

# Preface

The growth in the world population and the related increase in the demand for food and other household items set the task of intensifying agricultural production throughout the world. The solution of this problem requires ubiquitous applications of new technologies for cultivating agricultural structures, their primary processing and transportation to places of consumption or deep processing. Some of today's technologies, especially those that are out of date, are characterized by relatively low productivity and, in this connection, high consumption of energy resources. The latter increases the cost of production and, most importantly, leads to an increase in greenhouse gas emissions (i.e., to enhance the anthropogenic impact on the natural environment).

Solving this problem requires the use of new, energy-saving and environmentally less harmful technologies of a variety of different types, and not only in production, but also in the social sphere.

There was such a situation that information of this kind is needed not only directly by the worker in the village. The manufacturers and developers of such technical facilities and technologies and scientific organizations that are engaged in the development of technologies and equipment for the power industry of the village, production processes of various types, as well as the problems of housing and communal solutions, are showing great interest in new efficient means of conducting agricultural business, especially on a small scale, problems of the rural population.

An important issue is the organization of reliable power supply in an autonomous mode. The use of renewable energy sources can play an important role in this issue. And this means that information on the possible technologies of efficient generation of electric and thermal energy, its rational consumption through the use of energy-saving technologies will inevitably be in demand. Of great importance in the organization of intensive activities in rural areas can also be the use of efficient technologies for the cultivation of products and its processing on site with the least expenditure of energy, the amount of which at remote sites may be critically small.

## **OBJECTIVE OF THE BOOK**

The book is intended for agricultural business executives who are going to start and develop production, primarily in agricultural production. It will be useful for practical workers in the agro-industrial sector, small entrepreneurs, local authorities. A useful book will be for scientists, engineers and technicians engaged in research and development of new technologies and new effective technical means to solve the problem of energy consumption decrease in agro industrial sector and in the housing and communal services sector in the countryside.

In the book the information in creation of systems of generation electric and thermal energy with use of renewable energy sources will be displayed. Use of described technologies will allow to create in rural areas efficient and environmentally friendly an energy potential, sufficient for the organization of industrial and social-economic activity in these territories harmless for the surroundings.. The technologies of transfer of the electricity on considerable distances offered in the book will allow to make a choice in favor of more effective way of power supply of territory. I.e. or at the expense of the organization independent RES based power supply, or at the expense of joining to the centralized networks. Useful information on application of innovative power saving up electro technologies in processes of processing of agricultural products, realization of social programs in rural territories will be submitted as well..

The cases of best practice described in the book, specific examples of the implementation of new technologies may provide serious assistance to practitioners in their activities for agricultural production, energy saving technology implementation, intensification processes at the all studies of the rural objects energy supply, effective electricity transmission, electro stimulating technologies, treatment and primary crops proceedings, harvesting machinery, RES based energy systems implementation etc. The wide coverage of the problems envisaged in the preliminary content of the book gives reason to believe that the demand for book from buyers will be quite high.

The book edition provides an information interchange intensification between generators of new technologies and beneficiaries from their use. Such exchange, in turn, undoubtedly, will impulse the further development of the technologies described in the book.

Does not cause the doubts, that fact that for readers will represent a great interest all complex of the stated information and the book will receive undoubtedly great demand at readers.

The book presents the results of studies of various authors from around the world. Some chapters are the result of joint research by various teams, including international ones.

It comprise such topics as advanced technologies in the production of grain with low energy consumption, innovative energy saving technologies in the production of milk and meat, energy-efficient thermal processes in agricultural production, advanced technologies for primary processing agricultural products, intensification of technology processes by electric, magnetic and other influences, PV solar power plants for rural objects energy supply, wind based energy generation installations and systems, cogeneration PV Thermal modules fabrication and application, Rational Use Energy case studies, diagnostic and monitoring methods for energy equipment status in rural conditions, energy efficient electric equipment for heat supply in agriculture, electric pulse cultivation, pre-sowing seed treatment for Improvement of germination and yield growth as well as use of microwave energy at thermal treatment of grain crops, solutions for diesel, wind and solar power plants joint effective use and so on.

## **TARGET AUDIENCE.**

The book will be useful to a wide range of individuals, such as students of energy and agro-engineering specialties, experts and heads of municipal unions, managers of the ministries and other organizations responsible for development of agricultural production at entrusted with territories. the separate large businessmen beginning rural business and many other public organization for assistance to advancement of new technologies in social sphere.

## **Preface**

An extremely useful the book may become for small commodity producers in the countryside, various entrepreneurs of medium and small businesses as well as for inter-regional public organizations for assistance to advancement of new technologies in social sphere in view of environmentally friendly sustainable development. In general the book is intended for representation of the wide public advanced achievements in the field of agro-engineering and related to the rural business energy technical means which will be useful to a wide range of readers and doubtless positive impact on a solution of a problem of a sustainable development of new rural territories.

In addition, the introduction of energy efficient technologies and renewable energy sources into agricultural practice reduces the total cost of primary energy resources, i.e. reduces costs for the production of a unit of agricultural products, which in turn reduces its cost and gives the producer advantages in competing on the agricultural market both within each country, as well as in international agricultural products markets.

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Chapter 1 is dedicated to consideration improvement of traction and coupling properties of the small class tractor for grain crop sowing (By means of the hydropneumatic damping device). Sowing is one of the main operations in technological complex of cultivation of cereals. That's why only with high quality seed distribution along the length and depth of the row can the maximum productivity and yield be achieved. A tractor with seeding machine (seeding machine tractor unit) is subjected to continuously changing external influences that have a negative impact on the performance indicators of the technological operation. Based on the cereal cultivation technology, it is necessary to use tractors with transmissions that can absorb the oscillations and increase the stability of the coulter group of the seeding machine. Since this improves the quality of the operation, reduces the consumption of spent seed and fuel and increases environmental component of the process.

In Chapter 2 evaluation of the effectiveness of the use of programs in the design of power complexes based on renewable energy resources is presented. The chapter aims to described the study the prospects of energy complexes on the basis of renewable energy sources to provide electricity for the stand-alone consumers in different regions of Myanmar. In order to do that the territory of Myanmar is divided into some regions according to their amount of renewable energy sources, developed the methods for determining the optimum parameters and operation of the energy complex on the basis of renewable energy sources and analyzed the cost-effectiveness of those energy complexes in the power sector regional of Myanmar. It is give the mathematical formulation of the problem of optimization of the main parameters and operations of the energy complex on the basis of renewable energy sources for energy supply of numerous autonomous rural consumers of the Republic of Myanmar.

In the Chapter 3 energy saving system (for agriculture) based on heat pump for maintain microclimate of the agricultural objects are considered. At agricultural facilities, the main attention as a rule is paid to the formation and maintenance of their microclimate parameters, and mechanization of storage processes. As world experience shows, it is necessary to develop and implement energy-saving systems and the use of renewable energy sources. The authors have developed energy-saving systems based on the heat pump, with upgraded electrical regulators. The developed system (patent 100873), using thermoelectric elements and a low-potential energy source, allows to effectively maintain the temperature parameters of the microclimate during long-term storage of potatoes, but it requires a large amount of

electricity consumption (30...35 kW), so the authors have developed an energy-saving system based on a heat pump (patent 123909). The temperature regime is achieved by using a thermoelectric cooler-heater and electric heater. The designed humidifier allows you to maintain the necessary relative air humidity.

Chapter 4 gives results of a job for creation of gas turbine power plant of low power GTP-10S (Gas turbine power plant). Currently, there is an increase in the use of gas turbines. Nevertheless, today they are used only in the energy sector: aviation, armed forces and navy. The introduction of a new manufacturing technology developed by the author will make it possible to manufacture cheap and reliable installations and thus ensure an exceptional position on the Russian market for goods and technologies, and taking into account the use of intellectual rights, abroad. The scientific novelty of the sample is the method of calculating small engines with a centrifugal compressor, a centripetal turbine and a combustion chamber with a negative thrust vector of the air flow. It is shown that the developed microgas turbine cogeneration power generator consists of a microturbine engine with a periphery, a free power turbine necessary for the selection of mechanical power, a high-speed electric generator with permanent magnets, an electronic power conversion system, exhaust heat energy recovery system and an automatic control system.

Chapter 5 deals with issues related to Milk Pasteurization and Characterization Using Mono-Mode Microwave Reactor and Slotted Coaxial Antenna. Mono-mode microwave reactor is usually used to heat on a substance, especially foodstuffs. This is because heating using the microwave reactor can sustain the flavor, color, and nutrition of the food. Furthermore, this heating technique is cost-effective and time-saving compared to a conventional heating method. The mono-mode reactor is able to determine the absorption of microwave power accurately on the heated substance versus multimode reactor. In this chapter, a simple and precise mono-mode microwave reactor is designed and developed especially for research laboratories. The advantage of this reactor is to provide a more accurate calibration process, in order to improve the optimum energy used in the heating process, as well as the temperature of the specimen, can be determined more accurately. The reactor can generate output power from 30 Watts to 1500 Watts, operating at  $2.45 \pm 0.03$  GHz and capable of accommodating a specimen volume of 780 cm<sup>3</sup>. Pure water is used as a heated specimen to demonstrate the performance and efficiency of this reactor.

In the Chapter 6 theoretical and experimental evaluation of impact on soil by wheel drives of the self-propelled seeder is considered. It is dedicated to vertical axial loads on the soil from the wheels of a self-propelled seed drill, area of the contact patch, maximum contact pressure for the front and rear wheels and the density of the soil are determined by evaluations and experimental methods. The discrepancy between the theoretical and experimental indicators was: 1.4% and 2.0% for the rear and front wheels in vertical axial loads; 2.8% and 2.2% for the rear and front wheels by the contact area of the tires of the seeder with the soil and the maximum contact pressure; 6.2% - the maximum discrepancy on the values of soil density at a depth of 7.6 cm. Soil hardness was measured in three zones: before the seeder's passage and after each of its passage in a rut behind the front and rear wheels at six different depths, determined by the marks on the soil densimeter tester density. Graphics of dependencies of soil hardness on the depth of measurement were constructed.

In the Chapter 7 readers may find the description of the performance improvement study of linear photovoltaic systems with concentration of solar radiation, submitted by scientist from Kazakhstan. In the chapter a new type of linear cooled photodetectors is considered, on the front walls of which in the focal region of the optical concentrator mirrors is installed an array of solar cells operating with the low-ratio solar concentration. This work is focused on the theoretical and experimental substantiation of the efficiency increase of photodetectors under conditions of an optimal combination between solar radiation concentration and heat transfer intensity of photovoltaic cells with heat carriers. The problem of

## **Preface**

obtaining a high temperature liquid due to the limitations of solar cells is solved by organizing the flow of fluid within the thermal collector channels in the focal region of an additional optical concentrator. A mathematical model of engineering characteristics calculation of the  $\Lambda$  - shaped photodetectors and cost calculation of electrical and thermal energy generation is presented. The research results are used in the development of industrial prototypes of photodetectors with a concentration of solar radiation and low production costs.

Optimization of spectral composition and energy economy effectiveness of phyto-irradiators with use of digital technologies are considered in the Chapter 8. It is known that in the case of using technology with the supplementary lighting, an irradiation spectral composition influences heavily effectiveness of the photosynthesis processes, development and productivity of vegetable crops. Hence, definition of general points at development and projecting of modern phyto-irradiators is one of high-priority tasks in techniques development for plants growing in conditions of protected ground. The research is aimed at review and effectiveness assessment of existing sources of illumination used in modern systems of supplementary lighting and at deduction of general points of development and projecting of phyto-irradiators based on results of laboratory investigations with use of modern digital technologies of monitoring and data analysis. The results of the comparative tests of light emitting diodes-based phyto-irradiators showed that the energy consumption per a product kilogram is twice less in the case of LED-irradiators. Based on the research results, general points were deducted for use at development of modern LED-phyto-irradiators.

Chapter 9 considers energy-saving technologies for pre-sowing seed treatment in a magnetic field. The purpose of the research was to establish the mechanism of the magnetic field impact on seeds to determine the most effective mode of pre-sowing treatment of seeds in a magnetic field and design parameters of the device for magnetic treatment of seeds. It is established that under the influence of a magnetic field the rate of chemical reactions occurring in plant cells is accelerated, solubility of salts and acids increases, and permeability of cell membranes accelerates the diffusion of molecules and ions through them. This leads to an increase in the concentration of ions in the cell and oxygen molecules and the growth of water absorption of seeds. Pre-sowing treatment of seeds promotes increased germination energy by 25-40%, germination - by 30 - 35%. The most effective pre-sowing treatment of seeds in a magnetic field is a magnetic induction of 0.065 Tl with four reversal magnetization, a pole division of 0.23 m and a seed movement speed of 0.4 m/s. With this mode of treatment, crop yields increase by 20–25%.

Chapter 10 describes mobile measuring complex for conducting mainly rural electric grids survey. An energy audit of the electrical network is required in the process of construction of new electrical networks as well as in justifying the reconstruction need of existing ones. In the paper the structure of a mobile measuring complex has been developed to conduct an electrical network survey without disconnecting consumers. The complex may be used to inspect 0.4 kV electrical networks and microgrids of the same voltage class and allows to obtain data on voltage losses and electric power losses in network elements such as a power line (electric transmission line), a power transformer. The energy audit is proposed to conduct without disconnecting consumers in order to avoid an undersupply of electricity as well as to determine the real operating modes of power networks. Ultimately, the use of the developed measuring complex will increase the reliability of power supply to consumers and ensure the required quality of the electricity supplied to them.

Chapter 11 describes technology of managing reactions of biological objects at anthropogenically transformed territories. Solving the problem of increasing plant resistance, the development of environmentally friendly technologies is particularly important, which also contribute to the reduction of

resource costs for production and load on the environment. The research results indicate positive effect of treatment of plants and seeds with electrochemically activated (ECA) water, electric field and impulse pressure (IP). Presowing treatment of seeds with ECA water increases the germination rate and seed germination energy, improves the development of plants, their morphological parameters, etc. The reactions of economically dangerous pests and causative agents of infectious plant diseases to the use of ECA water are individual. The combination of presowing seed treatment with the treatment of vegetative plants provides the highest possible result.

Chapter 12 considers potential evaluation and best practices of solar power plant application in rural areas. Recreational rest and recovery zones require a daily hot water supply, and constant availability of electricity. Therefore, the need for renewable energy sources usage in the Lower Volga region as well as in another ones is obvious and that is why power plants with environmentally friendly component attracts significant attention everywhere. An analysis of the theoretically calculated potential renewable energy makes it possible to assert optimistically that the above mentioned region is promising for the renewable energy autonomous sources implementation. It may be noted that the potential wind and solar energy, in spite of the fact that it is distributed unevenly, is sufficient to provide energy for remote rural communities, and tourist facilities. There is conducted analysis of availability of actinometrical data required for heliotechnical calculations and are identified areas of applicability and accuracy of the information received from various meteorological information sources.

In the Chapter 13 development and research of PVT modules in computer-aided design and finite element analysis systems are considered. The chapter discusses the simulation of solar photovoltaic thermal modules of planar and concentrator structures in the computer-aided design systems KOMPAS 3D and finite element analysis ANSYS. To create photovoltaic thermal modules, a method for designing their three-dimensional models in the computer-aided design system has been developed. To study the thermal regimes of the created three-dimensional models of modules, a method has been developed for visualizing thermal processes, coolant velocity, and flow lines of a cooling agent in a finite element analysis system. As a result of calculations in the finite element analysis system using the developed method, conclusions can be drawn about the feasibility of the design created with its further editing, visualization of thermal fields and current lines of the radiator cooling agent. As an illustration of the simulation results, a three-dimensional model of a photovoltaic thermal planar roofing panel and an optimized three-dimensional model of a photodetector of a solar concentrator photovoltaic thermal module are presented.

In the Chapter 14 seed pre-activation study by means of LEDs radiation is given. To study the possibilities of seeds presowing activation, irradiation with LEDs emitting in the visible, violet and near ultraviolet ranges with a maximum of 405 nm was carried out. As a result of the growing experience, it was found that the height of wheat plants grown from the treated seeds significantly exceeds the control indicators except for the period of 45...55 days. To implement the flow technology of seed activation with LEDs optoelectronic irradiation unit was developed. The advantages of the given installation is the energy efficiency and of seed treatment efficiency, due to of the optimal radiation spectrum selection and treatment doses.

In the Chapter 15 improvement of technology of electrical and magnetic stimulation of seeds and crop plants is considered. Use of a variety of electrotechnics is a technologically efficient and environmentally friendly technique, which increases the productivity of cultivated plants. Stimulation of green plants and vegetable crops in electric field with the intensity of 5-50 kV/m made it clear that the maximum efficiency is observed in the growth period - an increase of up to 30%, compared to the control.

## **Preface**

Plants have been subjected to stimulation for 3 hours twice a day (in the morning and in the evening). Analysis of studies on the preseeded seed stimulation showed that the exposure to pulsed magnetic field improves the dynamics of germination and plant growth at the early stages of development by an average of 10...20%, and more uniform germination helps to ensure high yields.

Chapter 16 describes linear electromechanical transducer in the systems of welded joints of electrodynamic processing developed by Ukrainian scientists. Research is dedicated to establishing characteristic relationships between the induction type impact electromechanical transducer and parameters and quality indicators of electrodynamic effects on the welded joints. Developed two-dimensional circle-field mathematical model of transient discharge capacity at the branched electrical circuit with the coil inductance which changes dynamically, allowing by adjusting the parameters of the electromechanical transducer to achieve the necessary technological requirements for the characteristics of electrodynamic processing. Based on mathematical modeling of electrophysical processes in electromechanical transducers induction type for electrodynamic processing of welded joints, reasonably geometrical parameters massive disk and the contact area in which the necessary conditions are created to reduce residual stresses in the weld joints.

Chapter 17 presents artificial bee colony based optimization of hybrid wind and solar renewable energy system above artificial bee colony (ABC) algorithm was applied to optimize hybrids of wind and solar renewable energy system. The main objective of this research is to minimize the total annual cost of the system by determining appropriate numbers of wind turbine, solar panel and batteries, so that the desired load can be economically and reliably satisfied based on the given constraints. ABC is a recently proposed meta heuristic algorithm which is inspired by the intelligent behavior of honey bees such as searching for food source, collection and processing of nectar. Instead of Gradient and Hessian matrix information, ABC uses stochastic rules to escape local optima and find the global optimal solutions. The proposed methodology was applied to this hybrid system by the help of MATLAB code and the results were discussed. Additionally, it is shown that ABC can be efficiently solve the optimum sizing real world problems with high convergence rate and reliability. The result was compared with the results of PSO.

In the Chapter 18 the study of luminescence spectra of seeds of crop species for diagnostic quality is described. Optical luminescent biological objects diagnostics methods and biotissues are considered. According to the previously developed method, excitation and photoluminescence spectra agricultural plants seeds, including cereals, legumes, fodder, technical and vegetable, were measured. The typical excitation spectrum lies in the range of 355...500 nm and has two maxima: the main one at 424 nm and the side one at 485 nm. The luminescence spectrum lies in the range of 420 ... 650 nm and has a maximum in the region of 500...520 nm. The maximum luminescence is less pronounced than in the excitation spectrum. The measured spectral luminescence characteristics forage plants seeds by scarification. Due to the scarification forage plants seeds spectral characteristics increase. In Galega seeds with multiple scarification observed qualitative changes in the excitation spectrum associated with the appearance of a new maximum at a wavelength of 423 nm. Similarly for clover seeds. The obtained results can be used to create seed diagnostics devices.

In the Chapter 19 researches in the field of technology electrohydraulic effect impact on water are described. The purpose of the study is to investigate the technology and technical means of electrohydraulic action on water. The authors justify the relevance of research. The design of the original negative electrode tip is being developed to increase the density of the electromagnetic field and reduce power loss. The design parameters of the electrohydraulic installation are shown. Modeling of factors influencing the process of electrohydraulic treatment of water according to the Plackett-Berman plan and the random

balance method is carried out; significant and insignificant factors are identified. The operation modes of the electrohydraulic installation are determined and optimized experimentally. The substantiation of the economic feasibility of using electrohydraulic water treatment technology in farms is being conducted. The prospects and scope of electrohydraulic technology are determined.

The book will be useful to a wide range of persons, such as students of power and agroengineering specialities, experts and heads of municipal unions, managers of the ministries and other organisations responsible for development of agrarian industry, the businessmen dealing with such a business and many others as for organisations like big consortium, inter-regional public organisation for assistance to advancement of new technologies in social sphere “sustainable development.”

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