USING BIOMASS AS AN ENERGY RESOURCE – A SOLUTION BASED ON THE CONCEPT OF RESPONSIBILITY TO THE NATURE AND THE MANKIND

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Abstract

Use of system approach in solution of the problem of an alternative to oil and natural gas is considered. The general idea of the system approach is substantiated as follows: each element of the approach must be based on the concept of responsibility of human for the prosperity of the present and the future generations as well as responsibility to the Nature (necessary conditions of the human society sustainable development). The system approach based on biomass is shown to have such character.

Preface

Dear Colleagues! All we came here because we are interested in the field of alternative energy and, therefore, the current condition of the energy sector is unindifferent to us and we desire to change the situation in the field of energy towards the technologies that are friendly to the Nature and the Mankind.

It means that WAESE-2009 gathered scientific and technical experts that deal with one or several of the following fields:

- Alternative energy,
- Conventional energy,
- Ecology,
- Transportation,
- System analysis.

Why exactly such combination of human activity areas?

Just because they are logically and closely related to each other.

According to estimations of the experts of the World Energy Council, the known reserves of oil and natural gas deposits (that constitute the basis of the modern conventional energy) are expected to be depleted by the middle of the present century.

Unfortunately, using conventional non-renewable fossil energy carriers is still irrecoverably harming the Planet's nature in general and the human ecology in particular (destruction of ecosystems, of flora and fauna, aggravation of the greenhouse effect etc).

The basic consumer of the conventional energy carriers is transport. For now, they are still the only real and available energy source. The major part of vehicles run on natural gas or fuels produced out of oil, unlike, for example, boiler-plants that can operate both on coal and other solid fuels.

Different solutions of the mentioned set of problems are proposed in the field of alternative energy which considers the ways of generation, transformation and accumulation of renewable energy of different nature.

And the solution of the main problem – of an alternative to conventional non-renewable energy carriers – is impossible without its system analysis and system (interdisciplinary) approach. System analysis is a wonderfully efficient instrumentation which allows to approach any problem and to find methods of its solution the most complex and objective way.

In order to solve the problem of an alternative to oil and natural gas it is necessary to concentrate knowledge of such fields as:

- Heat energy and electrical energy,
- Ecology,
- Economics,
- Instrumentation,
- Machine engineering,
- Labour protection,
- Law etc.

System analysis of the problem and system approach to its solution imply development of such issues as determination of alternative energy resources, their preparation, creation of technologies of their conversion into useful energy, utilization of waste products, estimation of economic efficiency, elaboration of the corresponding legislation.

Sustainable development of the mankind is impossible without such approach as long as this approach implies our responsibility to our prosperity and prosperity of the future generations.

The basic problems of alternative energy

What are the basic problems that are encountered by alternative energy today?

The following groups can be distinguished:

1. Technological – unresolved problems of physical implementation of a particular method of energy generation. For example, performance coefficient (efficiency) restrictions, presence of polluting non-utilized wastes, economical inefficiency of processes and so on.
2. Inertia of political will relatively to alternative renewable energy – the transition to this kind of energy must possess a strong lobby oriented towards the responsibility to human development and the Nature condition. Regrettably that the only powerful energy lobby often asserts interests of only conventional energy. It is more specific for the counties with considerable reserves of fossil fuels.
3. Central heating remains the most spread way of energy supply, though its energy efficiency is low. It implies that all energy losses at energy transfer from the source to an end consumer are paid by the latter. Unlike this, the basic focus of alternative energy is small-scale energy which implies minimized distance of energy transfer from the source to an end-consumer or even generation of energy directly at the place of its consumption.
4. Irresponsible inertia of mind of producers and consumers of energy – unwillingness to change the common way of life. Applied to energy, it is expressed in idea of inexhaustibility of fossil energy resources during our life time and thus of unnecessity to replace them.

5. Substantially low level of legal and social culture and responsibility of people relatively to energy and ecology.

General idea of solving energy problems

To solve the specified energy problems, there must be a general idea that would relate to each problem simultaneously.

This idea has been mentioned above and it is very simple – **Responsibility for prosperity of the present and the future generations as well as responsibility for environmental condition**.

The responsibility to the Nature implies observance of a kind of "Hippocratic principle" while interacting with it in the course of continuous scientific-technological progress. In other words, the development of the mankind must not harm the Nature, or this harm must be minimal and repairable.

The responsibility for prosperity of the present and the future generations is obviously and closely related to the responsibility to the Nature as long as human lives in the Nature and directly influences on its condition. However this responsibility includes one more substantial aspect – moral-intellectual legacy left to the future generations in the form of advances in science, technology, human interrelations and relations of human with the Nature.

Hence, if this simple idea is the base of all aspects of human living activity including, of course, energy, humans will get a real chance to reach harmony in relations with the Nature and themselves providing thus sustainable development and prosperity.

Otherwise, the mankind will obviously and unavoidably degrade and extinct.

Therefore, the solution of the problem of an alternative to oil and natural gas must be of system or complex character. It means that the following directions must be elaborated:

1. Development and technological perfection of alternative methods of generation, transformation, storage and utilization of energy.
2. Reduction and termination of the corresponding negative influences on the Nature in general and human ecology in particular.
3. Increase the level of knowledge of people about conventional and alternative energy.
4. Increase the level of responsibility of people, first of all, relatively to their ecology.
5. Creation of necessary legislative and political fundamentals.

Using biomass as a solution based on the concept of responsibility

The first two activity directions given above imply determination of an energy resource and technologies of generation of useful energy carriers. The latter must meet the following requirements:

1. Availability.
2. Renewability.
3. Ecological friendliness (ecological appropriateness) of both the energy resource and the technologies of generating useful energy.
4. Possibility to improve the current ecological situation (possibility to recoup the harm that has been made to the Nature by the present moment).

5. Economical appropriateness of generation of useful energy such that the latter could be a real competitor to the energy generated from oil and natural gas.

The listed requirements are met by such energy resource as biomass which contains vegetable and animal organisms and products of their living activity and treatments. Moreover, not all kinds of biomass can be used for energy generation – only vegetable organisms and products of their living activity and treatment as well as products of living activity of animal organisms. Biomass also includes domestic and industrial organic wastes the major part of which is just accumulated at landfills.

Availability, renewability and ecological appropriateness are obvious and undoubtful.

Processing of biomass in the form of organic wastes also obviously leads to improvement of ecological situation.

Solution of tasks of ecological and economical appropriateness of energy generated from biomass depends on technologies of biomass treatment. There are a number of technological problems that need to be solved to resolve the specified tasks.

Problems of biomass transformation into energy

To compete with conventional fossil fuels – oil and natural gas – the following biomass technologies problems must be resolved:

1. fuel generated out of biomass must be liquid or gaseous as long as the powerplants of all modern vehicles are based on internal combustion engines;
2. energy output from a mass (volume) unit of biomass must not be less than energy output from a mass (volume) unit of oil and natural gas;
3. economical and energetic expenditures connected with generation of liquid or gaseous fuel out of biomass must be less than economical and energetic output from it;
4. the technology of biomass transformation into energy must possess no exhausts into the environment;
5. the energy generating technology must be applicable irrespectively of the object of energy supply.

Solution of problems of energy generation out of biomass

To solve the problems given above, it is the most reasonably and efficiently to use the methodological instrumentation that has already been mentioned – system analysis.

The process of energy carriers production out of biomass is the analysis object (a system) which is represented as a “black box” with inputs (biomass weight, the process energy, probable additional reacting substances) and outputs (fuel products, non-fuel products – wastes, technological indices of the process).

The basic technologies of biomass transformation into energy known today are:

1. Combustion;
2. Fermentation;
3. Direct hydrothermal liquefaction;
4. Hydrogenation;

5. Etherification – biodiesel production;
6. Gasification;
7. Pyrolysis.

Analysis of the given technologies from the point of view of solving problems of biomass transformation into energy made it possible to select pyrolysis as an object of improvement according to a set of criteria: process efficiency, complexity of design and technological appearance, process dynamics, generated useful product, generated by-products, ecologically friendliness and the prospects of the further analysis and perfection.

System analysis of traditional pyrolysis process allowed to distinguish the reasons influencing on energy output from biomass and to determine the reserve capabilities and to find design and technological solutions that result in its increase.

As a result of the conducted analysis, an Author's technology of biomass transformation into energy has been developed. It makes it possible to transform a mass unit of biomass (vegetal mass) into energy which amount is comparable to specific energy of conventional fossil fuels without producing any kind of waste products. The technology has been named Glushkov's Pyrolytic Regeneration.

Conformity of the Glushkov's Pyrolytic Regeneration concept to the concept of responsibility

Responsibility to the Nature – biomass is transformed into energy carriers with no waste products that would require additional treatment and utilization, with zero carbon dioxide emissions.

Responsibility to the mankind – generation of energy carriers with indices comparable to oil and natural gas and with substantially less cost along with reduction of pollution of the environment.

Complex solution of the problem of an alternative to conventional fuels

As it was specified before, to solve the problem of an alternative to conventional fossil fuels it is necessary to use the complex approach. Solution of just design and technological problems is unable to solve it.

To increase the level of people's knowledge concerning energy situation and technologies, to increase the level of responsibility and create the corresponding required legislation, cooperative work of scientists and governmental authorities is necessary.

Scientists should develop and release scientific and scientific-popular materials concerning problems and advances in the field of energy that possess both scientific-informational and methodical function (for example, the Author's book "System analysis of the problem of an alternative to oil and natural gas").

Governmental authorities should take measures to support and popularize distribution of the information provided by scientists, and to elaborate the corresponding legislation.

Therefore, the system approach to solution of the problem based on use of biomass has a really responsible character.

References

Vladimir A. Glushkov (2007), **System analysis of the problem of an alternative to oil and natural gas**, Scientific and publishing centre ″Regular and Chaotic Dynamics″, (Moscow-Izhevsk, Russian Federation).

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