap (20.4 PJ/an)**;**
- agricultural wastes, resulting from cereals, corn, vine residues, 4799 x 10^3 tap (200.9 PJ/an)**;**
- biogas, 588 x 10^3 tap/an;
- urban and household wastes 545 x 10^3 tap/an.

Wood for fire and agricultural wastes represent almost 80% from the total biomass quantity, while wood wastes coming from industrial processes, almost 6.5%.

The heat resulted from biomass burning holds various\ percentages in primary resources balance, in respect with the type of wastes or final destination (Buzdugan and Tripsa, 2006).

Biogas was used in past in large quantities. Nowadays, biomass is used only for heating, spontaneous burning for cooking and hot water preparing. House heating is on the second place of using biomass. Almost 95% of used biomass nowadays is fire wood and agricultural wastes, the rest being represented by wastes coming from wood processing. Production capacity of wood saws is 3.3 Math, while in other industry fields is 4.7MW.

Market potential for biomass conversion is very large, but funding and subventions are necessary for developing this field. Direct burning in stoves and roasters for burning, cooking and preparing hot water represents almost 95% from the total used biomass, with a total capacity of 4.8 kW. The feed is manually and has efficiency between 15% and 50%. Burning in steam generators and industrial applications represents almost 5% from the total amount of used biomass (Jefferson, 2006).

Biomass usages can be classified in the following market segments:

- replacing a part of fossile fuels from urban heating installations (wood splints)
- using biomass as substituent of fossile fuel (wood splints and logs as industrial fuel from steam generators and hot water boilers) instead of oil;
- improving the usage of biomass for urban heating in small towns and villages, located near resources, where the population doesn't have access to gas network distribution;
- usage of straws and other agricultural wastes in generators for biomass burning to heat the isolated farms or small villages ;
- maximum priority is using biomass for thermal purposes and to replace the oil.

Biomass conversion could be the best and cheapest method for urban heating in Romania.

4. Conversion of biomass

Biomass can be converted into useful forms of energy using a number of different processes. Factors that influence the choice of conversion process are: the type and quantity of biomass feedstock, the desired form of the energy, i.e. end-use requirements, environmental standards, economic conditions, and project specific factors. In many situations the form in which the energy is required determines the process route followed by the available types and quantities of biomass (Demirbas, 2001; Gavrilescu and Christi, 2005) (Fig. 2). The conversion technologies to utilize biomass can be classified into four basic categories (, 2001):

- direct combustion;
- thermochemical processes;
- biochemical processes;
- agrochemical processes.

Biomass can be converted into three main products: two related to energy – power/heat generation and transportation fuels – and one as a chemical feedstock (McKendry, 2001).

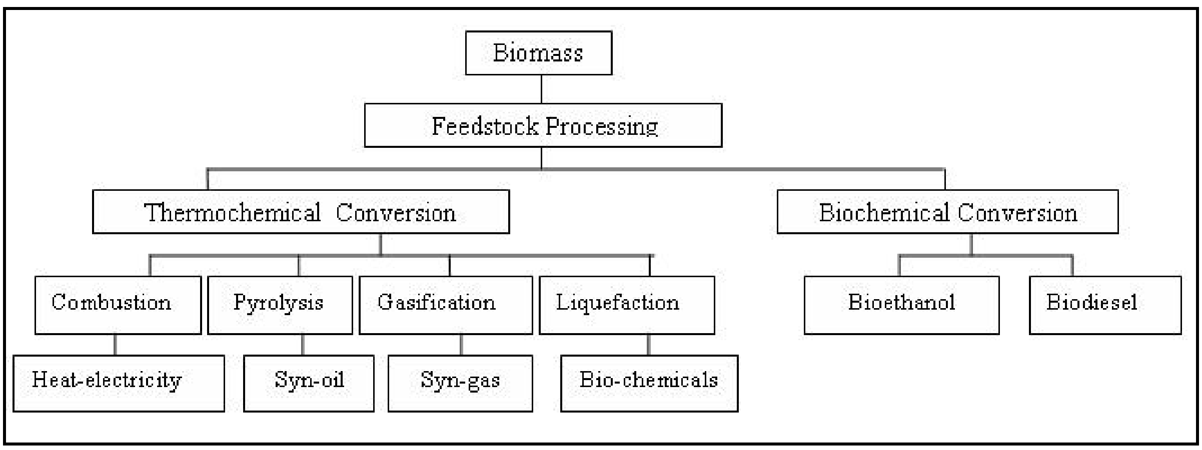

Fig.2. Main biomass conversion processes

4.1. Thermo-chemical conversion

Thermo-chemical biomass conversion does include a number of possible roots to produce useful fuels and chemicals from the initial biomass feedstock (Overend, 2002).

Thermo-chemical processing of biomass and wastes offers a number of ways to produce energy and if this is applicable, a potential attractive method is provided to avoid waste accumulation. In addition to obtain heat from biomass, wastes can be converted into a mixture of gases, liquids and carbon char (Fig. 3) (Jackson and Löfsedt, 1998). The proportions of the various products are dependent upon the feedstock, temperature and pressure of the reaction, the time spent in the reaction zone, and the heating rate.

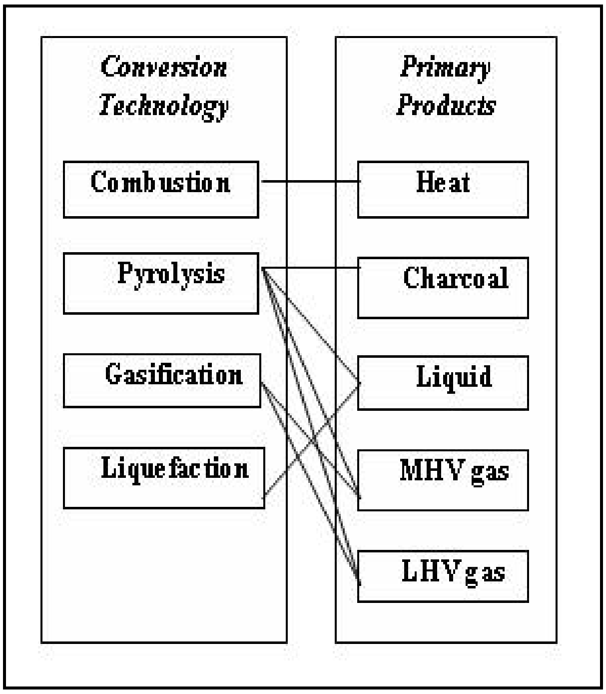

Fig. 3. Thermochemical conversion processes and primary products

Large industrial scale furnaces and boilers have been developed for burning bark, wood, wood wastes, black liquor from pulping operations, food industry wastes and municipal solid wastes. The high moisture content and variable composition of many biomass sources makes them difficult to achieve the same cost-benefit as fossil fuel furnaces in smaller units, but larger units can be very efficient, nearly matching the performance of fossil fuel furnaces.

Along with combustion of biomass and waste, a well-known technology, the major areas of current research focus appear to be pyrolysis and gasification. However, combustion technologies are simple and their dominant role among technologies currently in use would be mentioned.

4.1.1. Combustion

Direct combustion is a thermo-chemical conversion process type that utilizes as major biomass feedstock wood, agricultural wast, municipal solid and residential waste to produce fuels for heat, steams or electricity. In general combustion models of biomass can be classified as macroscopic or microscopic. The macroscopic properties of biomass are given with for macroscopic analysis, such as ultimate analysis, heating value, moisture content, particle size, bulk density, and ash fusion temperature. Properties for microscopic analysis include thermal, chemical kinetic and mineral data (Ragland et al., 1991; Demirbas, 2004). Physical property values vary greatly and properties such as density, porosity, and internal surface area are related to biomass grades whereas bulk density, particle size, and shape distribution are related to fuel preparation methods (Demirbas, 2004).

Combustion is widely used on various scales to convert biomass energy to heat and/or electricity with the help of a steam cycle (stoves, boilers and power plants) (Demirbas, 2000a).

The advantages of co-firing are apparent: the overall electrical efficiency is high due to the economies of scale of the existing plant (usually around 40%) and investment costs are low up to negligible when high-quality fuels as pellets are used. Also, directly avoided emissions are high due to direct replacement of coal. Combined with the fact that many coal-fired power plants in operation are fully depreciated, this makes co-firing usually a very attractive Green House Gases mitigation option. In addition, biomass firing leads to lowering sulfur and other emissions (Faaij, 1999).

Combustion of biomass produces hot gases at temperatures around 800–1000 ^{0}C. It is possible to burn any type of biomass but in practice combustion is feasible only for biomass with moisture content lower than 50%, unless the biomass is pre-dried. High moisture content biomass is better suited in the case of biological conversion processes.

4.1.2. Pyrolysis

Pyrolysis is defined as the thermal destruction of organic materials in the absence of oxygen, or partially combusted in a limited oxygen supply, to produce a hydrocarbon rich gas mixture, an oil-like liquid and a carbon rich solid residue (Demirbas, 2000c, d). Pyrolysis converts biomass at temperatures around 500^{0}C, in the absence of oxygen, to liquid (bio-oil), gaseous and solid (charcoal) fractions. The process can be adjusted to favor charcoal, pyrolytic oil, gas, or methanol production with a 95.5% fuel-to-feed efficiency. Pyrolysis can be used for the production of bio-oil if flash pyrolysis processes are used and are currently at pilot stage (Fig. 4) (EUREC, 1996). The bio-oil can be used in engines and turbines and its use as a feedstock for refineries is also being considered (McKendry, 2001, 2002a).

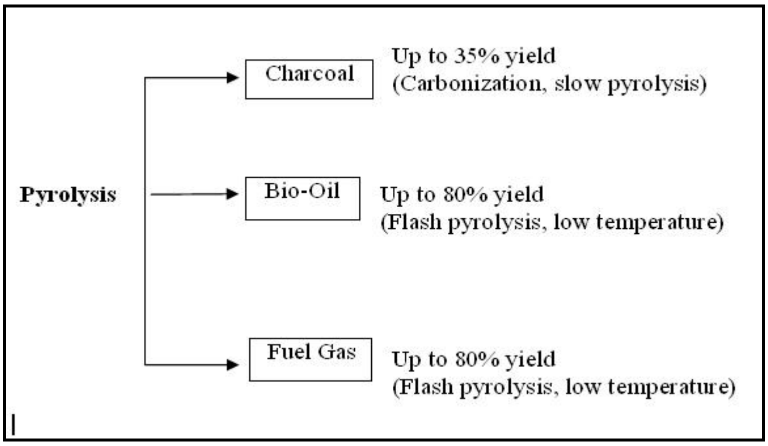

Fig. 4. Pyrolysis process

Bio-oil contains about 40 wt% of oxygen and is corrosive and acid. The crude oil can also be upgraded (e.g. *via* hydrogenation) in order to reduce the oxygen content. But upgrading comes with both economic and energy penalties (Faaij, 2002; Radlein, 1998).

Some problems in the conversion process and use of the oil need to be overcome; these include poor thermal stability and corrosiveness of the oil. Upgrading by lowering the oxygen content and removing alkalis by means of hydrogenation and catalytic cracking of the oil may be required for certain applications (Demirbas, 2000a, b). Pyrolysis of wood has been studied as a zonal process (Demirbas, 2004). Thermal degradation properties of hemicelluloses, cellulose and lignin can be hierarchized as follows (Chum and Overend, 2001):

Thermal degradation of hemicelluloses - of cellulose - of lignin

Pyrolysis of biomass is thermal decomposition of the fuel. As with coal, pyrolysis is a relatively slow chemical reaction occurring at low temperatures. The reaction mechanisms of biomass pyrolysis are complex but can be defined in five stages for wood (Demirbas, 2000a; Demirbas 2004):

- Moisture and some volatile loss.
- Breakdown of hemicelluloses; emission of CO and CO_2.
- Exothermic reaction causing the woody biomass temperature to rise from 525 to 625 K; emission of methane, hydrogen and ethane.
- External energy is now required to continue the process.
- Complete decomposition occurs.

4.1.3. Gasification

Gasification is a form of pyrolysis, carried out at high temperatures in order to optimize the gas production. The resulting gas, known as synthesis gas, is a mixture of carbon monoxide, hydrogen and methane, together with carbon dioxide and nitrogen. Biomass gasification technologies have historically been based upon partial oxidation or partial combustion principles, resulting in the production of a hot, dirty, low calorific value gas that must be directly ducted into boilers or dryers. In addition to limiting applications and often compounding environmental problems, these technologies are an inefficient source of usable energy.

Biomass gasification is the latest generation of biomass energy conversion processes, and is being used to improve the efficiency, and to reduce the investment costs of biomass electricity generation through the use gas turbine technology. High efficiencies (up to about 50%) are achievable using combined-cycle gas turbine systems, where waste gases from the gas turbine are recovered to produce steam to be used in a steam turbine. Economic studies show that biomass suffocation plants can be as economical as conventional coal-fired plants (Demirbas, 2004; Toft and Bridgwater, 1996).

Practically, gasification is the conversion of biomass into a combustible gas mixture by partial oxidation at high temperatures, typically in the range 800–900 ^{0}C. The low calorific value gas produced (about 4–6 MJ/N m^3) can be burnt directly or used as a fuel for gas engines and gas turbines (LRZ, 1993; N.R.I. 1996). The produced gas can be used as a feedstock (syn-gas) in the production of chemicals (e.g. methanol) (McKendry, 2001). The gas is very costly to be stored or transported due to its the low energy density so it has to be locally used.

The gasification of coal is well known, and has a history back to year 1800. The oil-shortage of World War II imposed an introduction of almost a million gas producers to fuel cars, trucks and busses. One major advantage of gasification is the wide range of biomass resources available, ranging from agricultural crops, and dedicated energy crops to residues and organic wastes. The feedstock might have a highly various quality, but still the produced gas is can be standardized and transformed in a homogeneous product. This makes possible to choose the feedstock that is the most available and economic at all times (Adam, 2006). The precise composition of the gas from a reactor depends on the type of biomass used, the temperature, and the reaction rate.

Gasification technology has been used quite successfully for direct heat applications, as a sophisticated gas cleaning system is not required. Thermo-chemical gasification involves decomposition and devolatilization reactions that may be represented as:

$$\mathbf{C_aH_{\beta}O_{?} + yO_2 + zN_2 + wH_2O + \mathit{dh}\ ? \qquad + x_6CH_4 + x_7C\mu Hp + x_8O_2 + x_9N_2}$$

$$\mathbf{x_1C + x_2H_2 + x_3H_2O + x_4CO + x_5CO_2}$$

In the above presented equation, $C_aH_{\beta}O_{?}$ represents biomass, and y, z and w are molar numbers of oxidant. Air (oxygen, nitrogen, and water vapor), oxygen, steam or a mixture of these may be used in this partial oxidation. On the output side of the equation, x_1, x_2, x_3, etc., are molar numbers of char, hydrogen, carbon monoxide, carbon dioxide, methane, higher hydrocarbons (tar vapors), traces of unreacted oxygen, and nitrogen produced by these reactions. Theoretical, zN_2 should be equivalent to x_9N_2 (i.e., the nitrogen in the air remains inert). The heat requirements (*dh*) for the reaction to occur may be supplied either by *in situ* combustion of part of the biomass or heat applied from an external source. Note that by replacing air in the reaction with pure oxygen, all nitrogen is removed from the mass reaction equation (UN, 1996; Jackson and Löfsedt, 1998).

Air gasification produces a low heating value gas (4-7 MJ/Nm^3), while oxygen gasification produces a medium heating value gas (10-18 MJ/Nm^3). Although air gasification produces a low heating value, it is the more widely used gasification technology. It avoids the cost and hazard of oxygen production and usage, as well as the complexity and cost of multiple reactors.

The product, consisting of char (carbon), H_2, H_2O, CO, CO_2, CH_4, and $C_{\mu}H_p$ (with O_2, and N_2), is a relatively low energy density combustible gas which may be burned directly for space heating or drying, or which may be used in a boiler to produce steam and/or electricity or (after some cleaning to remove entrained char) in an internal combustion engine .

For power generation, the down draft gas producer has been found to be most suitable, as it is capable of producing clean gas. The main problem in biomass gasification for power generation is the cleaning of gas so that it as to be free of impurities before entering the engine. The development of a gas cleaning system is as important as that of the development of a gas producer (Toft and Bridgwater, 1996).

4.1.4. Liquefaction

Liquefaction is the conversion of biomass into a stable liquid hydrocarbon using low temperatures and high hydrogen pressures (WSL, 1993).

The process produces a marketable liquid product. The interest in liquefaction is low because the reactors and fuel feeding systems are more complex and more expensive than for pyrolysis processes. A generalized conceptual flow sheet for liquefaction is shown in Fig .5.

Concerning the catalytic effect of alkali hydroxides and carbonates, there has been little description about that a catalyst plays in liquefaction with some exceptions (Demirbas, 2001).

4.2. Bio-chemical conversion

Biochemical conversion is the process by which biomass is converted into gas (CO_2/CH_4), waste (compost or fertilizer) and water (water or C_2H_5OH) by using microorganisms.

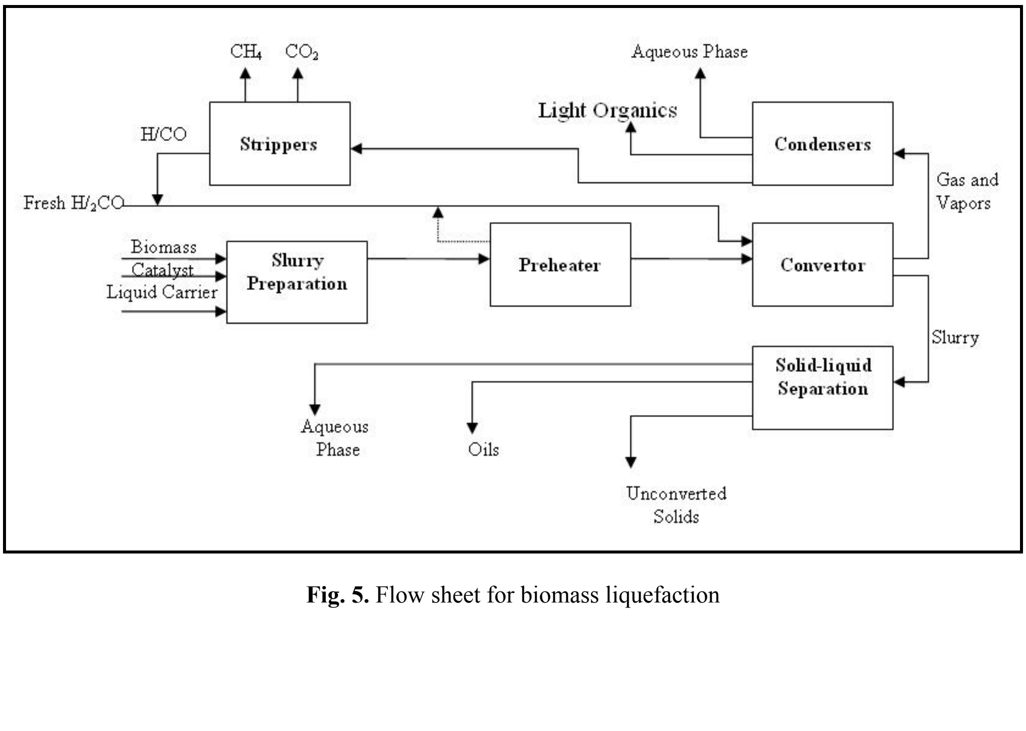

Fig. 5. Flow sheet for biomass liquefaction

The biochemical processes refer mainly to (1) aerobic fermentation which produces compost, carbon dioxide and water, (2) anaerobic fermentation which produces fertilizer and gas (CH_4/CO_2) and (3) alcoholic fermentation which produces ethanol (C_2H_5OH), carbon dioxide (CO_2) and waste.

Biochemical procedures, non-pollution methods, characterized by low energy consumption, have been studied by specialists mainly with regard to biogas, ethyl alcohol, compost and protein obtaining. But, the world-wide application of such procedures has not gone beyond preliminary experiments on a pilot scale, with few industrial results or as stations of producing biogas and compost, placed according to specific and local responsibilities (Demirbas, 2000a, c).

Biochemical systems are among the most promising, environmentally sustainable alternatives for reducing atmospheric carbon dioxide (CO_2) levels. Biomass can act as a reservoir of carbon or as a direct substitution for fossil fuels with no net contribution to atmospheric CO_2 if produced and used sustainable (Kücük, 1995).

The sun is the energy source on which all terrestrial life is based. The energy of solar radiation is the driving force of the biological cycle. Only about 0.1% of the energy received by the earth from the sun enters into photosynthetic production of organic matter. Roughly 150-200 billion tons of dry organic matter is estimated to be produced annually in the world as vegetation in forests, grasslands, marshes, oceans, estuaries, lakes, rivers, tundras etc.

Approximately half of the energy tied up in photosynthesis is involved in plant respiration. Biochemical conversion methods are inverse photosynthesis. This action can be converted inversely by using some microorganisms (Demirbas, 1998).

4.2.1. Anaerobic digestion

Anaerobic digestion is the decomposition of biomass through bacterial action in the absence of oxygen. It is essentially a fermentation process and produces a mixed gas output of methane and carbon dioxide. The product generated by the decay, in the absence of air, of sewage or animal waste is known as biogas.

Biogas is most commonly produced by using animal manure mixed with water which is stirred and warned inside an airtight container, known as a digester. Digesters range in size from around 1m^3 for a small household unit to as large as 2000 m^3 for a large commercial plant (Ramage and Scurlock, 1996). The biogas produced can be burnt directly for cooking and space heating, or used as fuel in internal combustion engines to generate electricity.

Methane gas produced in landfill sites eventually escapes into the atmosphere. However, the landfill gas can be extracted from existing landfill sites by inserting perforated pipes into the landfill. In this way, the gas will travel through the pipes under natural pressure for use as an energy source, rather than simply escaping into the atmosphere to contribute to greenhouse gas emissions (Demirbas, 2001; Gavrilescu and Macoveanu, 1999). The gas composition is 65-70% methane, 35-30% carbon dioxide and negligible traces of other gases (e.g. H_2S and H_2) and is saturated with water. The gas has an approximate heating value of about 26 MJ/m^3 (Demirbas, 2000d).

The biomass is converted by bacteria in an anaerobic environment, producing a gas with an energy content of about 20–40% of the lower heating value of the feedstock. Anaerobic digestion is a commercially proven technology and is widely used for treating high moisture content organic wastes (80–90%). Biogas can be used directly in spark ignition gas engines and gas turbines and can be upgraded to higher quality i.e. natural gas quality, by the removal of CO_2.

Used as a fuel in spark ignition gas engines to produce electricity only, the overall conversion efficiency from biomass to electricity is about 10–16%. As with any power generation system using an internal combustion engine as the prime mover, waste heat from the engine oil and water-cooling systems and the exhaust could be recovered using a combined heat and power system. A typical flow sheet for processing biomass using anaerobic digestion is shown in Fig.6.

Anaerobic fermentation, where the waste is kept without oxygen for approximately 2-8 weeks around 310 K, not only solves the pollution problem but also produces energy and organic fertilizer from a renewable source. Animal waste has created a major waste disposal problem and is becoming more acute because greater numbers of animals are being raised on concentrated feedstocks.

4.2.2. Alcoholic fermentation

Ethanol can be produced from certain biomass materials which contain sugars, starch or cellulose. The best known source of ethanol is sugar cane, but other materials can be used, including wheat and other cereals, sugar beet, Jerusalem artichoke and wood. The choice of biomass is important as feedstock costs typically make up 55-80 % of the final alcohol selling price (W.E.C., 1994). Starch based biomass is usually cheaper than sugar based materials but requires additional processing. Similarly, cellulose materials, such as wood and straw, are readily available but require expensive preparation.

Ethanol is usually produced by fermentation. Typically, sugars are extracted from the biomass crop by crushing, mixed with water and yeast and kept warm in fermenters. The yeast breaks down the sugar and converts it to methanol. A distillation process is required to remove the water and other impurities in the diluted alcohol product (10-15% ethanol).

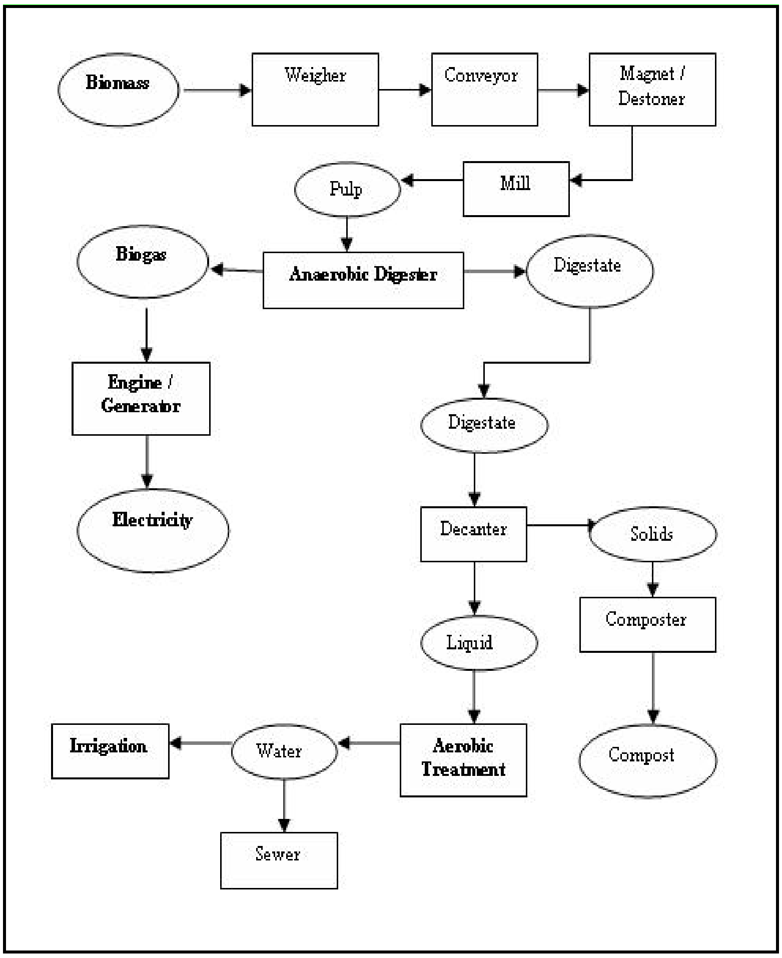

Fig. 6. Flow sheet for anaerobic digestion of biomass

The concentrated ethanol (95% by volume with a single step distillation process) is drawn off and condensed to a liquid form.

Ethanol can be used as a supplement or substitute for gasoline in cars. Brazil has a successful industrial scale ethanol project which produces ethanol from sugar cane for blending with gasoline. Some vehicle adaptations are required for full gasoline substitution.

Crop residues are often used to supply the external heat required for the process. There is a significant energy loss in the distillation stage, particularly the complex secondary distillation process required to achieve ethanol concentrations of 99% or better. This may be acceptable, however, due to the convenience of the liquid fuel and relatively low cost and maturity of the technology (Demirbas, 2001).

5. Benefits of biomass utilization

Biomass is a renewable, potentially sustainable and relatively environmentally benign source of energy. If it is grown and utilized on a sustainable basis, biomass is carbon dioxide neutral. Thus, the substitution of fossil fuels for energy production using biomass will result in a net reduction in greenhouse gas emissions and the replacement of a non-renewable energy source. Many large power producers in industrialized countries are looking for biomass as a means of meeting greenhouse gas reduction targets (Demirbas, 2001). The natural decomposition of biomass produces methane, which is about twenty times more active as a greenhouse gas than carbon dioxide (Demirbas, 2000a, b).

There is, therefore, an additional greenhouse gas emission in burning biogas, landfill gas and biomass residues to produce carbon dioxide.

Biomass fuels have negligible sulfur content and, therefore, do not contribute to sulfur dioxide emissions, which cause acid rain. The combustion of biomass produces less ash than coal combustion, and the ash produced can be used as a soil additive on farm targets.

Biomass is a domestic resource, which is not subject to world price fluctuations or the supply uncertainties of imported fuels. In developing countries in particular, the use of liquid biofuels, such as biodiesel and ethanol, reduces the economic pressures of importing petroleum products.

Perennial energy crops (grasses and trees) have lower environmental impacts than conventional agricultural crops.

6. Environmental impacts of biomass energy

As with all forms of energy production, biomass energy systems raise some environmental issues that must be addressed. In biomass energy projects, issues such as air pollution, impacts on forests and impacts due to crop cultivation must be addressed on a case by case basis. Unlike other non-renewable forms of energy, biomass energy can be produced and consumed in a sustainable fashion, and there is no net contribution of carbon dioxide to global warming. One example is a closed loop system in which carbon dioxide will be taken up by new plant growth at the same rate that it is released by using the harvested biomass for fuel. (Jefferson, 2006; Robu et al., 2005) Such bioenergy crops would have little or no net contribution to atmospheric carbon dioxide as a greenhouse gas. On the other hand, when fossil fuels are burned, carbon is released that has been stored underground for millions of years, making a net contribution to atmospheric greenhouse gases. Therefore, if managed carefully, biomass energy can have significant environmental advantages over the use of fossil fuels. An appropriate level of biomass energy use can have less environmental impacts than our current means of energy production (Demirbas, 2001).

7. Conclusions

This brief introduction regarding the usage of biomass as a renewable energy resource for preventing the natural and antropogenic disasters disclose the importance of biomass for the environment and humankind existence.

Multiple changes adaptation and choosing the right way represents probably the essence of survival, and having in mind the hopes of humankind for a better understanding and knowledge of living systems, for satisfying the increasing needs of humankind, for preserving and protecting the environment, the usage of biomass as a renewable energy resource remains an efficient way of solving the social-economical problems of this millennium beginning society.

Therefore, it must be underlined the beneficial effect of regenerating energies not only regarding the environment protection, but also in economical and social domain. Thus, increasing the air quality, energetic security, but also the percentage of labour force who work and developing the business frame are key-objectives that can be achieve trough renewable energy promotion.

Biomass could be recommended as the main renewable source energy in Romania.

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