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CONTENTS

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BIOMASS ENERGY CONVERSION

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Recent trends in biofuel production and use sector have to be essentially corrected to maintain the balance of agricultural products structure insuring food security and sustainability.

In the present stage of biofuel market development, the environment protection motivation will reasonably prevail over that of fossil fuels market uncertainty in view of oil resources run down. Taking account to the recent trends (decentralized power generation and electric traction oriented innovations in automobile production industry), it is advisable to strengthen the role of burner type biofuels that do not compete with the food industry in the agricultural products markets.

Today, the most economically expedient option for burner type biofuels production technology is composite micro-fine suspensions and emulsion on the basis of low grade fossil oil derivatives that insure stable environmental effect at substantially lower production cost compared to ICE dedicated biofuels. These energy bio-products typically contain 20% to 50% of hydrous biomass and can be prepared using energy saving, low-temperature, hydrodynamic or/and ultrasonic cavitation processes.

The cultivation and use of microalgae as a renewable hydrous component of composite burner fuels may be regarded as an effective option providing a number of socio-economical, environmental and technological and other advantages, particularly, the following ones:

– no arable lands are required, no territorial competition with traditional food crops,

– better opportunities to utilize the rejected heat and to return exhaust carbon oxides of thermal power systems into the bio-energy use cycle,

– much simpler technological procedure for composite biofuel preparation: practically no pretreatment is required,

– possibility of utilizing both nonorganic and organic components of cattle farm waste flows in algae photosynthesis cycles.

***Keywords**: biofuel, wood security, biomass, cultivation of microalgae, ultrasonic cavitations process.*

Energy crisis does not threaten humanity with depletion of oil, gas, and coal due to the development of renewable energy. This will also solve the problem of environmental pollution emissions from transport and power stations.

The use of biotechnology in agriculture is focused on sustainable agricultural development, food security, obtaining of high-quality, organic food, recycling of various industrial wastes, restoration of soil fertility [1].

Bioenergy development contributes to the emergence of new sources of energy. Production of electricity and heat from biomass is also significantly increased. Prospects of biofuels remain a subject of debate in the world. Research and development of innovative solutions in this area continues, and the main result is transformation of renewable raw materials in a wide range of products on an industrial scale.

Programs, and the use of fluid and solid biofuels in the world grows at a rate of not less than 10% per year. Most intensively the biofuel market has been developing in the EU and is expected to exceed 10% by the year 2020 in the transport sector of Europe. So it is evident that the problem has to be solved on the way of

compromise among multiple factors (social, economical, environmental, technological, etc, [2-5].

The development of biofuels has a social importance by creating new jobs and the development of science and will provide economic returns in the form of reduced energy consumption, growth and profitability of engineering. Environmental dividends are assumed in reducing greenhouse gas emissions and reductions in waste, as well as full and deep processing of raw materials.

World production of bioethanol exceeds 36 billion liters. Leading in this market are Brazil and the U.S. Russia - the second country in the world in the areas of agricultural land. The question of the production of "green fuel" is only considered. In this case, the prospects of the business in question. One of the main reasons - is the lack of raw materials, high excise taxes on ethanol and the lack of government support.

Technology of production of biofuels from lignocellulosic (wood, wood waste, etc.) and other biodegradable waste needs to be improved, and probably will be ready for commercial use in 5-7 years.

Cellulose can be used in addition to fat, sugar compounds - all this can be split and get fuel. In the U.S., ethanol is made from corn and wheat, and in Brazil - from sugar cane [6].

Representatives of international organizations and scholars have recently noted that the industry consumes a significant amount of agricultural raw materials for the production of biofuels, and this despite the fact that millions of people in the world are starving. An international forum of ASEAN Media Forum 2012 noted that an excessive increase production of ethanol and biodiesel threatens global food security. In the EU, task is to work out measures for the production of bio-fuels so that the appearance on the world market of biofuels not harm the internal state in Europe.

Biofuels industry has a huge potential revival of the rural economy and at the same time contributes to energy independence and reduce greenhouse gas emissions.

In recent years the development of the industry has slowed down, as the production of biofuels from agricultural products has caused a global rise in food prices.

It is shown that biofuels threaten food security through prices. As a result of changes in the structure of land investments confirmed the massive displacement of traditional communities, the replacement power supply and deepening food insecurity. So the principle of prior informed consent and full participation of all stakeholders in transactions with the land will be effectively implemented as a prerequisite for any land transactions.

Negative experiences with jatropha as feedstock for biofuel production have shown that in addition to the land water resources are under pressure. Investment in land is increasingly understood as both investment in water resources. Needs of analysis and integration of land and water, so that the regulation of land use can not be made without assessing the impact on water resources.

In Russia, more than 100 million ton of biomass available for energy purposes is produced per year. The energy equivalent of this amount of raw materials is more than 40 million ton of reference fuel (300 million MWh). Only 10% of this renewable biomass resource is involved in recycling processes. One of the largest producers of waste is agriculture. According to statistics, in Russia in 2010 in the sector of Agriculture and Forestry been produced almost 68 million tons of wastes. Of the total amount of wastes were used or neutralized 18.8 million tons accounting for at least 28% by volume.

The Russian Federation currently processing and neutralization affect about 30% of the waste. The goal is to create a multi-step progressive new technological approaches. Also important is the development of production base for bioenergy.

Following set of measures are under development:

- Industrial production of non-food biomass for fuel and energy resources;
- Biofuel production and its components from biomass specified properties;
- Production of electricity and heat from biomass;
- Energy utilization;
- Disposal of greenhouse gas emissions in energy production cycles, industrial and municipal wastewater for non-food production of biomass.

Effective and reliable source of raw materials for bioenergy will become timber industry complex. The total area of forest land and forest in Russia is 1.2 million hectares or 69% of the country. The wood reserves are about 82 billion cubic meters, more than a quarter of world reserves. Annually harvested more than 500 million cubic meters of wood and this figure continues to grow.

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Many international organizations have recognized the negative effects of the use of land for biofuel production on food security. For Russia, the most profitable biodiesel feedstock is rapeseed. Sunflower seeds can be sown only once in five years - it quickly depletes the soil, and rape - every two years, alternating it with wheat. In Russia there are many areas that are favorable for the cultivation of rape or equivalent - colza.

Rape is not the only biofuel crop. In Russia, one of the main raw materials for "green gasoline" could be potatoes. This culture is suitable for the production of bioethanol. In this case, of 10 kg of potatoes can get 1 liter of ethanol and 1-2 kg of dry feed.

Promising raw material is also an topinambur. Topinambur advantage in the high yield (up to 400 kg / ha and the same green material). Alcohol yield is 1.5-2 times higher than that of potatoes.

Certification schemes are necessary for access to the market of biofuels. These schemes should be multilateral, multifunctional and transparent.

The success of biofuel experts associated with the state support of these projects. Priority issues that are solved by using biofuel projects, the reduction of dependence on external suppliers of oil and increase rural employment. The second factor driving the development of alternative fuels, is the struggle for the environment.

The main obstacle to the start of production of biofuel in Russia experts call "misguided excise policy" of the state, due to which the cost of the new fuel will be higher than traditional gasoline. Biofuel production in Russia is subject to the same taxes as vodka. Support for biofuels should be the abolition of the high ex-

cise taxes on motor spirit. Unless remove these taxes, the production of biofuels will never be profitable.

Land availability, population density and per capita income may provide preliminary orientation to the desirability of biofuel policies and the type of policy that would be most appropriate. Innovative technology can identify tradeoffs of different systems of production and their positive / negative impact on food security.

In 2013 professor Dmitry Strebkov has been appointed as a member of the Oversight Group to review the report of HLPE on Biofuels and Food Security[1].

The report by HLPE Project Team on Biofuels and Food Security under guidance and oversight of the HLPE Steering Committee analyses the issues of food security related to the biofuel world markets development. The research performed by the team features proficiency, completeness and argumentativeness. The ideas and conclusions are supported by extensive statistical data. No doubt, the problems that have been competently brought to light are of vital importance today for large areas in global scale.

At the same time, it has to be noticed that safety and sustainability of life are not limited by only food and drinkable water provision. The environmental issues are also of prime importance and the substitution of fossils by biofuels is believed to be one of the most effective approaches to reduce the anthropogenic impact on the nature.

Our vision of the possible solution in the sphere of biofuels production and utilization is based on the recent trends in power and transport industries. These are decentralized power generation and ever growing importance of electric traction. Therefore the share of ICE-dedicated motor fuels, including biomass derived ones and, accordingly, the demand for energy crops such as rape, maize and others will be constantly decreasing.

The extensive biomass resources produced in rural areas are a powerful potential for local CHP sector development and independent heat and power supply, based on mini-CHPs operating on composite burner biofuels, in areas with practically no access to grid or where the grid power quality and/or reliability are poor. We already have technological solutions to implement this concept with the use of modern piston type steam engines (such as Spilling Energie Systeme GmbH, PolyComp) in combination with boilers equipped with efficient flame cups for composite biofuel combustion.

Composite biofuels are principally prepared on the basis of hydrous organic components. It is well known that up to 20% of water contained in any fuel in form of microfine emulsion acts as catalyst during combustion processes making them essentially more intensive and efficient. Therefore only 10% of water in even grade heavy fuel oil result in reduction of carbon soot by 80 to 90%, that of NO_X by 50% and that of SO_X by 30%.

In Laboratory of biofuel technologies of All-Russian Research Institute for Electrification of Agriculture (GNU VIESH) we carry out experiments on microwave assisted combustion of composite biofuels comprising 50% and even more of liquid and/or solid organic components of various nature using flame cups of original design. Composite burner biofuel typically contains 20% to 50% of hydrous organics (plant biomass, cattle dung etc.) blended in a heavy, low grade, oil derivative such as fuel oil using energy efficient technological methods that employ hydrodynamic and ultrasonic cavitation processes to obtain stable microfine multi-component emulsions/suspension.

[1] Committee on World Food Security. High Level Panel of Experts on Food Security and Nutrition. Biofuels and Food Security. The final report, May 2013,110pp

This approach makes it possible to implement the environmental advantages of biofuels at substantially lower production cost without the need for additional large area arable lands [7-9].

One of the most promising biofuel-dedicated crops is microalgae. The idea to produce biofuels from algae dates back to the 1970s when the world experienced a number of the oil shocks. The advantages of algae as a raw material for biofuel preparation are its enormously high productivity compared with terrestrials kinds of plant biomass and the possibility to save arable lands for food-dedicated and other traditional agricultural crops. Algae can be effectively cultivated in natural or artificial ponds on marginal lands, shallow lagoons, in cooling hydro systems of thermal power stations (TPS) and so on. In the latter case, it is technically easy to make use of rejected heat for algae productivity optimization and to employ algae's explicit photosynthetic properties for utilization of CO_2 contained in TPS flue gases [5].

Algae cultivation in closed photobioreactors is an option that makes it possibly to obtain phytomass of specific chemical composition for biofuel chemmotological properties enhancement.

So far, biofuel dedicated algae cultivation on a commercial scale has not been reported because the research in this field remained focused entirely on biodiesel as the only option. The problem is that the cost of biodiesel produced from algae grown in ponds would amount to US$240 to US$332 per barrel (Lawrence Berkeley National Laboratory, 2010) while the current price of crude oil does not exceed US$100 per barrel. That was the major reason for US Department of Energy to shut down the algae research program, in 1996. A decade has passed before it was started again but algae derived biodiesel has not yet found commercial application.

Our research has demonstrated the possibility of overcoming the algae fuels "production cost barrier" within the concept of composite biofuels described above. As a hydrous component of composite burner biofuel, microalgae suspension is an ideal organic material featuring very high grade of natural dispersiveness (down to 1 micron for planktonic strains derived from *Chlorella vulgaris* that is most commonly found in natural ponds of moderate climate zone). Microalgae suspension can be easily blended into grade heavy fuel oil using cavitation technology without any pretreatment insuring ultrafine and stable biofuel [10].

One of the new trends in the use of algae to remove CO_2 from the exhaust gas of thermal power plants and other industries. The exhaust gases contain a high percentage of carbon dioxide (up to 20% CO_2). Typical thermal power, coal, emits up to 13% CO_2. Thus, the thermal power plants are a major source of air pollution CO_2. Exhaust emission of CO_2 and use of alternative energy will lead to stabilization of atmospheric concentrations of CO_2 and prevent global warming.

Microalgae absorb CO_2 during growth, so that they can be used to remove CO_2 from the exhaust gas of thermal power plants and other industries.

Currently microalgae on a commercial scale in the open air is mostly grown in artificial shallow ponds of up to thousands of square meters.

Problems cultivation of microalgae in ponds led to the development of new technology for growing, based on the algae use of photobioreactors for the optimal functioning of the cultivation (or biofuel from microalgae).

Photobioreactors for growing algae can use only one-fifth or one-tenth of the land necessary for open ponds for the production of the same amount of biomass of algae. To use photobioreactors commercially, they need to be

the most efficient use of solar energy and have kept the purity of cultures of microalgae and the necessary conditions of cultivation [10].

Integrated use of key existing technologies will reduce dependence on imported fossil fuels and limited domestic resources, decarbonise the electricity sector, improve energy efficiency and reduce emissions in the industrial, transportation and residential sectors. This will reduce the growth in energy demand, reduce imports, strengthen national economy and significantly reduce greenhouse gas emissions.

Non-food competing crops for biofuel production should be evaluated in terms of their direct and indirect impact on food security as competing with food raw materials for the land, water, labor, capital and other investments.

Numerous case studies on biofuels show the importance of the transition to a more comprehensive strategic approach to bioenergy. In countries with large hinterland biomass mobilization for different types of bio-energy may be the most effective strategy for the development of electricity and alternative energy, water management and the creation of local energy systems.

Conclusions

1. Recent trends in biofuel production and use sector have to be essentially corrected to maintain the balance of agricultural products structure insuring food security and sustainability.

2. In the present stage of biofuel market development, the environment protection motivation will reasonably prevail over that of fossil fuels market uncertainty in view of oil resources run down.

3. Taking account to the recent trends (decentralized power generation and electric traction oriented innovations in automobile production industry), it is advisable to strengthen the role of burner type biofuels that do not compete with the food industry in the agricultural products markets.

4. Today, the most economically expedient option for burner type biofuels production technology is composite micro-fine suspensions and emulsion on the basis of low grade fossil oil derivatives that insure stable environmental effect at substantially lower production cost compared to ICE dedicated biofuels. These energy bio-products typically contain 20% to 50% of hydrous biomass and can be prepared using energy saving, low-temperature, hydrodynamic or/and ultrasonic cavitation processes.

5. It may be advisable to use burner type biofuels to feed stand-alone CHPs for independent energy supply of rural and other remote localities on the basis of mainly renewable organic wastes (those of agricultural production, timber harvesting and treatment, etc.).

6. In small stand-alone CHP systems, the new type piston steam engines may be effectively used. In the range below 1MW such system consumes only 0.1 to 0.115 kg of reference fuel per 1kWh of electric power while for steam turbines and diesel ICEs this parameter amounts to 0.15 kg/kWh and 0.174 to 0.2 kg/kWh, respectively.

7. The cultivation and use of microalgae as a renewable hydrous component of composite burner fuels may be regarded as an effective option providing a number of socio-economical, environmental and technological and other advantages, particularly, the following ones:

– no arable lands are required, no territorial competition with traditional food crops;

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INTELLECTUAL PROGRAM COMPLEX OF SUPPORT DECISION-MAKING ON ENSURING ELECTRICAL SAFETY OF PRODUCTION

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The intellectual program complex of support of decision-making on ensuring electrical safety of production represents the set united by information and communication process technical and the software functioning in interrelation with the user, capable on the basis of data and knowledge to synthesize the purposes and to develop rational faultless decisions on achievement of the objectives – to prevention of production electrical injuries, incidence prevention, improvement of working conditions.

Keywords: *intellectual program complex, decision-making support, electrical safety of the production, the formalized professional knowledge, not programming user, efficiency of a program complex*

General provisions. The most effective way of realization of actions for decrease in production electrical traumatism and to improvement of working conditions in production electrical installations is the automated decision-making on ensuring electrical safety of the production, real conditions of the production environment considering factors, the economic resources of the enterprise allocated for ensuring electrical safety, and the formalized knowledge of ensuring the electrical safety, transformed by software in rational decisions in concrete production.

The intellectual program complex of support of decision-making on ensuring electrical safety of production (IPC SDMEE) represents the set united by information communication process technical and software, telecommunication and computer systems and the technologies functioning in interrelation with the user (the person or group of people), capable on the basis of data and knowledge to synthesize the purposes and to develop rational faultless decisions on achievement of the objectives – to prevention (decrease) in production electrical traumatism, prevention of incidence working in electrical installations, to improvement of working conditions [1, 2].

The data and knowledge of a condition of electrical safety of production are formalized and collect in databases and knowledge of dynamic expert system. Resources of databases and knowledge are used for synthesizing of the purposes and local goals on decrease in production electrical traumatism, prevention of incidence and improvement of working conditions and electrical installations. Means of dynamic expert system make the decision and the operating influence which results of action can be predicted by the block of forecasts is developed and are considered at acceptance of a final decision by dynamic expert system. Made decisions are systematized and take place in a database and knowledge (see fig.).

The information carriers applied at formation of databases and knowledge of IPC SDMEE, are interconnected, have computer screen images and the corresponding program maintenance.

Developed decisions are shown in two options – completely corresponding to the saved-up decisions in the knowledge base or the adapted new decisions which are reflecting knowledge of the user of a program complex and not reducing degree of correctness of earlier saved up decisions on similar circumstances.

Information support. Information support of IPC SDMEE turns on the special information carriers having mainly screen computer image and if necessary firm (paper) representation. Possibility of use of available carriers and forms of account is provided. Data on electrical injuries and their material consequences, on other types of incidents on electrical installations, about diseases working in electrical installations, about performance of actions for providing demanded level of electrical safety and indications of the current administrative documentation, on a condition of an training level on electrical safety, about parameters of working conditions in electrical installations are subject to collecting.

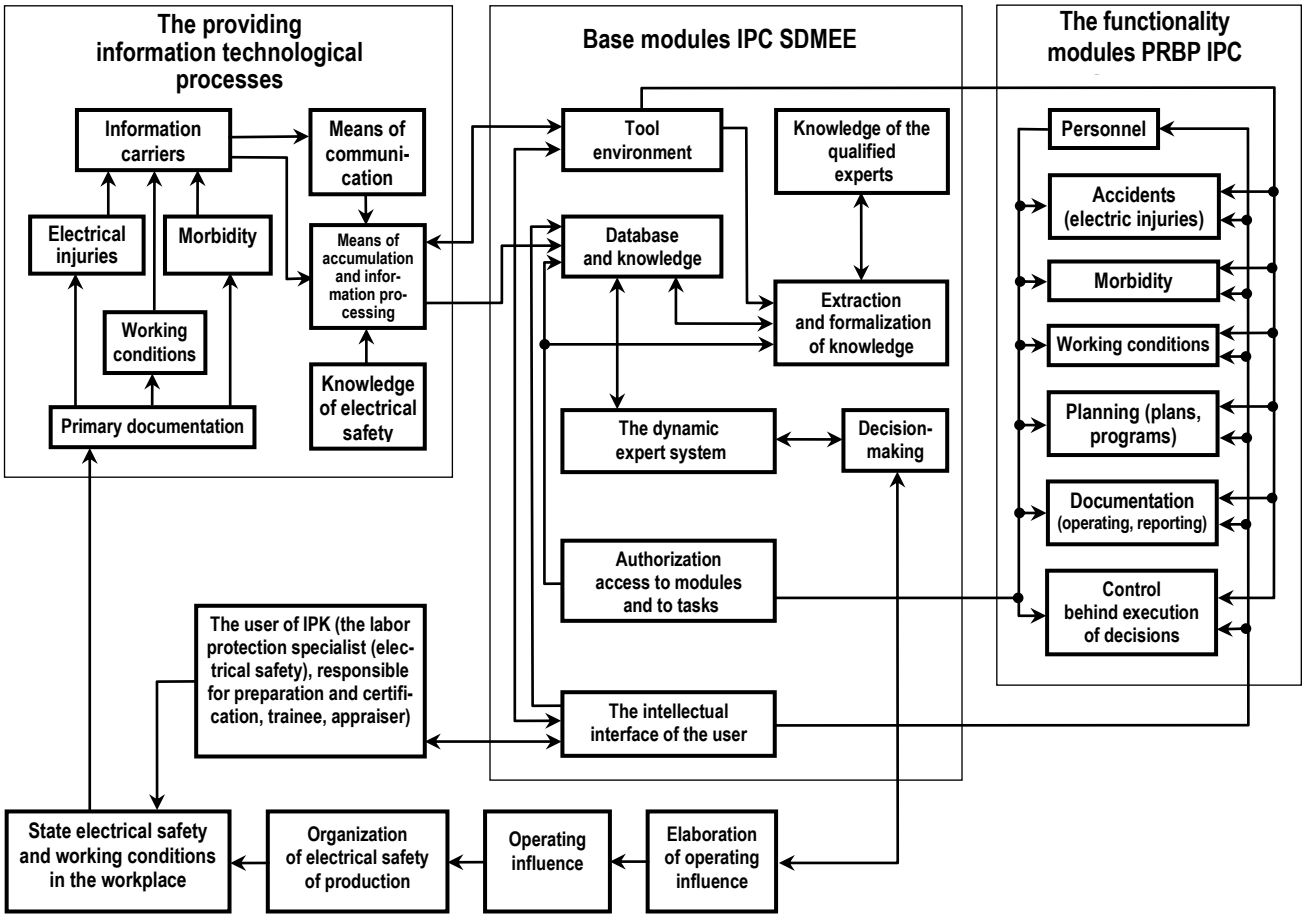

Fig. 1. Functional and technological structure IPC SDMEE

The main information carriers – a registration leaf of accident (electrical injury), a card of additional data to a registration leaf, the disability card, the card of control of working conditions – reflect contents of the similar existing approved documents and have unambiguous comparability of information containing in them [3, 4].

Information carriers provide obtaining the unambiguous characteristic of electrical injuries, the exception of minor information, and achievement at their filling with persons of different qualification, with a different education level of full comparability of data, their necessary completeness, reliability and efficiency is production the caused disease and working conditions on a workplace with electrical installation.

Procedures of setup of information carriers on a certain production from any terminal device with authorization of access to this procedure, additions of limited number of not used consistent values of characteristics supporting possibility in adjusted sections that guarantees the fullest reflection of specifics of concrete production, working conditions, features of circumstances of accident are provided, is production the caused disease and information needs of specific labor protection specialists with obligatory saving of the data reflected by similar existing primary documents. Information carriers can carry out a role of primary documents in the form of firm copies if they contain all necessary data and are signed by officials (with possibility of use of a digital signature).

Database and knowledge. The formalized knowledge placed in specialized databases and knowledge is applied to development and decision-making in IPC SDMEE. IPC supports standard technology of auto formalization of professional knowledge and provides not programming professional with tools of his independent formalization of knowledge own or allocated with it in their natural look corresponding to earlier stored professional experience and intuitive skills. The most significant from the point of view of production expediency acquire knowledge of electrical safety of production

by extraction of expert knowledge with use of computer procedures.

Two levels of representation of knowledge are allocated: the first – factual information and specially processed data, knowledge of classification signs in electrical safety of the production, the second – descriptions, the relations, comments, rules and procedures, knowledge of the classification conditions, the knowledge concentrating all necessary for the solution of a certain task of ensuring electrical safety of production [5].

At large volumes of knowledge for the organization of rational operating knowledge, reductions of time of search of the necessary decision and achievement of real operating time of system uses the third level of representation of knowledge – level of meta knowledge, knowledge of, knowledge of the knowledge, their structure and the principles of the functioning containing strategy of search of various groups of decisions, allowing to get rid of full search and the analysis of knowledge.

The factual information (facts) containing data on a condition of electrical safety, incidence and working conditions to be stored in a type of lists in a database of relational type. Each record is considered as event realization - accident (electrical injury), a disease, a concrete condition of working conditions. Set of the facts in the form of values of the attributes drawn from base or received from the expert, is used in search and decision-making procedures.

In the generalized dynamic expert system of the safety of the production of knowledge are presented with facts that fix the quantitative and qualitative indicators of the electrical safety characteristics of accidents (electrical injuries), occupational disease, condition or that production, demographic characteristics of workers, etc., and the rules that describe in logical conditions as the ratio between the facts.

The rule in the knowledge base of IPC to look like a certain semantic structure "IF <logical expression>, THEN <the procedure text> [comment]". The part "IF" is under construction as a logical combination of some objects and events and characterizes conditions of applicability of the rule (value of logical expression more than 0), part "THEN" is represented as the list of works which need to be executed at the accepted logical combination of the facts or its change, and concentrates the actions made by system by search of decisions. Comments are used for formation of explanations as in the correct and inexact and wrong directions of search.

Rules will organize the formalized way of submission of recommendations, instructions or strategy and provide a natural way of the description of processes of impact on a condition of electrical safety of the difficult and quickly changing production environment. Application of rules simplifies an explanation of ways of receiving by the program of the concrete conclusions.

Graphic images and the descriptions accumulated in a database and knowledge, supplement results of text formalization of knowledge. The built graphic representation of the actions preceding decision-making on ensuring electrical safety, contains experience and skills of the professional production worker and reflects the knowledge accumulated earlier formalized in the graphic images, placed in the knowledge base on safety of production with collectively verified graphic images (representations).

Intellectual graphic images are created by not programming professional users with application of network base of collectively verified graphic primitives. Again created intellectual graphic images place in the knowledge base on electrical safety of production after comparison to complete graphic representations and use for effective realization of these representations at decision-making on safety of production [6, 7].

Expert systems. The intellectual program complex in a mode of dialogue develops rational decisions on increase of level of electrical safety with use of procedures of the target expert systems built and filled by data and knowledge depending on objectives for automation and achievement of necessary quality of the main professional and production functions of the labor protection specialist (electrical safety). For support of process of search of decisions and their assessment software of IPC use the approaches imitating actions of workers, organizing information processing similarly to the processing made by the person, including interactive dialogue systems of planning, optimization and decision-making.

The dynamic expert system of IPC SDMEE supports decisions of the expert working with it, but doesn't replace it, possesses necessary flexibility and adaptability. Target expert systems are configured to the solution of a certain circle of information and technological problems of ensuring electrical safety of production. Decision-making in the environment of target expert systems is realized by functions of the organization of mechanisms of a conclusion, procedures of search and reasoning's, justifications and explanations of decisions and conclusions, identifications of inconsistent knowledge. Results of functioning of each target expert system are easily perceived, without special work are estimated by the user, increasing its efficiency. The professional personal aspect of decision-making, style and methods of work of the user is considered.

The target expert system models activities of the expert for electrical safety in narrow subject domain at the solution of a certain task, combining information and referral functions with decision-making functions with use of means of flexible dialogue of the user with system. The user joins in IPC as one of its functions and is considered as a unit with the network terminal of a network program complex.

Decision-making. In procedures of decision-making imitating models for formation of strategy of the search, being accompanied are used by justifications and explanations, dynamic processes of the visual solution of a task. In a mode of decision-making search of high-quality decisions in insufficiently certain situation with an active role of the expert in electrical safety will be organized at alternation of two procedures: extraction of knowledge and their presentation. System work in such mode is calculated on experts of rather high qualification, the system carries out a role of the specific tool of the labor protection specialist (LPS), supplies users with various information, carries out various calculations, makes "traditional" data processing, processing of graphic and hypertext data presentation, forms alternative decisions, increasing overall performance of LPS.

The network distributed knowledge bases provide to personal IPC flexible means of expeditious acquisition of a wide range of territorially carried qualified decisions for acceptance of the most expedient in specific working conditions.

Software of IPC SDMEE provide development and decision-making in the following main directions according to professional needs of labor protection specialists (electrical safety): prevention of production electrical injuries; prevention it is production the caused incidence; formation of the contents, recommendations and urgent measures of instructions; routine and advance planning of actions for the prevention of production electrical injuries and incidence prevention; providing with means of individual protection; complex assessment of workplaces on electrical safety level.

For submission of all possible plans of distribution of preventive measures (resources) and decisions on ensuring electrical safety of production the tree of the distributions (decisions), which each level describes different types of decisions in a considered situation is used. Any possible plan of distribution of actions and actions corresponds to a certain way which should be passed from a tree root (the appointed purpose) through its various branches. Decision-making is preceded by the analysis consisting in certain formalization and high-quality justification of the decision in a mode of network comparison, carried out at intuitive level the person making the decision from the point of view of the most preferable consequences.

Two procedures of search of the most rational decision are realized. In the first the count is formed and all his ways in search of the best alternative of achievement of the purpose are estimated. Maximizing value of a way in the column taking into account time and the cost of its construction is made. Strategy is feasible only at a small number of rules because of possibility of combinatory explosion. In the second procedure the way is estimated at time of its formation on each step and process of creation of the count comes to an end if the found way answers a preset value of function of an assessment. As criterion of value of a way the preference given by the user, a difference between issued and desirable information, number of the integrated models can be used the complex criterion estimating accuracy of rules.

Software of expert systems of IPC realize possible strategy of decision-making by the professional user by means of multi screen technology of hierarchical menus in the form of the dialogue which is reproducing habitual ways of a manipulation by information and not demanding from the

user of special computer knowledge, and provide obtaining necessary output documents for a preliminary visual estimate and then on firm carriers.

Functioning of IPC is initiated by the person making the decision, in the flexible dialogue environment, and process of decision-making consists in a choice of some set of a set of alternatives and their streamlining. Some is guaranteed independent of action of the user the bottom level of quality of the decision which can be raised as a result of influence of competence, professionalism of the person making the decision, decision-making choosing this or that method, its ideas of consequences of the decision, a choice of a method and the previous experience.

The made decision is fixed by primary documentation and (or) information carriers (including electronic), is transformed to the operating influence arriving in organizational production structure, influencing a condition of electrical safety and working conditions on workplaces, and reflected in a database and knowledge for the subsequent use for decision-making.

About efficiency. It is possible to carry the indicators allocated in four groups to indicators of efficiency of functioning of IPC SDMEE: efficiency of information support; quality of software; operational characteristics; quality of decision-making.

Information carriers of a program complex provide the expeditious automated collecting and accumulation of a solid data about accidents (electrical injury), diseases, working conditions in electrical installations in necessary volume, possibility of rigid feedback for control of results of impact of entered preventive actions on a condition of electrical safety of operating production with territorial and personal indexation.

The new system of the accounting of data on a condition of electrical safety allows to receive the unambiguous characteristic of an electrical injury, a disease and working conditions on a workplace and practically to exclude minor information; to provide full comparability of the information carriers given at filling with the personnel of different qualification; sharply to reduce time of registration of data on an electric trauma, a disease and working conditions in electro installations; to show to users of IPC and consumers of information carriers in two options – in the form of an electronic image and in the form of the firm copy; objectively in a complex to estimate a condition of electrical safety and electrical safe working conditions at the organizations the interconnected operational account and the analysis of data on production electrical traumatism, incidence and working conditions.

IPC SDMEE software on the basis of expert technologies provide possibility of continuous building and updating of knowledge with application of text and graphic procedures; independence of quality of decisions of level of special knowledge of users; possibility of search of optimum decisions, including with an assessment of their economic feasibility; the bottom level of quality of the decision (a faultlessness and economic feasibility), independent of action of the user who raises with increase of professionalism of the person making the decision, and in process of IPC application; possibility of building of number of automated tasks and operations, including not programming professional; rigid feedback, timely assessment and the accounting of results of application of decisions in operating production at elaboration of concrete preventive actions for creation of electrical safe working conditions; realization of network technology of use of functions and maintenance of modules of software.

In the category "efficiency" of IPC SDMEE and the made decision on ensuring electrical safety of production technical, economic and social aspects generally are allocated.

Technical efficiency is defined by the accuracy and completeness of implementation of the made decisions on ensuring electrical safety of production.

As criteria of profitability of software on decision-making demanded machine resources, time of search of the decision and more integrated indicator – costs of search the decisions considering expenses of manual and machine time for search of the decision, an hourly average rate working at IPC are considered.

The social aspect of quality of made decisions is connected on the one hand with decision-making of IPC forming conditions for ensuring electrical safety of production, preservation of human resources, health working which can be characterized by economic indicators by the correspond-

ing techniques. With another – the process of decision-making has high technological effectiveness, meets high requirements of ergonomics and turns work of the labor protection specialist in creative and attractive.

Costs of ensuring functional suitability of IPC calculate taking into account labor input and complexity of the project and are defined by the volume of a program complex (for example, number of lines of programs) and its database and knowledge (for example, number of values of registered parameters, number of lines of logical records of base). At an assessment of expenses costs of network interaction of software, of protection against unauthorized access, on maintenance are reflected in a stage of development and the subsequent operation (costs of detection and elimination of defects and mistakes, on development and modernization), on ensuring mobility of software (possible platforms, reuse areas, autonomy level) also.

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THE HEATING SYSTEM FOR LIVESTOCK WINTERING PREMISES

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In the article alternative, local, compact and energy-saving solution for heating of livestock wintering premises is suggested.

Keywords: *vortex hydraulic heat generator; compact; local; energy-saving.*

Currently, agriculture is facing the problem of large-scale implementation of energy-saving technologies which would allow to reduce material costs in the production of new products, as well as energy consumption in this process. A prospective trend in this field is the use of alternative energy sources.

One of alternative renewable energy sources is vortex energy [1, 2] which involves the technologies using whirled flows of continuous medium (for example, liquid and gas) for their transformation into thermal energy and temperature and pressure gradient.

Conventional heat generators widely used in engineering and everyday life, are energy converters using combustion heat of various types of fuel (liquid, solid and gas). Their disadvantages are environmental pollution with combustion products and considerable financial expenses for energy carriers transportation and storage.

Within the framework of this project, the Samara State Aerospace University in cooperation with GNU VIESH have developed an independent compact energy-saving, operationally flexible and technologically safe heat power plant – "Vortex Hydraulic heat generator" (VHHG). VHHG is one of the trends in the solution of problems of providing population, industry and agriculture with heat energy, especially in regions located in regions distant from centralized energy networks. This is a plant generating heat through changing physico-chemical parameters of liquid medium while it flows under complex influence of accelerated and decelerated movement. Flow acceleration is provided through generating vortex in the systems for whirling the flow of a vortex heat generator with simultaneous narrowing of flow in a nozzle, and deceleration – though its subsequent expansion in a cavitation tube of the heat generator and flow vortexing at the outlet of a cavitation tube.

The heat supply system on the basis of VHHP (Fig. 1) comprises the system for flow whirling 1, the cavitation tube 2, the vortexing device 3, heat transfer unit (heat exchanger, batteries, calorifiers, etc.) 4, the hydraulic pump 5, with the electric motor 6 and the control panel for controlling the heat generators operation 7.

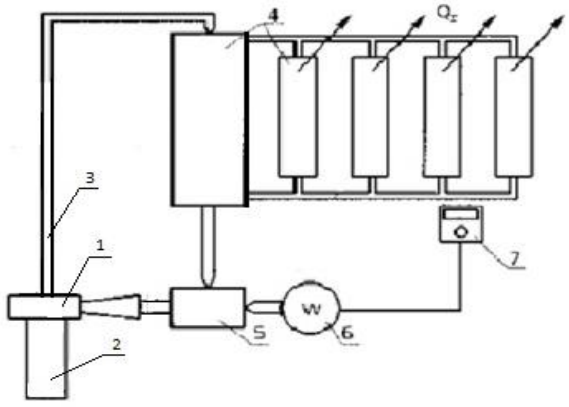

Fig. 1. The diagram of the decentralized system for heat supply on the VHHP basis

The miniature vortex heat generator (VHHG) operating from a hydraulic pump, is used as a heat source. Electric energy is used only for power supply to hydraulic pump drive of the heating system, and the hydraulic pump is powered only for water

heating. When the heating system is cooled down to the specified temperature, the hydraulic pump is switched off (with the use of the automated device for control of the specified air temperature in the premises). That is why the hydraulic pump with capacity of 1 kW, for example, in fact consumes only 0.5 kW in one hour of operation, and the hydraulic pump with 0.6 kW capacity – only 0.3 kW.

The testing results demonstrate that with the use of the hydraulic pump with 1.0 kW capacity, water in the heating system is heated to the temperature above +60ºC with energy consumption of up to 17 – 19 kW·hour, and with the use the hydraulic pump with 0.6kW capacity – to about +50ºC with energy consumption of up to 12 – 14 kW·hour.

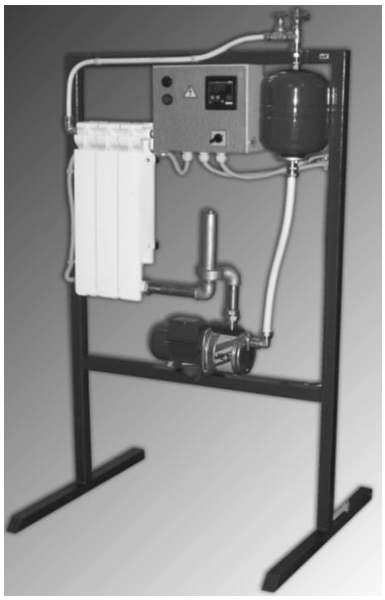

Fig. 2. The vortex hydraulic heat generator

The vortex hydraulic heat generator (Fig. 2) has the following advantages:

- heat capacity of the pilot plant (0.5…5) kW for heat supply to premises;
- the plant is ecologically safe; it is not necessary to combust hydrocarbon fuels (coal, oil, gas);
- no heating elements;
- electric energy is used only for power supply to the hydraulic pump drive;
- water treatment is not required;
- the possibility to heat liquid of any origin (water, oil, gas condensate);
- automatic temperature maintenance in the specified temperature range;
- low operate and maintenance costs.

The VHHG applications are rather wide and flexible, for example, the above-mentioned configuration can be operated with hydraulic pumps with up to 5 kW capacity. In addition, VHHG can be adjusted for maintaining any temperature in premises – thus, for example, VHHP with 1.0 kW capacity can provide +12ºC in a cattle farm with up to 160 m² area, and the same VHHG with a hydraulic pump of 2.5kW capacity would provide +12ºC in a cattle farm with up to 550 m² area.

Conclusions

It is reasonable to use the suggested heating system on the VHHG basis for the development of compact and low-cost heating systems of agricultural premises for livestock wintering.

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COMPOSITE FUEL

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The technology for production of composite fuel (cf) has been substantiated and suggested. The use of this fuel allows to increase combustion efficiency of hydrocarbon fuel, to reduce dust and harmful substances emission into the atmosphere and to optimize combustion process in industrial plants. The technology has been developed to the stage of industrial tests; in addition, composite fuel performance has been tested at a number of energy facilities.

Keywords: *methyl and ethyl radicals, combustion process, radical ions, composite activated fuel, vortex, hydrocavitation, rotary pulse.*

Existing technologies of production of hydrocarbon fuel are based on high-temperature cracking process with the use of catalysts. This is the process of disintegration of higher hydrocarbons into hydrocarbons with lower molecular weight due to breaking of C----C bonds of hydrocarbons in gas phase. In this process highly volatile methyl and ethyl radicals are formed, that cannot be used in fuels. These processes are multistage and long-term and are characterized by low yield of gasoline fractions. The second problem deteriorating consumer properties of hydrocarbon fuels, is related to the organization of the process of fuel combustion in engines and boilers: by-products of incomplete combustion are generated and fuel calorific efficiency is lowered. It is explained by the fact that for its initiation and maintenance combustion process requires free radicals, 100% of which are produced in water phase extracted from air or contained in the form of admixtures in fuel. In experimental and theoretical terms it has been proved that the process of hydrocarbon combustion does not occur without water.

Where free radicals can come from? There are several sources of free radical generation: water-aerosol phase, radical ions in the form of microadmixtures, electron stream from ignition systems, etc. However, their concentration in air and fuel is insignificant. To raise the concentration of radical ions, special treatment of fuel termed activation is currently used. Due to activation, not only radical ions content is increased but liquid properties are changed (viscosity, flow ability, surface tension, etc.). In water and hydrocarbons new phases of substance emerge, that are stabilized by electrostatic forces of bound charges. In this case free radical concentration may increase up to 10^5 time, thus providing low-temperature combustion, more complete use of fuel and drastic reduction of concentration of incomplete combustion products, longer service life and higher capacity of an engine. In the development of technologies for production of combined activated fuel (composite fuel) on the basis of high molecular oil fractions (diesel fuel, kerosene, mazut, etc.), vortex hydro cavitation and rotary pulse (RP) units have been used (Fig.1 and Fig. 2).

The operating principle of these activators is based on intensive intermixing of various types of hydrocarbons and water at molecular level due to vortex movement and cavitation. It is known that when solid substances are affected by powerful impulses in water medium, they are not only disintegrated but also assume physicochemical and technological properties that differ from those that they assume due to dispergation to the same degree of

fineness in other disintegrators. Hydrodynamic cavitation is classified among phenomena providing such effect. Until recently it was considered an extremely negative phenomena, as it was accompanied by failures of hydraulic systems and erosion destruction of hydraulic equipment. However, recent research has demonstrated that in certain conditions it is possible to cause hydrodynamic cavitation of "stall type" when cavitation bubbles collapse in liquid and not on channel walls, which allows to use destructive cavitation effect for intensive processing of liquid compositions without destroying operating elements of equipment. In comparison with cavitation generated in ultrasound units, hydrodynamic cavitation has a whole range of advantages: lower specific costs, lower price of units, simple design and operation, the possibility to be used in combination with other effects.

Fig.1. The RP unit

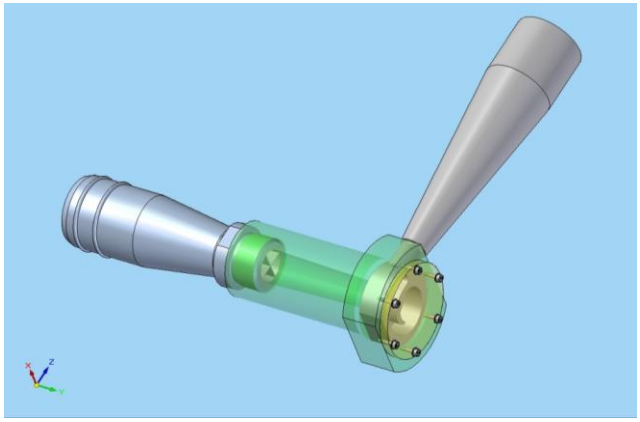

Fig. 2. The vortex hydro cavitator

Composite fuel (CF) is Hydrocarbon Fuel + Water associated at molecular level. This is a principally new type of liquid fuel differing from hydrocarbon fuel in peculiarities of burning out and heat exchange. In the process of associating of water and hydrocarbon fuel at molecular level, water becomes a kind of catalyst improving the process of fuel combustion. The use of units for composite fuel preparation provides the following advantages to customers' facilities:

- increase of initial fuel amount after processing by up to 50%; ·
- combustion heat of 138composite fuel is comparable to that of initial fuel;
- composite fuel viscosity is lower than that of initial fuel;
- the use of composite fuel at customers' facilities does not require changing of the system of fuel supply and does not lead to deteriorating of pulverization at existing system of fuel supply in comparison with initial fuel in the whole range of fuel temperature and pressure at fuel supply systems;
- composite fuel consumption at injection systems is reduced by no less than 15% in comparison with initial fuel consumption and does not lead to deterioration of boilers operation;
- composite fuel can be stored at temperature of 60…90°C in the same tanks as initial fuel;·
- composite fuel maintains its properties and quality for a long period of time;
- amount of structurally changed water introduced into fuel, can be as high 60…70%. therefore, fuel oil emulsions and waste water polluted with mazut can be introduced for utilization;
- even if large water lens are present in tanks for initial fuel storage, after being processed in the unit for preparation of composite fuel, high-quality fuel is produced;
- the use of the unit allows customers to exclude costs for initial fuel dehydration;
- due to the use of composite fuel at customers' facilities harmful emissions into the atmosphere are reduced (soot by by 30-50%, CO and NO_x - 2-3 times).

The findings of tests and research of composite fuel (Fig. 3 and Fig. 4)

Table 1. Tests for mazut and composite fuel combustion in vapor boilers

Fuel type		Mazut	CF	CF	CF	CF	CF
Fuel pressure prior to an injector	kgf/cm^2	6.5	6.5	6.5	6.5	6.5	6.5
Fuel temperature prior to an injector	°C	79	80	81	81	81	81
Vapor pressure in a drum	kgf/cm^2	3.85	4.35	4.35	4.3	4.05	3.95
Fuel humidity	%	3.6	4	10	15	20	25
Fuel consumption in one injector	л/ч	319	272	272	272	283	283

Table 2. CF research (diesel oil + water)

% water content	Specific heat of fuel consumption, kcal/kg (m^3)	Weight per-cent of sul-phur, %	Cetane number	Density, kg/l	Chilling temper-ature, T°C
40	10970	0.1	53(l)	0.85	- 40
50	11160	0.1	54(l)	0.832	- 39.4
Initial fuel	10300	0.2	35(l), 45(?)	0.83	- 35

Fig. 3. Exhaust gas emission in mazut combustion

CF spectrogram (research of the composite fuel specter comprising 60% of diesel oil and 40% of water, with the use of the Bruker AVANCE-300 spectrometer):

- CF specrometer (Fig. 5) is composed of groups of signal corresponding to CH_3, CH_2 and CH – groups of organic molecules within the range of chemical shifts 0-3 ppm and to groups of signals corresponding to aromatic groups of signals within the range of 6-8 ppm.;
- No signals corresponding to water molecules within the range of chemical shifts 4-6 ppm;
- That is, in liquid being researched there is mixture of organic molecules and no water. (For example, at Fig 6 the spectrogram of tap water is presented).

Fig. 4. Exhaust gas emission in composite fuel combustion

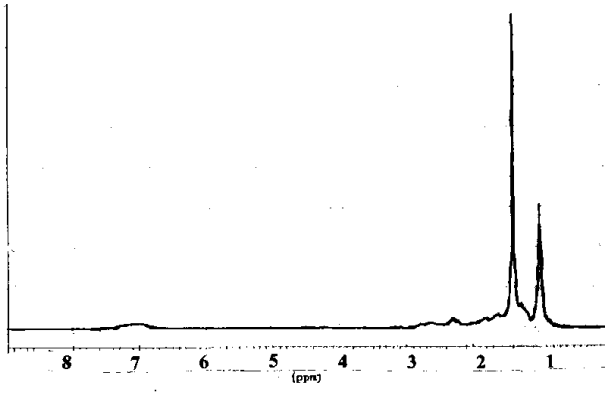

Fig. 5. Composite fuel specrogram

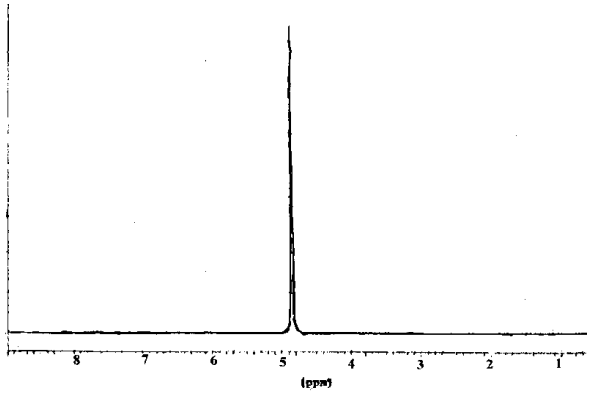

Fig. 6. Water spectrogram

Composite fuel produced with the use of vortex-cavitation technologies differs from 140 conventional dehydrated hydrocarbon fuel, as it contains hydroperoxide and hydrocarbon radicals, active atomical oxygen and is characterized by high level of radicalization and ionization. All these factors, without reduction of calorific efficiency per 1 kg of mass in total, considerably raise its combustion efficiency and make it possible to obtain substantial saving in comparison with combustion of conventional fuel types: mazut, diesel fuel, kerosene, gasoline, etc. In addition, it reduces toxic emissions to environment several times.

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THE LAW OF SURVIVAL AND ITS ROLE IN RENEWABLE GLOBAL ENERGETICS AND PROGRESSIVE EVOLUTION

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The progressive evolution directs the law of survival, the essence of which is opposite to the essence of the second law of thermodynamics. The second beginning destroys the structure emerged from the selforganised (live) the state of natural objects, preparing material for their second participation in the evolution of self-organized facilities. Law of survival and the beginning of a combined as a mirror of the dynamic symmetry into the General principle of natural history - the principle of power extremeness of self-organization and progressive evolution. Law of survival is realized in the form of energy saving mechanisms: phase transitions, fractal structures, solitons and other These mechanisms should be used in the global renewable energy.

Keywords: *law of survival; global renewable energy; the second beginning of thermodynamics, the principle of power extremeness of self-organization; progressive evolution; natural axiom - life - death»; the photoelectric effect, quantum equivalence of the photoelectric effect; determinism progressive evolution; exergy analysis; theory of potential effectiveness of complex systems; photosynthesis; spectral efficiency of photosynthesis; heat pumps; refrigerating machines; thermodynamic efficiency; exergy efficiency; energy analysis in economy*

1. The Second Law of Thermodynamics (SLT) – the Basic Law of Fuel Energetics and the Cause of Problems in Science and Energy Generation

It is known that S. Carnot's research [1] on the determination of potential conversion of primary energy carriers on the basis of the second law of thermodynamics is of paramount importance in the development of fuel energetics. However, the exergy method is unsuitable for similar analysis of renewable energy sources. This fact was revealed at the beginning of the XXth century by K.A. Timiryazev in his Croonian lecture "The Cosmic Role of Green Plants" [2] which he delivered on April 30, 1903 at the session of the Royal Society of London. The very title of the lecture suggests challenge to the science of that period. The cosmic role of plants was and still is in impressive natural process of solar energy conversion in photosynthesis process. This process runs counter to the second law of thermodynamics and its function – entropy. It is impossible to explain photosynthesis process on the basis of the second law of thermodynamics. It is in contradiction with "omnipresent and continuous growth of entropy".

In this connection, for the first time in his Croonian lecture Timiryazev formulated the problem of evaluation of potential conversion of solar radiation energy into chemical energy of organic substances by plants due to photosynthesis process. He expressed it in the following way [2, p. 345, V. I]: «I consider it needless to insist how important it is … to know…the share of solar energy that plants can use". In plain terms he stressed the relevance and importance of applied meaning of solar energy conversion for plant cultivation (in modern terminology).

Timiryazev determined that luminous values are not suitable for evaluation of radiation in plants cultivation. He was one of the first to research spectral efficiency of photosynthesis, which is vital for determining radiation exergy in plant cultivation, as it was found out later. During discussions on "heat death" of the Earth and the Universe, he, alongside with V.I. Vernadsky, H. Helmholz, N.A. Umov and K.E. Tziolokovsky suggested the existence of a still

undiscovered law whose essence is opposite to the essence of the second law of thermodynamics.

The answer to K.A. Timiryazev's challenge was presented in A. Einstein work [3] on the substantiation of quantum equivalence of photoeffect – quantum equivalence of direct conversion of radiation energy, published in 1905. It implies that radiation energy is not only emitted but converted in discrete packets – photons. Photoeffect (physical, chemical, biological) is proportional not to the amount of absorbed radiation energy, but to the amount of effectively absorbed quanta (photons). For this work A. Einstein was awarded the Nobel Prize.

Pure theoretical definition of photoeffect in accordance with Planck's formula is possible only in case if spectral characteristics of a radiation converter are similar to the same characteristics of absolutely black body. In the case of plants leaves, these characteristics principally differ from similar characteristics, which complicates the determination of radiation exergy in plant cultivation. For this reason the determination of radiation exergy is complicated for photoelectric converters, too [4, 5, 6]. In theoretical terms, radiation exergy is reliably determined only for heat converters. Adequate determination of exergy for plant cultivation is important not only for agricultural production, but also for environmental protection and preservation of nature and the biosphere in general.

In correspondence with the function of the second law of thermodynamics, natural structures are "universally and constantly" disintegrated, their energy is dissipated and entropy grows up to the entropy values of environment. This evolutionary trend in accordance with the second law of thermodynamics resulted in "violent discrepancy" with the theories of biological evolution (Darwinian, synthetic) [7]. The second law of thermodynamics also entails problems of its contradiction with any other branch of physics, as entropy growth testifies to the existence of time arrow, of its irreversibility, while basic postulates of other (classical) branches of physics envisage time reversibility [8].

It is for this reason that there is a contradiction between the second law of thermodynamics and the first law thermodynamics – the law of energy conservation and energy conversion equivalence which was established prior to the discovery of the second law of thermodynamics.

They have also revealed the problem of inconsistency of the second law of thermodynamics with the third principle of thermodynamics which states that in accordance with the second principle of thermodynamics "no thermodynamic processes can provide absolute zero of thermodynamic temperature. At the same time, sub-zero values of absolute temperature have been obtained empirically.

So, the Gibbs paradox emerged which, as it turned out later, it was impossible to solve even recognizing the second law of thermodynamics an independent law applicable to all natural processes. It relies on the fact that in mixing different substances with similar physical state, their entropy values are summarized. In this case entropy possesses additive property. If parts of chemically similar substances in the same physical states are mixed, their entropy remains equal to the previous value of each part being mixed (entropy additivity does not exist).

It is generally admitted that this and a whole range of other scientific problems, revealed as early as in the XIX century and related to classical thermodynamics, have so far not been solved. These problems significantly impede the development of technologies and engineering.

The fact that problems related to classical thermodynamic, have not been solved for a long time, considerably impeded the development of renewable energy which, in general, is based on the use of self-organizing energy-saving phenomena. This is the one of major reasons of poor state of internal energetics of Russia and other post-Soviet states [6].

2. Evolutionary (Post-Non-Classical) Paradigm of Cognition of the Law of Survival (LS) Opposite in its Essence to the Second Law of Thermodynamics

In the XX century computer and information technologies, as well as the Internet were rapidly developing. A major achievement in that period was the development of science of self-organization (non-equilibrium thermodynamics, synergetics, dynamics of complex systems), the formulation of the anthropic principle and quick shift of cognition paradigms.

Classical (mechanical) paradigm characterized by the determinism of classical mechanics,

in the first decades of the XX century was replaced by non-classical (physical) paradigm. It denied classical determinism and considered quantum states with self-organization elements and the indeterminacy principle. These paradigms of were characterized by methodological fragmentation of physical knowledge and understanding of man.

When the determinism of global progressive evolution and the anthropic principle was revealed, the non-classical paradigm of cognition was replaced by evolutionary (post-non-classical) paradigm of cognition. Its important characteristics are as follows: consideration of not only scientific achievements, but also of religion and culture in general, the integration of natural scientific knowledge with understanding of Man.

Having investigated scientific problems related to classical thermodynamics and believing into the soundness of some scientists' hypothesis of the existence of still undiscovered law in its essence opposite to the essence of the second law of thermodynamics, the authors relied on the evolutionary paradigm to verify this hypothesis. This law has been tentatively termed the general bioenergetic directivity of structures and functions of living systems, or in short, the law of survival (LS) [10, 11].

Modern evolutionists and their followers in related fields recognize the determinism and general directivity of progressive evolution of self-organizing nature, alongside with the Darwinian natural selection.

The prime general methodological postulate in the substantiation of the law of survival is the process of progressive evolution on the Earth which is a thermodynamically closed system in terms of substance exchange.

This fact is evident from the observed phenomena of limited exchange of meteorite substance on the Earth. In a system thermodynamically closed in terms of substance, progressive evolution is possible only in the presence of circulation of substances – elements composing self-organizing systems, in particular, living ones. It has been proved by experiments that such circulation of biophile elements really exists. In accordance with [8] and [9], only portions of percent of total content of chemical elements – nitrogen and carbon on the Earth surface, are circulating in the living part of the biosphere in a practically closed cycle. This fact testifies to the energy-saving directivity of biospheric processes and limited time of existence of both species and individual self-organizing natural objects, notably, of living ones.

Because of the necessity of substance circulation, systems that have left the self-organized state, must be destroyed (utilized). For this purpose, the law and mechanisms performing this process are required. Among the known laws, this process is characteristic of the second law of thermodynamics and its basic function – entropy. In accordance with the second law of thermodynamics and entropy, structures are universally and permanently destroyed, their energy is degrading, and their entropy is growing up to the level of environment. It should be added that it is characteristic only of objects that have left the self-organized state. At the same time, objects that are in the self-organized state, continue to maintain their structures and functions in accordance with the law of survival.

It is evident that because of neglect of the law of survival, in the works on progressive (global, universal) evolution, the role of the law directing it, is attributed to the second law of thermodynamics [12, 13]. However, the second law of thermodynamics, not only because of its basic function (entropy) but also because of its prohibitory definition, is unsuitable for the explanation of the essential creative law of Nature – its progressive evolution. To justify the unfounded attribution of a directing role to the second law of thermodynamics, in [12] an improbable mechanism is invented – the photon mill, and in [13] – the "mini-max" principle.

The wording of the LS essence reflects its directed creative nature in progressive evolution: each element of self-organizing Nature in its development (individual, evolutionary) is spontaneously directed to the state of the most full (effective) use of available free energy by the system of a trophic level to which it belongs. In nature LS is realized in the form of individual mechanisms of energy saving: phase transition, golden proportion, fractal structures, solitons, etc.

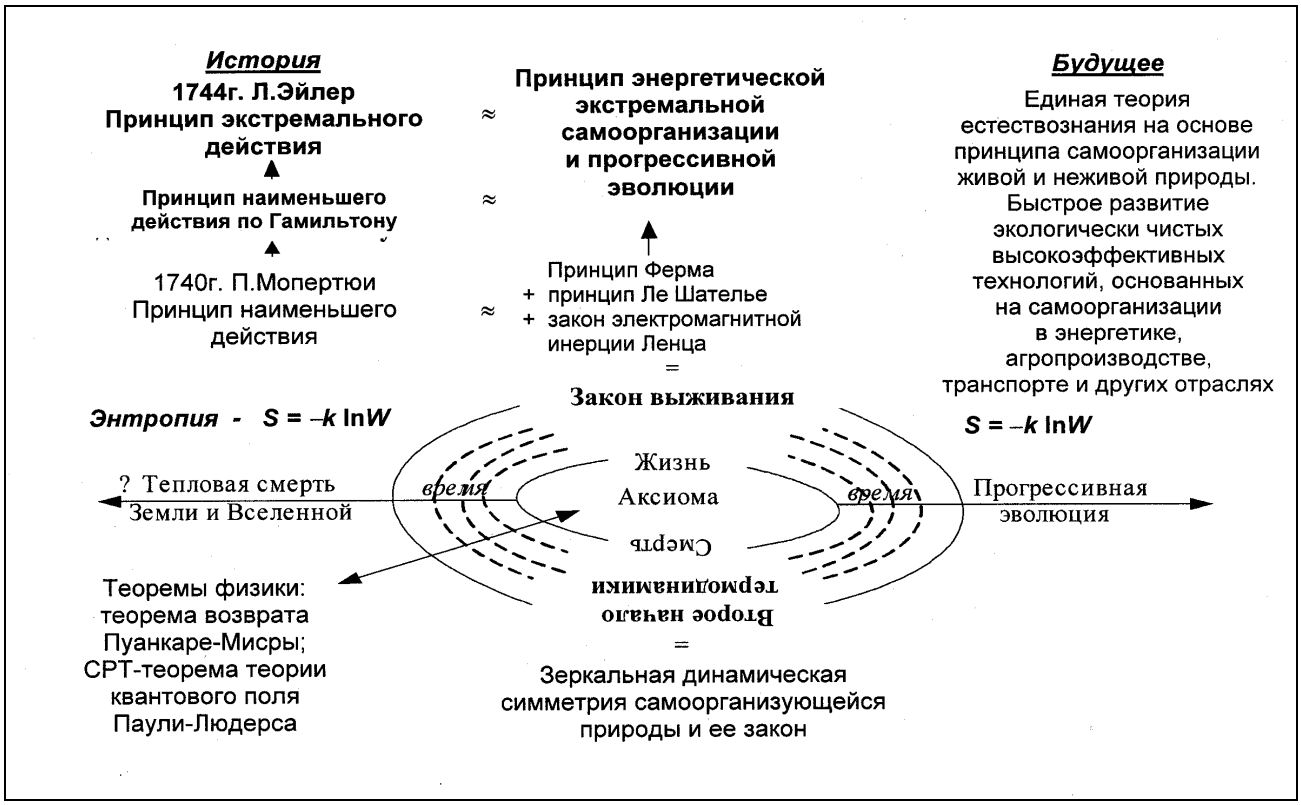

Fig. 1. Logical diagram. The principle of energy extremality of self-organization integrates the second law of thermodynamics and opposite in its essence law of survival as mirror dynamic symmetry, as well as phenomenal physical-chemical principles and theorems of physics

3. The Unity and Opposition of the Essence and Functions of LS and SLT

Neither LS, nor SLT are independent natural laws of nature. In the form of mirror symmetry they are inseparably united into a natural principle of energy extremality of self-organization and progressive evolution (PEESO and PE) (Fig 1).

The general axiom simultaneously reflecting LS, SPT, PEESO and PE appears to be the widely known phenomenon: the emergence of a self-organizing object (including organisms) – its birth – existence for a certain time period (life) and destruction – death. In short: life – death. This natural axiom is irrefutable. The use of this phenomenon as an axiom in literary sources was unsuccessful. Philosophers confirm its indisputability [14].

The unity and opposition of essences and functions of LS and SLT are confirmed by the immanent law of method inversion by K. Marx [15, 16]. This natural law formulated by Marx, is determined by the symmetry of Nature and its laws, as well as by the fact that symmetric laws are not discovered simultaneously. More often, one of symmetric laws is discovered, but they believe that it covers the whole nature, but later it turns out that it works only in some part of nature, and in another part the other symmetric law acts, which probably has the opposite essence.

Marx discovered the law of method inversion on the basis of the development of mathematics and transfer of arithmetic and algebra to integral calculus. Laws characteristic for arithmetic and algebra, do not work in integral calculus which involves other laws, but both the first and the second are adequate in their fields.

"According to the modern concepts, the second law of thermodynamics is not an exact law of nature similar to the law of conservation of momentum or the law of conservation of energy. The second law of thermodynamics has a statistic character and for that reason is implemented only "in the average". The difference in the formulations is as

follows: the statistic formulation of the second law of thermodynamics states that in a closed system processes accompanied by entropy growth, are the most probable, whereas the thermodynamic formulation considers such processes the only possible.

This difference is essential: the statistic formulation of the second law of thermodynamics not only does not deny but, on the contrary, assumes the possibility of progress whereby a system passes from more probable states to less probable ones, and entropy decreases, while the thermodynamic formulation totally excludes the possibility of such processes".

"In nature, alongside with energy dissipation, inverse processes always occur that result in emergence of new types of energy from "dissipated" energy, for example, energy of electric charges (lightning), energy of vortices and tornadoes, energy of excitation and disintegration of atoms, etc." [17].

The second law of thermodynamics was discovered empirically on the basis of the analysis of structure and functioning of a non-natural and non-self-organizing object – heat engine transforming heat generated by combustion (the process of fuel disintegration) into work. However, attempts were made to extend the second law of thermodynamics to self-organizing natural objects. In particular, it was extended to the conversion of energy by living organisms – plants, but this attempt failed. At the beginning of the development of classical thermodynamics, natural objects were not divided into self-organizing (non-equilibrium) and equilibrium (non-self-organizing, chaotic). The attempts to logically integrate the second law of thermodynamics with classical physics have led to the conclusion that the second law of thermodynamics is "foreign matter in an orderly system" of classical physics.

At the same time, according to Maupertius, in classical mechanics the principles of least action was known, and in classical optics - the phenomenological Fermat's principle which was the underlying principle of all optics. The analysis of these principles on the basis of the second law of thermodynamics has allowed to establish that their essence is opposite to that of SLT and corresponds to the essence of LS.

LS, PEESO and PE made it possible to solve all the above-mentioned century-long problems related to classical thermodynamics, and to solve the major problem of biophysics – to logically integrate the physical and biological theories. On this basis, natural scientific explanation of a great many phenomena that have been reliably established empirically or mathematically but so far have not been explained by modern science, has been given. Among such phenomena there are: phase transitions, ontogeny and biological law, fractal structures, golden proportion, solitons, etc. All these phenomena are the LS mechanisms or consequences [10, 11].

The solution of century-long scientific problems and natural-scientific explanation of many phenomena on the basis of LS, PEESO and PE confirm high reliability of substantiation, as well as high cognitive possibility of their use in the development of the fundamentals of unified knowledge and of highly-effective technologies and engineering solutions in many branches of production, first and foremost, in renewable global energetic and agricultural production.

4. The Law of Survival (LS) and Determinism of Progressive Evolution

Modern theories of biological evolution (Darwinian, synthetic) are based on natural selection of positive mutations from a whole range of random mutations. The theory of neutral selection at molecular level (the level of genetic material - macromolecules) testifies to the existence of mechanisms of cause-and-effect determinism and progressive directivity in the evolution of self-organizing Nature [18, 19].

The structure of the evolution tree of the biosphere organisms, built on the basis of cytochrome c analysis, is the evidence of this determinism. At all its branch nodes without any exception the same binary three-link fractal is observed. It should be noted that in accordance with LS, fractal structures are an energy-saving mechanism of the LS manifestation. This fractal energy-saving determinism of evolution clearly demonstrates the evolution tree of the development of organisms from microorganisms to Man. As can be seen, fractal determinism of energy

conservation involves two basic stages of evolution – biological and social.

In the period of physicochemical stage of evolution development, energy-saving mechanism of LS manifestation – golden proportion – emerged at the stage of evolution of elementary particles in distribution of energy in the process of their interaction [20]. Then this mechanism was subsequently transferred to biological objects (organization of organisms, functioning of their life-support systems) and social processes (architecture, music, economy) [10, 11, 21]. This indicates that the process of progressive evolution is characterized by spontaneous determination of conservation not only of energy and substance, but of information, too.

The consequence of such conservation is beauty and harmony of self-organizing objects of Nature itself and of laws (regularities, principles) reflecting its organization and functioning [10, 11, 21]. All that surrounds us, including ourselves, have been created through progressive evolution. In the outer world and inside us there is information on determinism and properties of progressive evolution. It is no accident that in the process of cognition principally new scientific principles are discovered due to intuition.

There is good reason to consider that intuition is related to genetic information of an individual. For example, it follows from the phenomenon of ontogeny, or biogenetic law, previously considered a phenomenal event but explained in natural scientific terms on the LS basis as a mechanism of conservation of energy [11], substance and information. It is appropriate to recall that the essence of ontogeny is in the fact that in the embryonic (postnatal) period of development an organism repeats the development of its species. This phenomenon in itself testifies to the existence of information on the species development in the genome of an individual organism. Intuitive cognition may be considered as transfer of information from genome to the consciousness level. Intuitivism as a school thought recognizes priority of intuitive cognition over all other types of cognition, including mathematical proof preferred by theoretical physicists. Unfortunately, this has led and is still leading to ignoring of physical essence and its substitution for mathematical relationships only slightly related to physical essence.

Intuition in combination with information from contemplation of the outside world created through progressive evolution, played and is still playing a vital role in cognition, especially in the Ancient world for Socrates followers and pre-Socrates researchers. In the Antique period an essential element of cognition was a teleological method which in the Aristotle's logic played a key role in the formulation of a thesis on an object of cognition. All subsequent operations of logical research are aimed at proving the truth or invalidity of telic thesis.

On the basis of LS, PEESO and PE, as well as of the above-mentioned elements of cognition, really ideal properties of progressive evolution have been revealed [21]. These properties are related to spontaneous directivity of progressive evolution of self-organizing nature in accordance with the LS conservation of energy, substance and information. This directivity for economy results in beauty and harmony of self-organizing natural objects. As a self-organizing object becomes more complex, its evolution speed is accelerated. These ideal properties of progressive evolution have been confirmed both theoretically and empirically.

Let us consider empirical confirmation of evolution acceleration accompanied by complication of an evolving system. In recent years experimental research has been carried out to establish the structures of the entire genomes of organisms. The structures of entire genomes of humans and mice have been determined. In the structure of the entire genome of mice only one percent of structures differ from the structures of the entire genome of humans. At the same time in the structure of the entire genome of humans over ten percent of structures differ from the entire genome of mice. Therefore, as is evidenced by the structures of the entire genomes of these organisms, since the time of the separation of the genetic branches of humans and mice, human evolution has accelerated over ten times.

The above-mentioned five ideal real properties of progressive evolution are inseparable. Metabolism, energy exchange and information (control) processes in organisms occur simultaneously in the same structures. They are termed the triad of life. On the basis of the Plato holon concept, the inseparable really ideal properties of progressive evolution can be considered as a holon of the high-

est level of self-organizing evolving nature. According to Plato, holons of the lowest level are quantum of action (Planck's constant) and other physical constants characteristic of basic entities of self-organizing nature at its lowest hierarchical level (elementary particles, time, space, etc.).

General methodological essence of quantum of action and other physical constants, as well as of progressive evolution with its inseparable really ideal properties can be perceived only on the basis of the Plato holon concept with due account of ideal properties of inseparable entities of Nature. Plato's "Idealism" appears to be real ideal materialism whose role in cognition is superior to all the existing new philosophical concepts of cognition.

5. Renewable – Global Energy and the Law of Survival

With the appearance of heat engines using various types of fuel, the problem of adequate evaluation and testing of their efficiency emerged. This task was successfully solved by S. Carnot. He found out that the heat engine efficiency depends only on the gradient of heat carrier temperature at the engine inlet (T_1) and the outlet (T_0). This dependence is known as the Carnot formula:

$$\text{efficiency}_{\text{т}} = 1 - \frac{T_1}{T_0}, \qquad (1)$$

The type of heat carrier (gas, vapor) does not affect the heat engine efficiency.

This important dependence constituted a ground for further substantiation of the second law of thermodynamics and of classical (equilibrium) thermodynamics in general. The only published work by S. Carnot [1] is important, as alongside with this dependence, he put forward the general research methodology which, however, was not considered fully enough. Without understanding of peculiarities of this methodology, this work is difficult to comprehend in general. The essence of the methodology is as follows. He subdivided the system "heat engines – various types of fuel" into two subsystems: set of "various engines" and set of "various fuels". Then he created an ideal engine working without losses – the Carnot's thermodynamical cycle which allows to evaluate the potential of fuel transformation into work. Further, considering the potential ability of fuel transformation he determined efficiency of heat engines of specified configurations.

Later this methodology was termed the theory of potential efficiency of complex systems (TPECS). It can be applied not only to energy converters but also to other consumers (converters) of various resources, notably, environmental ones. In quantity terms, potential ability of conversion of any fuel into work – exergy – can be determined through multiplying its total calorific value by efficiency.

However, for this purpose R. Clausius and W. Thomson introduced such the value of entropy instead of exergy. In an effort to simplify the evaluation of potential ability to convert heat energy into work, R. Clausius introduced the notion of reduced heat $Q_{П}$, which he defined as the relation of heat Q to the temperature of its heat content T:

$$Q_{\text{П}} = \frac{Q}{\text{T}}, \qquad (2)$$

Then he turned to increments, and termed $\eth Q$ increment of entropy:

$$\eth\text{Q} = \eth\text{S} = \frac{\eth Q}{T}, \qquad (3)$$

The formula (1) shows that with increase of heat carrier temperature at the engine inlet, fuel efficiency (exergy) at the inlet of the engine grows, and in accordance with the formula (3) with increase of temperature of heat content its entropy decreases at constant Q. Consequently, entropy S characterizes not the heat working efficiency, and its opposite characteristics. In fact, entropy growth characterizes decrease of working efficiency – exergy – of not only thermal but of other types of energy. Thus, they introduced such value as entropy – the function of the second law of thermodynamics, which is extremely difficult to comprehend.

In spite of its complexity for understanding, this value was used by the majority of power engineers of the world to analyze heat conversion into work or electric energy till the eighties of the XX century. In that period most of power engineers turned from entropy to exergy analysis as more reliable and easy to be used for calculations and interpretation.

Fundamental difficulties were faced in entropy analysis in investigation of equipment implementing the opposite process in comparison with

heat engines: refrigerating units and heat pumps converting work (or electric energy) into cold and/or heat.

It is traditionally thought that refrigerating units and heat pumps are using the "inverse Carnot cycle". In principle, it is not true. In fact, refrigerating units and heat pumps are implementing opposite process in comparison with heat engines – they convert work or electricity into low-temperature heat – energy of lower quality. There are problems with analytical dependences traditionally used for analysis of energy conversion of refrigerating units and heat pumps, too.

The Carnot's formula (1) shows that in the absence of temperature gradient it is impossible to use heat, in particular, the heat of environment wherein this converter is situated. In fact, the heat of environment is one of the most available and widely used sources of energy.

This reality can be most clearly and precisely explained and understood on the basis of the law of survival (LS) [6, 10, 11]. As working process refrigerating units and heat pumps are using self-organizing, highly energy-saving phase transition – evaporation – condensation, and not the "Carnot's cycle" or any other thermodynamic cycle used in equipment converting heat into work. As refrigerating units and heat pumps convert high-quality energy (work, electric energy) into low-quality – low temperature – heat, their efficiency can exceed 100%.

However, in accordance with the definition of the second law of thermodynamics, this is impossible. Evidently for this reason efficiency factor of conversion of energy of refrigerating units and heat pumps is termed correspondingly "cooling" and "heating" coefficient and not efficiency.

Logical-mathematical proof of the suitability of the use of efficiency factor in respect to energy-converting characteristic of heat engines is as follows [6]. It has been proved that it is adequate to use efficiency factor to characterize energy-converting ability of heat engines transforming heat into work. This indicator is widely used and determined in accordance with the Carnot' formula [1]. Refrigerating units and heat pumps are carrying out the reverse process – transformation of work into heat. For these converters it is adequate to use efficiency factor to characterize their energy-converting ability. It can be defined by the Carnot's formula, that is, in accordance with the definition of inverse value, unity must be divided by the right part of the Carnot's formula. In the result of this operation we shall obtain dependence usually used to calculate "cooling" and "heating" coefficients for refrigerating units and heat engines correspondingly. This confirms reliability of logical-mathematical evidence of adequacy of the use of efficiency factor to characterize the energy-converting ability of refrigerating units and heat pumps, quite as much as of heat engines.

As it was mentioned at the beginning of this article (p. 140), alongside with environment heat, the most important renewable energy source is the energy of optical part of solar specter and conversion of this energy in the plant photosynthesis process. This natural process generates the largest amounts of free energy on the Earth, accumulated in organic substance. Annually accumulated amounts of this energy exceed total energy generated by industrial equipment worldwide, by tens of times.

According to the definition of labor formulated by the Ukranian cosmist S.A. Podolinsky who extended the labor definition suggested by K. Marx, supplementing human labor with the "labor" of the rest of Nature, by "labor" we should understand "such physical and psychical actions that increase free energy yield on the Earth" [22]. Free energy accumulated on the Earth surface due to the natural process – plant photosynthesis – should be classified as "labor of the rest of Nature".

The evaluation of potential convertibility of solar energy by plants is extremely important not only for agricultural production but also for environmental protection, biosphere research and preservation of nature. As the problem of fossil fuels exhaustibility is becoming ever more urgent, solar energy is used for generating technogenic energy in the form of electricity and heat. In this case it is also necessary to determine radiation exergy. On the basis of the analysis of published works in this field [4, 5, 6, 10, 11] it can be said that in theoretical terms radiation exergy is reliably determined only for thermal conversion of radiation. Theoretical determination of exergy of complex (non-monochromatic) radiation is impossible, as green leaves of plants, as well as photovoltaic converters (silicon photocells) in their optical and energy-

converting characteristics do not correspond to similar characteristics of absolutely black body.

On the basis of works by K.A. Timiryzev [7], F. Einstein [3] and S.A. Podolinsky [22] the method of determination of radiation exergy for plant cultivation has been developed. It was discussed at the III International Congress on energy conversion by plant systems, held by the German Institute of Molecular Biology and the Humboldt University in Berlin, and published in this University scientific magazine [23].

The theoretical part of this method involves the determination of absolute spectral efficiency of photosynthesis of monochromatic radiation with wave length of 680 nm corresponding to maximum relative spectral efficiency of this process. Value of this variable was determined with the use of two independent methods: 1) on the basis of the Einstein laws of quantum equivalence and the laws of photochemistry; 2) on the basis of the second law of thermodynamics and real values of temperature of the Sun radiating surface (6000 K), as well as of average value of optimum temperature range of natural habitat of plants (300 K).

Then relative spectral efficiency of photosynthesis was determined also with the use of two independent methods: 1) estimated determination of this value considering the spectra of absorption of basic photosynthetic pigments and their averaged concentration in plants leaves, with due consideration to laws of photochemistry and quantum equivalence of photoeffect; 2) statistical processing of experimental data to establish relative spectral efficiency of photosynthesis with the use of the gasometric method. The most reliable results were submitted by 6 authors describing 66 series of experiments involving various plants species: both herbaceous and woody.

Values of relative spectral efficiency determined with the use of the two independent methods are closely similar almost in the whole range of photosynthetically active spectral region, with the exception of the 300-380 nm range wherein spectral intensity of solar radiation is relatively low.

Exergy capacity e_c (irradiance) of solar and any other spectral content $\varphi(\lambda)$ can be defined with the use of the method of graphic integration by the following formula:

$$e_c = 0{,}95 \int_{\lambda_1=300}^{\lambda_2=750} \varphi(\lambda)_c K(\lambda)_\phi d\lambda, \qquad (4)$$

where 0,95 – maximum spectral efficiency of photosynthesis of radiation with 680 nm wave length; t_1, t_2 – time of the beginning and the end of radiation action; λ_1, λ_2 – radiation wavelength; $K(\lambda)_\Phi$ – relative spectral efficiency of photosynthesis (photosynthesis spectrum of action).

For total radiation (direct + diffuse) near the Earth surface the value e_c amounts to 20 % of the total energy of the optical region of solar radiation.

An important part of research aimed at the development of the method of determination of radiation exergy for plant growing, was the substantiation of the law of survival (LS) whose essence is opposite to that of the second law of thermodynamics. This research was based on the post-nonclassical (evolutionary) paradigm of cognition, considering the achievements of evolutionary determinism, as well as of religion and culture in general.

The initial solution of the problem of solar radiation to be used in plant growing was suggested by A.A. Nichiporovich, the corresponding member of the USSR Academy of Sciences [24]. It involved generation of the so-called "physiologically active radiation" (PAR) – radiation in the range of 380 – 720 nm wave length and its measurement with the use of a device with indiscriminate spectral response. The PAR method was designed to consider not only the photosynthesis process but also other photo physiological processes of plants: photoperiodism, photomorphogenesis, etc.

However, the analysis of these processes and their comparison with photosynthesis demonstrated that they require tens of times less energy supply (solar radiation) than photosynthesis – major energy-converting mechanism of plants. The PAR method does not take into account various values of specific spectral efficiency of photosynthesis in the range of 300 – 750 nm wave length. This is a critical weakness of this method. Moreover, in the same range it does not consider difference of spectral efficiency of other photophysiological processes in plants.

It is predicted that in the development of renewable energy direct conversion of solar radiation into electric power with the use of technological devices – photo cells, will play a global role. Purely

theoretical determination of radiation exergy of this type of conversion is also impeded for the same reason as the determination of this value for energy conversion in the process of plant photosynthesis. Spectral characteristics of photocells differ fundamentally from similar spectral characteristics of absolutely black body.

The most widespread converters of this type are silicon crystalline photocells. Typical spectrum of activity of photovoltaic silicon converters is presented at Fig. 2.

Relative spectral efficiency of this converter is similar in form to the Gaussian curve. Considering the most common designs of converters of this type, it would be appropriate to substantiate "standard" spectral relative efficiency of silicon photovoltaic converters. It can be used for the determination of exergy of solar radiation when it is converted into electric energy. Absolute spectral efficiency for radiation with wave length corresponding to maximum spectral efficiency of a photocell will apparently be equal to 0.94-0.95, as in the case of exergy determination for the process of plants photosynthesis.

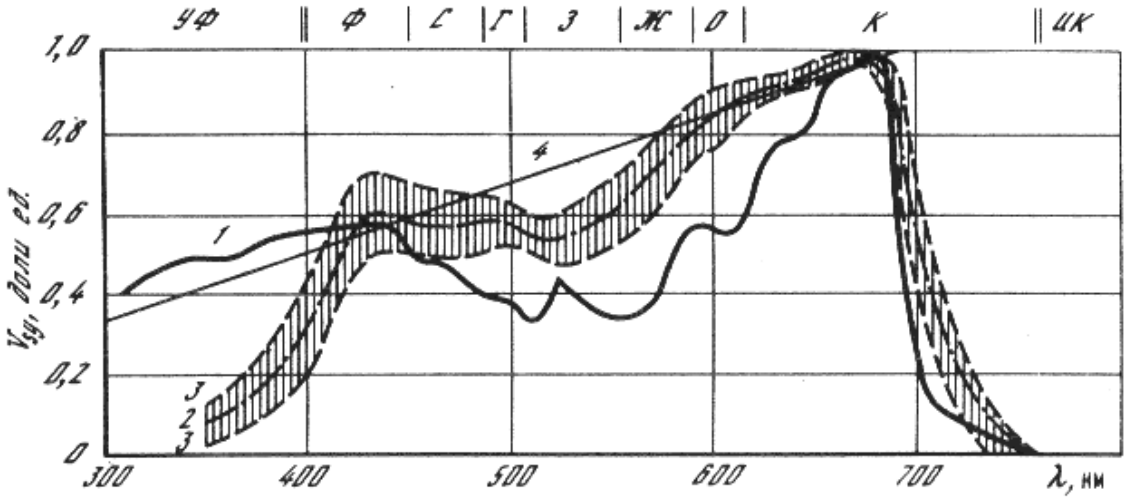

Fig. 2. Spectral photosynthesis efficiency of optical radiation
1 – calculated data (according to I.I. Sventitzky; 2 – average value of experimental data of six foreign authors (statistical processing by V.A. Mudrik and I.I. Sventitzky); 3 – confidence interval; 4 – spectral density of photon radiation when using an optical radiation source with equal-energy spectrum.

Taking into account the law of survival and other related innovative postulates, it became possible to determine exergy of renewable energy sources – environment heat and solar radiation – that are the most promising for the development of global energetic.

Summary and Conclusions

Human consciousness and activities determinate by consciousness, are mostly defined by ma's perception of the outside world. This particularly applies to scientists striving to create new concepts in science, engineering and technology. Let us try to specify innovative concepts determined by LS. In short, they are as follows:

- the law whose essence is opposite to the essence of the second law of thermodynamics, have been revealed and its definition has been formulated. It has been termed the Law of Survival (LS);

- it has been established that the second law of thermodynamics is applicable only to equilibrium (non-self-organizing) systems and is not applicable to self-organizing systems;

- it has been shown that due to SLT self-organizing systems (including living ones) that have left self-organized state, are utilized. Due to SLT and its function – entropy – the structures of systems that have died, are destroyed, their free energy degrades and entropy grows up to the level balanced with environment;

- it has been revealed that the second law of thermodynamics (SLT) and the law of survival (LS) are logically integrated in the form of mirror dynamic symmetry into the general natural principle of energy extremality of self-organization and progressive evolution (PEESO and PE);

- progressive evolution is directed by LS. Subject to this law, natural self-organizing systems come into existence and function. LS is manifested in the form of individual natural mechanisms of energy and resource conservation: phase transitions, golden proportion, fractal structures, solitons, phenomenal extremum principles used as initial postulates in physical theories, etc.;

- natural axiom – "life-death" simultaneously reflecting LS, SLT, PEESO and PE, has been established;

- using quantum equivalency of photo effect and LS as initial postulates, the methodology of exergy conversion of energy of radiation (of light) by plants in the photosynthesis process, has been developed;

- on the basis of LS, PEESO and PE, the century-long scientific problems related to classical non-equilibrium thermodynamics, have been solved. The key problem of biophysics has been solved resulting in logical conceptual integration of physical and biological theories;

- on this basis phenomenal events that have been reliably substantiated empirically or mathematically, but have not been explained in scientific terms: ontogeny or biogenetic law, golden proportion, fractals, solitons, extremum physicochemical principles, etc;

- on the basis of LS, PEESO and PE really ideal properties of progressive evolution: its spontaneous directivity to saving of energy, substance and information, have been revealed. This saving consequence is the beauty and harmony of self-organizing natural objects. As evolving systems become more complicated, their evolution is accelerated;

- it has been demonstrated that the anthropic principle is a consequence of progressive evolution. Its essence has been expressed in such a way that its scientific substantiation both at macro and micro level is evident. Any general scientific theory is not correct if it does not envisage the emergence of physical conditions for life on the Earth, the birth of life and man- observer. This description reflects objectively existing reality of the anthropic principle at macro level, thus satisfying the requirements of scientific evidence. Real calculations of the values of the Earth physical conditions suitable for living, revealed that these values can be obtained only if physical constants in these calculations are determined with accuracy not lower than 9-12 decimals. If calculation accuracy is lower, it is impossible to obtain conditions suitable for living. At macro level the anthropic principle wording also reflects objective reality;

- all that exists on the Earth – from microparticles whose properties reflect physical constants, to man-observer – has been created through progressive evolution. That gives grounds to assume that processes of progressive evolution at all its stages proceed with precision accuracy;

- it has been revealed that the evolution tree of the biosphere organisms is characterized by binary three-link fractal which confirms the economic character of progressive evolution at all its stages;

- human society is an integral part of the Universe and the Earth biosphere. At present it seems to be the leading element of the evolution on the Earth. Human race major difference from the rest of nature is consciousness and conscious activity but we lack understanding of our mission and of global determinism of progressive evolution, which are revealed by the anthropic principle. This principle is no less important for conscious activities of human society, as the law of gravitation for the development of technologies. It should be the basis for the development of all social knowledge and culture in general.

- the rigid determinacy of the possibility of emergence of humanity at the earliest stage of progressive evolution – emergence of microparticles, as it follows from the essence of the anthropic principle, is apparently not accidental. Considering spontaneous directivity of progressive evolution to conservation of energy, substance and information, it is reasonable to suppose that humanity is predestined to intensify these properties. In any case, human conscious activity should not come into conflict with these properties of progressive evolution of the other, nonsocial part of nature.

- an important step in the development of the methodology of cognition is transition to the evolutionary (post-non-classical) paradigm considering evolution determinism, religion and culture in general. The inclusion of the Plato holon concept into this paradigm of cognition would contribute greatly to its development, as recognition of this concept significance has been delayed for over two millennia. In accordance with this concept, really ideal properties of progressive evolution are holon of the highest level of the self-organizing nature and quantum of action and other physical constants characterizing microparticles are holons of the lowest level of Nature.

This postulates determined by LS, allow to come to the conclusion that the anthropic principle is a consequence of progressive evolution characterizing the level of its precision – high accuracy of the realization of this global process of self-organization of Nature. Cautious attitude to the principle on the part of methodoligists and theoretical physicists concerning its precision [25] generates a need to formulate it in a form demonstrating its scientific substantiation.

The essence of the anthropic principle essence is as follows: through astronomical calculations of existing physical conditions on the Earth suitable for birth of life and man it has been established that these conditions can be obtained only if physical constants used in these calculations, are determined with accuracy not lower than nine-twelve decimals. It is impossible to determine real physical conditions on the Earth suitable for life at lower accuracy of determination of physical constants. Moreover, it is impossible to determine real energy interaction of particles, nuclear structures, atoms, etc.

It seems that already at the level of emergence of elementary particles characterizing physical constants in the process of progressive evolution, it "envisaged" the formation of physical conditions on the Earth suitable for the birth and existence of life and man-observer. The required accuracy of the determination of physical constants for calculation of physical conditions on the Earth apparently demonstrates the level of accuracy (precision) of the realization of progressive evolution at the earliest stage of its development - emergence of microparticles characterized by physical constants.

Therefore, the anthropic principle is the evidence of the determinism of progressive evolution and, to a certain extent, of its really ideal properties. This principle has also been revealed in research not related to the study of evolution, but it demonstrates determinism of the beginning and of the leading element of progressive evolution – man-observer. Therefore, this principle appears to be the determined foundation of the relationship of natural sciences and anthropology.

There seems no escaping the conclusion on the similarity of its role in anthropology to the role of gravitation in natural sciences. It is impossible not to note the key role of the anthropic principle in the development of the theory of cognition of "life sciences" and of unified comprehensive knowledge. In this light, let us try to formulate the essence of the anthropic principle in such a way as to demonstrate its scientific adequacy.

It can be formulated in the form of requirements to general scientific theory. Any general scientific theory is not correct if it does not envisage the emergence of physical conditions for birth and existence of life and man-observer on the Earth. This wording reflects the essence of the anthropic principle at macro- level – the level of man-observer. It reflects the existing reality – physical conditions for life on the Earth really exist, as well as man-observer.

The above-mentioned definition of the anthropic principle at macro level demonstrates high precision accuracy of general spontaneous directivity of evolution of self-organizing nature towards progress. It also testifies to the deterministic relation of all basic physical constants, though the determinacy of these relations was previously denied. This dependence evidently reflects ideal properties of progressive evolution – first and foremost, conservation of energy, substance and information of their structural organization and functioning.

In general, the anthropic principle is deemed to be the beginning of cognition of the mission of man-observer as the most important element in the whole system of evolutionary progress. It allows to theoretically solve the key problem of ethics: what is goodness in general?

According to G. Moore [26], it does not seem possible to answer to this question on the theoretical basis – apparently, because there is no answer to the question "what is life from the cosmic view-

point? The answer to this question is possible on the basis of LS. From the cosmic viewpoint life is a phenomenon opposite to useless dissipation (degradation) of free energy – exergy. This is the purpose of progressive evolution. In accordance with LS and the anthropic principle, evolutionary (historical) development of human society cannot be spontaneous. It must be channeled in the same direction as the progressive evolution of the rest of nature.

On the basis of principles of logic, man must intensify this directivity of self-organizing nature. At the worst he should not impede this directivity, and at the best – intensify it due to conscious thinking. It may be no accident that man was endowed with this unique specific ability characteristic exclusively of human beings, and, most likely, it is designed to foster general spontaneous directivity of progressive evolution and its transition to a new higher level of progressive development.

It is currently stated that it is impossible to solve the key problem of ethics on the theoretical basis, so it is being solved intuitively, most often for egoistic purposes. This is evidenced by the published work by Nobel laureate, ethologist K. Lorenz entitled "Civilized Man's Eight Deadly Sins" demonstrating phenomena of modern capitalist society flagrantly adverse to humanism. These phenomena seem to be direct consequences of egoistic solutions of the key problem of ethics.

The history of the development and destruction of many civilizations on the planet Earth demonstrates that so far humanity has not found progressive direction of its development in spite of existence of progressive teachings on its development both in science and in many religious trends. Unfortunately, in modern ethical, social and psychological knowledge there are no laws and principles which might serve as the basis for theorization of this knowledge. The anthropic principle and LS may well play the role of theoretical principles in this sphere of knowledge.

Really ideal properties of progressive evolution which are physically inseparable, are inherently determined by LS. The anthropic principle, being a consequence of general spontaneous progressive directivity of evolution, confirms the manifestation of these properties at its initial physicochemical stage when elementary particles characterized by physical constants, emerge. This principle demonstrates original high precision accuracy of the realization of the process of progressive evolution and the teleological reflection of the possibility of birth of man-observer at a certain stage, which is possible only if precision accuracy of progressive evolution revealed at micro level, is observed. It is not by coincidence that this process teleologically determines the birth of man-observer whose role in this process is evidently determined, too. It is extremely important to bring it to light on the basis of LS and the anthropic principle, as well of really ideal properties of progressive evolution.

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ANNUAL CONTENTS - 2013

Research in Agricultural Electric Engineering Volume 1 (№1)

Contents

Research in Agricultural Electric Engineering Volume 2 (№2)

Contents

Research in Agricultural Electric Engineering Volume 3 (№3)

Contents

Research in Agricultural Electric Engineering
Volume 4 (№4)

Contents

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