

Məqalə redaksiyaya daxil olub: 11.04.23

The article was received by editorial board on: 11.04.23

Статья принята к печати: 11.04.23

APPLICATION OF INNOVATIVE SYSTEMS AT THE FACILITIES OF THERMAL ENERGY

Abstract

A well-known problem in the direction of the development of the modern economy is the innovative direction of ensuring and the effectiveness of the introduction of new forms of consolidated types of economic activity of industrial and service enterprises. The issue of formation and development of innovative systems adapted and capable of efficient use of ecological, organizational and technological resources of production at many enterprises is topical. The main function of which is to ensure a balance in the process of developing an effective innovative development strategy to eliminate destructive consequences in the process of innovation production. Insufficient effective use of innovations by enterprises is due to the need to improve the efficiency of the implementation of the economic development strategy of enterprises and the introduction of targeted innovative technologies. They can reflect the technological essence, organizational content and industry specialization of many industries. Systemic principles determine the essence of the development of a modern innovation economy.

An analysis of existing scientific hypotheses about the effect of a magnetic field on a water molecule is provided. The features of magnetic water, which were introduced in many sectors of the life of the EU countries, are noted: energy, construction, medicine, light and heavy industry, agriculture, healthcare, and many others. International experience is shown that contributes to the achievement of the Sustainable Development Goals - a decisive force in the current issues of Green Technology. It is aimed at minimizing the negative impact on the environment. Innovative green technologies promote energy efficiency, reduce waste of water, resources and waste, and lead to a reduction in carbon emissions. This provides a holistic framework for resilience and mitigation of their climate change impacts.

The article deals with the main issues of modernization of heat generation processes at thermal power facilities, including housing and communal services. Modernization is connected with the use of magnetized water in heat generation processes and positive results have been obtained.

The use of technologies using magnetic water contributes to the saving and conservation of natural resources, and the solution of many environmental issues. The paper reveals the issues of the features of the economy of nature management at the stage of improving information management methods.

The proposed management methods in the environmental and economic dimension have found application in the modernization of systems of thermal power facilities and many other industries, including the further use of environmental measures at thermal power plants as objects of economic analysis, subject to the environmental efficiency of management, integrated management of production processes of thermal power facilities.

Key words: innovative systems, management, greening, heat supply system, reagent-free water preparation, magnetized water, energy efficiency, vital activity of organisms.

I. INTRODUCTION

Well-known scientists worked in the direction of innovative research, the scientific works of

domestic and foreign scientists, such as V. Heits, A. Zharinov, P. Kulikov, V. Nordhaus, O. Orlovskaya, Samuelson, E. Toffler, were devoted to the theoretical and practical aspects of the researched issues, etc. It is necessary to emphasize and note the scientific and practical achievements and significance of the above-mentioned authors, which relate specifically to the identification of the functional innovative development of manufacturing enterprises and service enterprises, there is a need to continue this direction, especially now, during the establishment and future reconstruction of the country. That is why the issue of determining the priority directions of innovative development in the conditions of global changes and integration of the country's economy into the European dimension is becoming increasingly urgent.

Today's innovative technologies are radically new or improved technologies that significantly improve production conditions. They usually have: reduced capital intensity, are characterized by greater environmental friendliness, lower energy consumption.

The development of innovative technologies in the world is increasingly competing with each other, focusing on four components of innovative transformations.

The state policy of the development of the national innovation system of Ukraine is most vividly reflected in the Law of Ukraine "On Innovative Activity" and is terminologically defined as follows: "Innovations - newly created (applied) and (or) improved competitive technologies, products or services, as well as organizational and technical solutions of production, of an administrative, commercial or other nature, which significantly improve the structure and quality of production and (or) the social sphere".

The state of innovative technologies in Ukraine The state of innovative activity in Ukraine is defined by the majority of experts-scientists as a crisis and one that does not correspond to the current level of innovation processes in industrially developed countries and the needs of innovative development.

Therefore, in our opinion, the proposed topic is very relevant and modern, with the current condition - the war in Ukraine. Now it is very necessary to implement the best technological components of innovative technologies for the reconstruction of the country.

II. LITERATURE ANALYSIS

The analysis of the available data of the scientific and technical literature convinced us that the solution to the investigated problem is promising and extremely necessary.

In the researched sources of literature, attention is paid to the research, under different operating conditions, to conduct the most detailed research on the control of individual components of the system "receiving magnetized water - preparing it to be sent to the TEO system - operation in TEO systems.

" In the literature review, analyzing more than 200 sources, including V.I. Klasen on the spread of the cluster model, on the kinetics of changes in the structure of water by Y. I. Frenkel, and the probability theory of L. B. Boltzmann, attention is paid to almost 70 years of positivity use of reagentless water preparation, including in heat supply systems.

Despite the fact that these issues remain understudied to date and require further research [10-12, 13, 14].

The study of fundamental theoretical developments on this problem was and is being carried out by the following outstanding scientists, whose works on the mechanism of nature use, ecology and rational nature use and energy conservation should be noted: G. O. Bilyavskiy, V. V. Honcharuka, V. I. Danilov-Danilyana, I.I. Dedyuba, M.Y. Ishchenko, E.S. Malkina, V.G. Prokopov, V.F. Protasov, E.I. Pupyrev, N.F. Reimers, V.P. Kucheryavoy, A. I. Salyuk, Y. M. Satalkina, V. M. Udod, N. M. Fialko, V. Y. Shevchuk, Y. M. Navrotsky, V. F. Protasov, I. I. Mazur and others.

The analysis of scientific and technical publications proved that some issues of in-depth knowledge of the theoretical concept of the operation of thermal power facilities and its impact on the environment are not sufficiently considered [1-10, 11].

III. OBJECT, SUBJECT, AND METHODS OF RESEARCH

The object of research is the structure and algorithm of the functioning of heat supply system objects.

The subject of research: interactions between material flows of systems of thermal energy facilities (TEO).

Research methods. The work uses a complex system-generalized approach, the following methods are used: analysis and forecasting; interpretation of the obtained results; statistical and mathematical. It should be noted that, as the experience of making and justifying any level of management decisions shows, the solution of the scientific-applied and organizational-economic problem of determining the expediency of the incorporation of the national economic system and compliance with the new format of functioning becomes relevant. It is appropriate to recognize and carry out the identification of real conditions / prerequisites and restrictions based on the results of the implementation of the state's integration choice. As you know, to a large extent, ensuring a sufficient level of economic and energy security of entrepreneurship, and not only for Ukraine, but also for any country in the world, should be based on dominants. For innovative development, therefore, it is necessary to consider the following concepts.

MAIN PART

Environmentally and energy-efficient use of thermal energy in all spheres of heat supply plays a significant role in energy conservation of the country. All these stages in heat supply systems, water passes in different sectors, where changes in the composition, structure and properties of water and heat exchange surfaces of systems, scale formation (Fig. 1), which leads to deterioration of heat exchange processes, heat energy indicators, which affect the general indicators, can occur energy efficiency of the process (recent experiments showed a decrease in heat energy consumption by 15...22 % depending on the amount of initial scale). The energy efficiency of production processes is related to the transformation of energy into something more suitable for production (thermodynamics), that is, the processes obey the laws of thermodynamics. They complicate the theoretical consideration and substantiation of regime parameters. The use of traditional heat supply systems does not always meet the accepted thermal standards for fuel consumption and environmental requirements [10-13]. The method of reagentless water purification is highly effective, i.e., accelerated reagentless water purification in magnetic fields, with the help of which positive results have been achieved in such sectors of the economy as industry, the residential and communal sector, and the agro-industrial complex. Considering the main role of water supply systems in everyday human life, magnetic treatment of natural and technical water, various solutions, has recently been widely used to improve many technological and biological processes.

Thanks to this, it is possible to explain the nature of the loss of all types of energy at the TEO and carry out a quantitative assessment of its changes - the result of our further work.

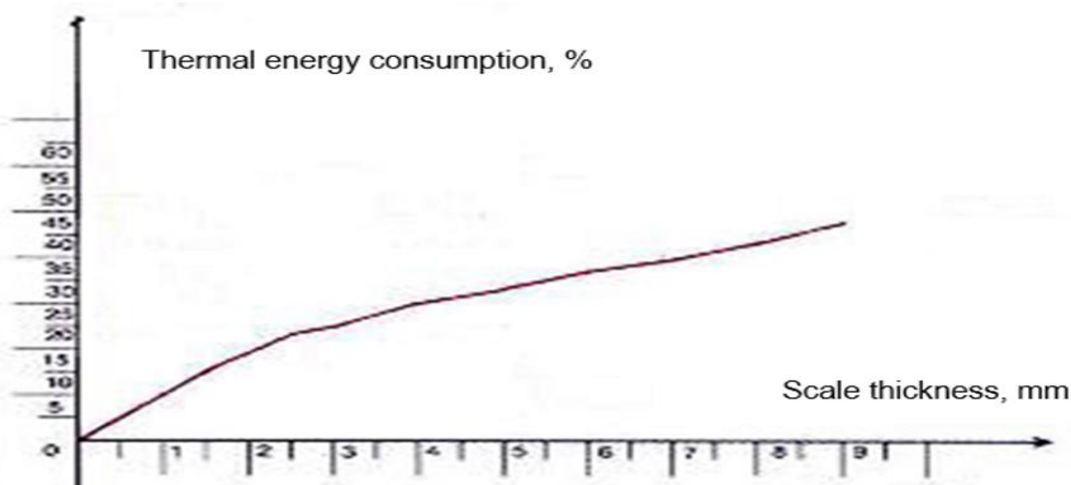


Fig. 1. Graphical dependence of thermal energy consumption on the thickness of the scale layer

In many existing scientific hypotheses, the magnetic field affects water molecules, which causes changes in the "spin" of the protons of the nuclei of these molecules with the release of some molecular energy, which leads to the destruction of water clusters and the transformation of

magnetized water into a liquid from unbalanced H₂O molecules, which have a tendency to be active interaction with other substances and, due to the small size of monomolecules, to an active increase in the rate of diffusion processes of the transfer of such water, including in ultramicropores of capillary-porous bodies, into which ordinary water cannot penetrate. The noted features of magnetized water aroused great interest not only in the scientific environment, but also among workers in many fields of life: energy, construction, light and heavy industry, agriculture, health care, and many others.

In the former USSR, the problems of the theory and practice of magnetic water began to be dealt with in the 50s of the last century [1, 2, 3, 4, 5 and others]:

- in power engineering, the main attention was paid to the problems of cleaning the heat exchange surfaces of boilers, heat exchangers and pipelines from scale;
- in construction, the main attention was paid to the production of building materials: cement stone, concrete, gypsum, bricks, etc., to ensure an ecologically safe environment for people;
- in agriculture, the main attention is focused on the use of a significant increase in the intensity of diffusion transfer of magnetized water for moistening seeds and during irrigation;
- the result of a significant increase in the intensity of diffusion transfer of water and aqueous solutions in colloidal capillary-porous bodies is used in textile production technologies;
- in health care processes, the ability of magnetized water, blood, etc. to destroy deposits on the inner surfaces of blood vessels is used.

Humanity is now in such a phase (pollution of the atmosphere, hydroecosystems, soil, etc.) of its development, when nature is not able to neutralize, with the help of self-cleansing processes, negative influences on it (as well as on the human community). One of these impacts is environmental pollution by wastewater. Magnetic treatment of wastewater reduces and reduces the cost of its treatment in three directions: own treatment of wastewater, improvement of the operation of biochemical treatment facilities, reduction of the amount of wastewater.

Building materials are complex physicochemical systems, the properties of which depend on the nature of the binder, additives, technological properties of mixing water, temperature, and other factors. The kinetics, mechanism, and nature of material hardening processes are complex.

The effect of magnetic treatment of water is manifested not only in the processes of hardening and increasing the strength of samples, but also in the quality of products. The strength of products obtained with the use of magnetic treatment of water during kneading changes. I.A. Nelson and others established that the strength of concrete increases by 10...40 % [1]. As industrial tests show, the strength of concrete and other building materials (ceramic pipes, fireclay refractories) increases by 10...30 %. We take this fact into account for recommendations to reduce biodamage of building materials during their operation [9]. There is an opportunity to reduce the consumption of cement and water in the production of concrete. According to Y.V. Lizunov, 1700000 m³ of liquid concrete was produced by the management enterprises of "Saratov-Derzhbud" on treated water, the saving in water consumption was 4.5...6.5 % [8] .

Our research determined that concrete cubes made on magnetized water with the proposed solution (*) gain maximum strength on the 7th day, almost 90 % stronger than those made by classical technology (Table 1). Also, concrete samples are characterized by a decrease in the size of pores in their structure and the uniformity of their location.

The set strength of the cubes after steaming was 12 % more with our proposed solution.

Preliminary data allowed us to:

- solve issues related to resource-saving technologies by means of magnetic treatment of water and aqueous solutions;
- to develop an ecological assessment of building (concrete and reinforced concrete, etc.) materials and structures (which is characterized by high environmental criteria) to reduce the burden on the environment;
- to develop a technology to reduce biodamage of building materials (concrete, reinforced concrete, etc.) and structures.

As for medicine, V.I. Klassen's monograph suggests that the healing effect of magnetized water is related to its bactericidal properties and increased permeability of biological membranes. In other cases, the magnetic field affects the body directly. Thin sodium ions enter the cavity of the water frame, which is the dispersion medium of the blood plasma. Precipitates deposited on the walls of blood vessels dissolve faster in such a solution. Blood vessels acquire greater capacity, blood flow increases, blood pressure decreases and stabilizes. With long-term exposure to a magnetic field, metabolic processes in the body improve and its resistance (resistance) increases. Great doctors of past centuries - Hippocrates, Avicenna, Para-Celsius - treated many diseases with magnets.

Currently, the most well-known applications of magnetic water treatment are:

- internal use of magnetized water reduces the amount of cholesterol in the blood and liver, improves metabolism, promotes the release of stones from the kidneys, which are salts - oxalates, phosphates or urates with layers of mucus;
- obtained positive results in the treatment of eczema and dermatitis (S.I. Dovzhanskyi, Saratov);
- at the all-Union conference on magnetobiology and magnetotherapy (1990), reports were presented on the beneficial effect of baths with magnetized water and turbulent underwater massage on patients with protracted pneumonia, non-specific infectious polyarthritis, rheumatoid arthritis and other joint diseases;
- since 1973, baths with magnetized sea water have been used in Sochi for hypertensive patients (10 sessions of 10 minutes each), as a result of which most patients' blood pressure decreased, night sleep normalized, complaints of headaches, noise in ears, quick fatigue and pain in the heart;
- normalization of cholesterol metabolism in atherosclerosis (V.V. Lisin and E.N. Ivanov, Saratov);
- irrigation of the oral cavity with magnetized water helps to remove tartar, eliminate periodontal disease, prevents the formation of dental deposits, cleans enamel from soft plaque, stops bleeding gums (R.I. Mykhaylova, Central Institute of Stomatology);
- the introduction of magnetized water into the blood serum of sick people contributes to the normalization of its structure, which can be used for biocorrection of metabolic reactions in the human body;
- the increased oxygen content in magnetized water helps purify blood and lymph from foreign bacteria and viruses. Thus, one-time treatment of water with a magnetic field allows to destroy up to 90 % of coliforms in it.

The analysis of the effect of magnetized water on the flow of processes in various areas of its application indicates an insufficiently deep study of the dependence of the influence of magnetic field parameters on the results of the described technologies of its application.

The first steps in this direction were taken by the authors when researching the processes of concrete products using water treated with a high-frequency pulsed magnetic field, obtained using the Ilios-m apparatus of the Votali LTD company (Donetsk) [11-16].

IV. RESULTS

The thermodynamic resource and its dynamic mechanism in the process of industrial nature use cause, along with the energy resource and synergistic processes, the appearance of material flows of thermal energy objects. It is the energy component of the system that contributes to the emergence of thermal energy as a result of anthropogenic interactions. About the use in practical conditions - the result of the act and regulations of the work of introduction into the industry, with the introduction of the proposed scientific economic concept of the process, which gives a present and future result for the prevention of crisis and destructive phenomena to ensure the safety of the enterprise from the threat of destruction and crisis, helps to solve problems, related to the direction of sustainable development of the resource-saving and environmental protection model of enterprises.

V. CONCLUSIONS

Control in the ecological and economic dimension is used in the application of innovative systems for heat energy and many other industries. Application in the further direction of environmental protection activities at the TPP. Developed technological regulations for

implementation in production and planned series of further studies of objects in the direction of economic analysis, the state of environmental efficiency of economic management, complex management of production processes of thermal energy objects. One of the key problems of heat supply in Ukraine is the reduction of heat transfer from heat supply heating devices by 20 %. As a result, after some time of operation, they are observed to accumulate metal salt oxides in them. The consequences of this state are insufficient heat transfer, increased fuel and electricity consumption. The upgraded technology solves these problems and delivers 20 % energy savings. As a result of processing the results of the experiment, it was found that the most significant factors are the analysis of the general environmental technogenic situation, the technical condition of the system of thermal power facilities - output data that allow us to confirm the developed principles of integral control [14, 15, 16].

References:

1. Minenko V.I. (1970) Magnetic treatment of water-dispersed systems / Technology. 168 p.
2. Classen (1973) Water and a magnet. YOU / Nauka Publishing House. Moscow. 112 p.
3. Tebenikhin E.F., Gusev B.T. (1970) Treatment of water with magnetic poles in thermal power engineering / M..Energy". 144 p.
4. Stukalov P.S., Vasilyev E.V., Glebov N.A. (1969) Magnetic treatment of water / Sudostroenie. Publishing House, Leningrad. 192 p.
5. Pople I. A. (1951) Molecular association in liquid II. A theory of the structure of water / I.A. Pople // Proc. Roy. Soc. P. 163–178.
6. Davidzon M.I. (1988). Electromagnetic treatment of water systems in the textile industry / Moscow// Legprombytizdat. 178 p.
7. Baran B.A. (2010), Anthropogenic water pollution and its cleaning methods / Bulletin of the Khmelnytskyi National University. P.234-237.
8. Gaev A. Y. (1990), Ecological foundations of construction production / Sverdlovsk. Publishing House of the Ural University.180 p.
9. Ivanov F.M. (1984), Biodamage / Stroyizdat, 320 p.
10. National report on the state of the natural environment in Ukraine in 2011 (2012) / Center for Environmental Education and Information, 257 p.
11. Zhuravska N. (2019), Energy efficient processing of geothermal water for energy-heating objects of the building industry / World Multidisciplinary Earth Sciences Symposium WMESS. – M. Hory, Czech Republic. – Electronic resource. – iopscience.iop.org/article/10.1088/1755-1315/362/1/012116/pdf (Data of the application 2.03.2020).
12. Malkin E.S. (2017), Special issues of heat and mass transfer / Kyiv: KNUBA. 288 p.
13. Utility model patent UA No. 100236. Water treatment system in electromagnetic fields / Malkin E.S., Furtat I.E., Zhuravska N.E., Kovalenko N.O. Registered 07/10/2015. - Kyiv: Ukrpatent. - 3 p.
14. Zhuravska N.E., Malkin E.S. (2016), Environmental and energy-saving technologies with reagent-free water treatment / 3rd international science and practice. conf. "Water use. technologies. Buildings. Management. KNUBA. P.16 - 17.
15. Kulikov P. (2019), Technological-related manufacturing systems: problems of environmental and economic analysis of their status and management / P. Kulikov, N. Zhuravska // Wschodnioeuropejskie Czasopismo Naukowe. East European Scientific Journal (Warsaw, Poland), 7 (47), 2019 part 5. p. 60-63.
16. Kulikov P. (2019), Modern Possibilities of Management of Technogenic-Natural Systems of Heat-Energy Objects of Industrial and Construction Industry / P. Kulikov, N. Zhuravska etc // In: V. Onyshchenko etc (eds) Proceedings of the 2-International Conference on Building Innovations. ICBI 2019. Lecture Notes in Civil Engineering,73. Springer. pp. 115-121.

Nataliya Juravska

Ph.D., prof.ass., Kiyev Milli İnşaat və Memarlıq Universitetinin professoru

İstilik enerji obyektlərində innovativ sistemlərin tətbiqi

Xülasə

Müasir iqtisadiyyatın inkişafı istiqamətində məlum problem sənaye və xidmət müəssisələrinin birləşdirilmiş təsərrüfat fəaliyyətinin yeni formalarının təmin edilməsi və tətbiqinin səmərəliliyinin innovativ istiqamətidir. Bir çox müəssisələrdə istehsalın ekoloji, təşkilati və texnoloji ehtiyatlarından səmərəli istifadə etməyə qadir olan və uyğunlaşdırılmış innovativ sistemlərin formalaşdırılması və inkişafı məsələsi aktualdır. Əsas funksiyası innovasiya istehsalı prosesində dağıdıcı nəticələrin aradan qaldırılması üçün effektiv innovativ inkişaf strategiyasının hazırlanması prosesində tarazlığı təmin etməkdir. Müəssisələr tərəfindən innovasiyalardan kifayət qədər səmərəli istifadə edilməməsi müəssisələrin iqtisadi inkişaf strategiyasının həyata keçirilməsinin səmərəliliyinin artırılması və məqsədyönlü innovativ texnologiyaların tətbiqi zərurətindən irəli gəlir. Onlar bir çox sənaye sahələrinin texnoloji mahiyyətini, təşkilati məzmununu və sənaye ixtisaslaşmasını əks etdirə bilər. Sistemli prinsiplər müasir innovasiya iqtisadiyyatının inkişafının mahiyyətini müəyyən edir.

Maqnit sahəsinin su molekuluna təsiri haqqında mövcud elmi fərziyyələrin təhlili verilmişdir. AI ölkələrinin həyatının bir çox sahələrində tətbiq edilən maqnit suyunun xüsusiyyətləri qeyd olunur: energetika, tikinti, tibb, yüngül və ağır sənaye, kənd təsərrüfatı, səhiyyə və bir çox başqa sahələr. Yaşıl Texnologiyanın aktual məsələlərində həlledici qüvvə olan Dayanıqlı İnkişaf Məqsədlərinə nail olunmasına töhfə verən beynəlxalq təcrübə göstərilir. Ətraf mühitə mənfi təsirləri minimuma endirmək məqsədi daşıyır. İnnovativ yaşıl texnologiyalar enerji səmərəliliyini təşviq edir, su, resurslar və tullantıların israfını azaldır və karbon emissiyalarının azalmasına səbəb olur. Bu, onların iqlim dəyişikliyi təsirlərinin davamlılığı və yumşaldılması üçün vahid çərçivə təmin edir.

Məqalədə istilik enerjisi obyektlərində, o cümlədən mənzil-kommunal təsərrüfatında istilik istehsalı proseslərinin modernləşdirilməsinin əsas məsələlərindən bəhs edilir. Modernləşmə istilik istehsalı proseslərində maqnitləşdirilmiş suyun istifadəsi ilə bağlıdır və müsbət nəticələr əldə edilmişdir.

Maqnit suyundan istifadə edən texnologiyaların istifadəsi təbii ehtiyatların qənaətinə və qorunmasına, bir çox ekoloji problemlərin həllinə kömək edir. Məqalədə informasiya idarəetmə metodlarının təkmilləşdirilməsi mərhələsində təbiətdən istifadə iqtisadiyyatının xüsusiyyətləri məsələləri açıqlanır.

Ekoloji və iqtisadi ölçüdə təklif olunan idarəetmə üsulları istilik enerjisi qurğularının və bir çox digər sənaye sahələrinin sistemlərinin modernləşdirilməsində, o cümlədən istilik elektrik stansiyalarında ətraf mühitin səmərəliliyi nəzərə alınmaqla, iqtisadi təhlil obyektini kimi ətraf mühit tədbirlərinin sonrakı istifadəsi üçün tətbiq tapmışdır. idarəetmə, istilik enerjisi obyektlərinin istehsal proseslərinin kompleks idarə edilməsi.

Açar sözlər: innovativ sistemlər, idarəetmə, yaşıllaşdırma, istilik təchizatı sistemi, reagentsiz suyun hazırlanması, maqnitləşdirilmiş su, enerji səmərəliliyi, orqanizmlərin həyat fəaliyyəti.

Наталья Журавская

*к.т.н., асс. профессора, Киевский Национальный Университет
Строительства и Архитектуры, (Киев, Украина)*

ORCID 0000-0002-4657-0493

Применение инновационных систем на объектах тепловой энергетики

Резюме

Общеизвестной проблемой в направлении развития современной экономики является обеспечение инновационной направленности и эффективности внедрения новых форм консолидированных видов экономической деятельности предприятий промышленности и сферы услуг. Актуальным является вопрос формирования и развития инновационных систем, адаптированных и способных эффективно использовать экологические, организационные и технологические ресурсы производства на многих предприятиях. Основной функцией которого является обеспечение баланса в процессе разработки эффективной стратегии инновационного развития для устранения деструктивных последствий в процессе производства инноваций. Недостаточное эффективное использование инноваций предприятиями связано с необходимостью повышения эффективности реализации стратегии экономического развития предприятий и внедрения целевых инновационных технологий. Они могут отражать технологическую сущность, организационное содержание и отраслевую специализацию многих отраслей. Системные принципы определяют сущность развития современной инновационной экономики.

Дан анализ существующих научных гипотез о воздействии магнитного поля на молекулу воды. Отмечены особенности магнитной воды, внедренной во многие отрасли жизни стран ЕС: энергетика, строительство, медицина, легкая и тяжелая промышленность, сельское хозяйство, здравоохранение и многие другие. Показан международный опыт, способствующий достижению Целей устойчивого развития - решающая сила в актуальных вопросах Зеленых технологий. Она направлена на минимизацию негативного воздействия на окружающую среду. Инновационные зеленые технологии способствуют повышению энергоэффективности, сокращению потерь воды, ресурсов и отходов, а также сокращению выбросов углерода. Это обеспечивает целостную основу для устойчивости и смягчения их последствий изменения климата.

В статье рассмотрены основные вопросы модернизации процессов выработки тепла на объектах теплоэнергетики, в том числе ЖКХ. Модернизация связана с использованием омагниченной воды в процессах теплогенерации и получены положительные результаты.

Применение технологий с использованием магнитной воды способствует экономии и сохранению природных ресурсов, решению многих экологических вопросов. В статье раскрываются вопросы особенностей экономики природопользования на этапе совершенствования информационных методов управления.

Предложенные методы управления в эколого-экономическом измерении нашли применение при модернизации систем объектов теплоэнергетики и многих других отраслей, в том числе при дальнейшем использовании природоохранных мероприятий на тепловых электростанциях как объектов экономического анализа с учетом экологической эффективности управления, комплексное управление производственными процессами объектов теплоэнергетики.

Ключевые слова: инновационные системы, управление, экологизация, система теплоснабжения, безреагентная подготовка воды, омагниченная вода, энергоэффективность, жизнедеятельность организмов.