



UDC 502.131.1:502.15:504.12

TECHNICAL OBJECTS' ECOLOGICAL EFFICIENCY INDICATORS CONTROL

Voinova S.A.

Odessa National Academy of Food Technologies, Odessa

ORCID: <http://orcid.org/0000-0003-0203-0599>E-mail: voinova_s@yahoo.com

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DOI:

Abstract: Traditional automatic control systems do not solve the task of limiting the harmful effects of technical objects on the environment. The problem is to increase the effectiveness of means of its protection against the harmful effects of industry. Relevant is the use of indicators of environmental performance of technical objects as controlled parameters. A new approach to the control of technical objects is proposed. As the main control parameter it proposed to adopt the level of their ecological efficiency. Complicating circumstances of solving the problem is the insufficient knowledge of the factors of harmful effects on objects of living nature, their intensity, interrelation, mechanism, strength, and dynamics of exposure. Improving the economic efficiency of technical objects leads to an increase in their ecological efficiency. The solution to the problem is facilitated by the fact that traditional ACS should be left in action, adding to them an ecological efficiency control component. Heat-power engineering has a large impact on the environment through emissions and discharges of harmful substances and heat. To give to ASC the functions of controlling the ecological efficiency of the boiler (for SO_y emission), it is necessary to apply an additional, new control loop - regulator of SO_y concentration in furnace gases. An urgent task in the use of direct control of the ecological efficiency of boiler-furnace systems is the development and production of physical quantity sensors, reflecting the level of aggressiveness of the source of hazard, working in real time. Direct control of indicators of ecological efficiency is much easier in other branches of industry, in particular, in its food branch, where objects do not have a large-scale complex negative impact on the environment.

Анотація: Традиційні системи автоматичного управління не справляються із завданням необхідного обмеження шкідливого впливу технічних об'єктів на навколишнє середовище. Проблема полягає в підвищенні ефективності засобів її захисту від шкідливого впливу виробництва. Актуальним є використання показників екологічної ефективності функціонування технічних об'єктів як керованих параметрів. Запропоновано новий підхід до управління технічними об'єктами. Головним керованим параметром запропоновано прийняти рівень їх екологічної ефективності. Ускладнюючими обставинами рішення проблеми є недостатня вивченість чинників шкідливого впливу на об'єкти живої природи, їх інтенсивності, взаємозв'язку, механізму, сили, динаміки впливу. Підвищення економічної ефективності технічних об'єктів обумовлює підвищення їх екологічної ефективності. Рішення проблеми полегшується тим, що традиційні САУ слід залишити в дії, додавши до них компонент управління екологічною ефективністю. Теплоенергетика масштабно впливає на навколишнє середовище шляхом викидів і скидів шкідливих речовин і теплоти. Для додання САУ функцій управління екологічною ефективністю котла (по викиду SO_y), необхідно застосувати додатковий, новий контур управління з регулятором концентрації SO_y в топкових газах. Нагальним завданням на шляху використання прямого управління екологічною ефективністю котельно-топкових систем є розробка і виробництво датчиків фізичних величин, що відображають рівень агресивності джерела шкідливості, що працюють в реальному масштабі часу. Пряме управління показниками екологічної ефективності значно простіше в інших галузях промисловості, зокрема, в харчовій її галузі, де об'єкти не надають масштабного комплексного негативного впливу на навколишнє середовище.

Ключові слова: управління, екологічна ефективність, технічний об'єкт, система автоматичного управління (САУ), котельно-топкова система, навколишнє середовище.

Keywords: control, ecological efficiency, technical object, automatic control system (ACS), boiler-furnace system, environment.



Introduction

The successful functioning of the socio-economic system of the state is the basis of potential for its further development. However, the emerging resource, economic, social and ecological problems are largely due to its activities. Therefore, a targeted reduction of the integral ecological load from production and consumption processes is a global vital issue of the entire global community in the context of the transition to sustainable development.

Automatic control systems (ACS) of technical objects (TO) traditionally solve, mainly, the task of maintaining the parameters of the technological process, which affect the reliability and / or economic efficiency of these objects, at a given level. At the same time, their ecological efficiency (EE) is formed spontaneously and in most cases turns out to be extremely unfavorable for the natural environment. The result of this is the effects of anthropogenic destructive actions on the natural environment. They are increasingly becoming irreversible. Such a traditional concept of TO control under conditions of accelerated development of industry, and a corresponding increase of the volume of harmful effects on nature, is untenable. Therefore, the problem of developing a new concept, focused on a radical reduction of the impact of TO on the natural environment, was formed.

Statement of problem

In accordance with the new concept, it is necessary to accept as the main controlled technological parameter of the TO functioning the level of their EE. At the same time, to save, if it is necessary, control of other significant technological parameters, but as additional ones, which make it possible to maintain the parameters of the said process within the limits of its adopted regulations.

TO EE is a complex property. One should control one of the indicators forming it. Choice of it is a responsible and difficult task. In each case, this indicator represents the factor that is the most aggressive and dangerous for the environment among the existing ones. When assessing aggressiveness, as an object of impact should be chosen not only a man, but also representatives of flora and fauna in the area of TO. They are most often the most vulnerable to harmful actions.

The solution of these problems is complicated by a number of circumstances, in particular the following:

- mechanism, strength and dynamics of the harmful effects of various factors on objects of living nature, including the chains of their mediated effect on the biosphere, have not been studied enough;
- effect of the intensity of the impact of each factor on the nature and extent of damage to animate nature, have not been studied enough;
- it was accumulated little data on the quantitative side of influence, on the mechanism and strength of the joint influence of two or several factors, it was insufficiently developed methodological and instrumental base for the operational control of the strength of influence of factors and control of its consequences;
- there is a psychological barrier in the way of abandoning the former and the transition to a new concept (direct control of the level of TO EE) [1].

You should pay attention to the fact that the increase in the economic efficiency of TO, usually accompanied by a corresponding reduction in energy and raw materials consumption per unit of production, causes an increase in the EE of these objects [2].

Because of the aforementioned, the solution of the problem under consideration is facilitated by the fact that in TO the traditional ACS of the economic efficiency of the technological process should be save in action, but as the second one by importance. Other ACS may have to be given the same status, save them or update. It seems appropriate saved to use ACS to combine into a comprehensive system with enhanced functionality. Priority in it should belong to ACS EE.

To solve the above problems, it is advisable to use advanced ACS, with an increased intellectual level of their algorithms that are capable of implementing high-dimensional technological process control. The creation of such systems should be problem-oriented towards the direction and future development of the industry of application [3 - 7].

Solutions of problem

Using the idea of EE control is of interest for all branches of modern industry. Of particular interest are industries that are highly responsible for damage to the natural environment. This applies primarily to the heat-power engineering. Boiler plants used in station and industrial power engineering, as well as at each plant, have a detrimental effect on living nature. They, in particular, made emission and dumping of harmful substances and heat into the environment. In boiler plants they make a lot of effort to maintain high efficiency of equipment. Transferring efforts to EE control can bring a major ecological effect in this important sector of industry.

It should be noted that the harmful effects exerted by boiler equipment on the environment depends on the state of these objects. During the operation of power equipment, as the resource is consumed, the level of its technological efficiency decreases, including the level of ecological efficiency: the degree of harmful effects is progressively increasing. The analysis shows that the fleet of boiler plants operating in Ukraine (not counting micro-boilers) is about 60 thousand units of different unit capacities, operating on different types of fuel: solid, liquid, gaseous. Moreover, more than 95% of these units have worked more than 1.5 - 2.5 resources. The level of technological efficiency of this equipment is extremely low. This applies primarily to the level of ecological efficiency. Among the tasks of national importance facing the energetics sector of Ukraine, the most important, impatient should be recognized the task of updating power equipment, first of all, the park of boiler plants.



The high complexity of solving this problem, which has a problem character, is due to the fact that the domestic boiler-building industry is represented by only one engineering enterprise located in the town of Monastyrshche, Cherkasy region. The company produces a limited number of boilers of small unit capacity. At the same time, the country's energetics sector needs to renovation of thousands of boilers: power units of high unit capacity, industrial and heating units of medium and small unit capacity. The above shows that the solution of the problem under consideration requires very high resources, the level of which exceeds the possibilities that are currently available.

The analysis shows that along with the solution of the considered problem, it is necessary to solve another related problem that has emerged in the current energetics sector of Ukraine. It is necessary to normalize the structure of the fuel balance of the energetics industry. The share of solid fuel, amounting to about 55 percent, needs to be increased to a level of 85-90 percent, displacing the expensive imported gaseous and liquid fuels from the balance. At the same time, an increase in the share of solid fuel burned, respectively, will increase the emission of ash into the atmosphere, that is, increase the harmful effects of power engineering on the environment. To compensate for this negative effect, it will be necessary to implement a complex of research, production and technical measures. To solve this problem will require large resources. The positive effect of these events will be to increase the energetic independence of the domestic power engineering and industry as a whole.

When they burn in boilers sulfur fuel formed in furnaces sulfur oxides (SO_2 and SO_3) - SO_y - enter the atmosphere, have a harmful effect on the environment. Traditional ACS of burning process in the furnace does not have a direct effect on the emission of SO_y .

As an example, we present the proposed solution to the issue of controlling the emission of these oxides.

In boilers, the combustion process is traditionally controlled by an air regulator (economy) and a fuel regulator (heat load). The first one controls the flow of blow air in the furnace. It operates on the "steam flow" signal, the signal from the fuel regulator and the feedback signal on the amount of incoming air. The fuel regulator controls its feed and operates by the signal "steam pressure behind the boiler" and the feedback signal on fuel consumption or the position of the final control element on its flow.

To give to the ACS control functions of the boiler's EE (for SO_y emission), it is necessary to apply an additional, new control loop - regulator of SO_y concentration in furnace gases. It restricts SO_y from above, keeping with it the specified minimum level of boiler's EE (for this indicator). The regulator operates by the signal " SO_y ". To reduce the dynamic error, it is also given to it a dynamic (disappearing in statics) feed signal from the heat load regulator. The regulator controls the flow of solid bulk additives containing CaO or MgO (for example, ground limestone), introduced with the fuel into the furnace. Additive in the process of burning of fuel chemically binds sulfur oxides to solid products removed from the furnace with ash.

The example illustrates the availability of direct control of boiler-furnace systems' EE. However, for this it is necessary to have sensors of physical quantities that reflect the level of aggressiveness of the source of harmfulness (in our example, by sensor of concentration of SO_y in gases) working in real time. Such devices are scarce now. The development and evolution of their production is an urgent scientific and technical challenge.

Technical objects control on the basis of limiting their impact on the environment using direct control of environmental efficiency indicators is much simpler in other branches of industry, in particular, in its food branch, where objects do not have such a large-scale complex negative impact as in the energetics sector.

The world community is seriously concerned about the increasing harmful effects of world production on the environment, living and inanimate nature. A manifestation of this concern about the deteriorating state of the environment is the events held in all countries, international meetings. The decisions of world-class meetings, the Stockholm Conference (1972), the International Environmental Conference in Rio de Janeiro (1992), the Kyoto Protocol (1992) and the Paris Climate Conference (2015), became important. A vivid manifestation of the need to protect the natural environment is the adoption of an energy saving program that has an environmental protection substance.

The implementation of energy saving program activities is carried out in all countries of the world, including Ukraine. Participation in the implementation of the activities of the program is necessary and not only for energetics sector workers. Ecological culture should be inherent in every inhabitant of the planet Earth.

Conclusions

1. Traditional systems of automatic control of technical objects do not cope with the task of the necessary limitation of the harmful effects of these objects on the environment.
2. The problem is to increase the effectiveness of environmental protection from the harmful effects of industry.
3. It is relevant to use indicators of ecological efficiency of technical objects as controlled parameters.
4. A new approach to the control of technical objects was proposed on the basis of limiting their impact on the natural environment.
5. As the main control parameter it is proposed to adopt the level of ecological efficiency of the technical object.
6. Complicating circumstances of solving the problem is the insufficient knowledge of the factors of harmful effects on objects of living nature, their intensity, interrelation, mechanism, strength, and dynamics of exposure.
7. Improving the TO cost-effectiveness sets conditions for increases their ecological efficiency.



8. The solution to the problem is facilitated by the fact that traditional ACS should be left in action by adding the EE control component to them.
9. EE control is of interest for all branches of modern industry, especially for that ones, which is responsible for damage to the natural environment.
10. Heat-power engineering has a large impact on the environment through emissions and discharges of harmful substances and heat.
11. The harmful effect exerted by boiler equipment on the environment depends on the state of these objects.
12. Important task of Ukraine energetics sector is updating of boiler plants.
13. To give to ASC the functions of controlling the ecological efficiency of the boiler (for SO_y emission), it is necessary to apply an additional, new control loop - regulator of SO_y concentration in furnace gases
14. An urgent task in the use of direct control of the ecological efficiency of boiler-furnace systems is the development and production of physical quantity sensors, reflecting the level of aggressiveness of the source of hazard, working in real time.
15. Direct control of indicators of ecological efficiency is much easier in other branches of industry, in particular, in its food branch, where objects do not have a large-scale complex negative impact on the environment.

References

- [1] Kirsanova, T., Kirsanova, E., Luk'yanihin, V. *Ekologicheskij kontrolling – instrument ekomenedzhmenta*. Pod red. V. Luk'yanihina. Sumy: Kazackij val, pp. 1-222, 2004.
- [2] Mel'nik, L. *Ekologichna ekonomika*. Sumi: Universitets'ka kniga, pp. 1-346, 2002.
- [3] Voinova, S. "Pro aktual'nist' upravlinnya ekologichnoyu effektivnistyu tekhnichnih ob'ektiv", *Energetika ta elektrifikaciya*, no. 1, pp. 64-67, 2012.
- [4] Voinova, S. "Problematika upravleniya ekologicheskoy effektivnost'yu predpriyatiya pishchevoj promyshlennosti", *Avtomatizaciya tekhnologichnih ta biznes-procesiv*, no. 17, pp. 10-15, 2014.
- [5] Voinova, S. "Upravlenie effektivnost'yu funkcionirovaniya proizvodstva kak sredoohrannaya koncepciya", *Visnik ODABA*, iss. 60, pp. 449-453, 2015.
- [6] Voinova, S. "About significance of the control problem of ecological efficiency of functioning of technical objects", *Automation of technological and business-processes*, vol. 8, iss. 2, p.p. 19-22, 2016.
- [7] Voinova, S. and Voinov A. "Vozdejstviem mirovogo proizvodstva na prirodnyuyu sredu neobhodimo upravlyat" *Materiali naukovopraktichni konferencii «Energiya. Biznes. Komfort»*. Odesa: ONAHT, pp. 7-8, 2017.

Список використаних джерел

- [1] Кирсанова Т.А., Кирсанова Е.В., Лукьянихин В.А. Экологический контроллинг – инструмент экомеджмента / Под ред. В.А. Лукьянихина. – Сумы: Казацкий вал, 2004. – 222 с.
- [2] Мельник Л.Г. Екологічна економіка. – Суми: Університетська книга, 2002. – 346с.
- [3] Воїнова С.О. Про актуальність управління екологічною ефективністю технічних об'єктів / Енергетика та електрифікація, 2012, №1.- С. 64 – 67.
- [4] Воїнова С.А. Проблематика управління екологічної ефективністю підприємства харчової промисловості / Автоматизація технологічних та бізнес-процесів, 2014, № 17. – Одеса: ОНАХТ, 2014.- С. 10 - 15.
- [5] Воїнова С.А. Управление эффективностью функционирования производства как средоохранная концепция / Вісник ОДАБА, 2015, Вып. №60.- Одеса: ОДАБА, 2015.- С. 449 – 453.
- [6] Voinova S.A. About significance of the control problem of ecological efficiency of functioning of technical objects / Automation of technological and business-processes, 2016, Volume 8, Issue 2, p.p. 19 – 22.
- [7] Воїнова С.А., Воїнов А.П. Воздействием мирового производства на природную среду необходимо управлять / Матеріали науково-практичні конференції «Енергія. Бізнес. Комфорт», 16 листопада 2017р.- Одеса: ОНАХТ, 2017.- С. 7 - 8.