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EFFICIENCY OF PREPARATION FOR SOLID FUEL BURNING

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Abstract: The research presented in this study focuses on solid fuel and the process of preparing it for combustion. This topic is highly relevant as it plays a significant role in providing energy to the population and contributes to Ukraine's independence in the economic and energy sectors. Understanding the processes involved in solid fuel preparation is crucial for ensuring efficient energy production and minimizing negative environmental impacts. Therefore, this study aims to provide valuable insights into this area of research. The purpose of the work is to analyze the efficiency of preparation for burning solid fuel and to introduce effective tools that will allow to increase the efficiency of preparation to a new level. The article employed various methods to analyze the topic at hand, including the analytical method, deduction method, functional method, statistical method, synthesis method, and other relevant approaches. In the course of the research, the peculiarities of solid fuel and its differences with other sources from which energy is obtained were noted, errors in the preparation for the burning process of this object and the reasons for their appearance were analyzed. Ineffective methods of increasing the efficiency of preparation for burning solid fuel and their impact on the quality of this process were identified. It was determined that the process of burning solid fuel plays the most important role in increasing the efficiency of power plants of industrial enterprises and not only that.

Keywords: *Energy sector, Power plant, Supply, Process, Increase, Boiler plants*

1. INTRODUCTION

The competitiveness of industry in Ukraine largely depends on its level of energy efficiency and progressiveness. Recently, in many industrial enterprises, the energy sector is outdated, both morally and physically. The problems in the process of burning solid fuel are some shortcomings in the preparation for this process, and this

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is related to the issues of determining and optimizing efficiency indicators at the stages of development of methods of preparation, their functioning and development. Currently, almost 70% of all energy produced in Ukraine can be obtained from solid fuel by burning it. Solid fuel is the best option for replacing natural gas and has already replaced about 5.2 billion cubic meters of natural gas, which is almost 15% of the total consumption (Polozhai et al., 2021). In order to solve some issues related to Ukraine's energy supply in many areas, and especially in the energy sector, it is necessary to implement progressive and innovative mechanisms for efficient combustion of solid fuel. These include the reconstruction of the furnace of the boiler for stratified burning of solid fuel, the introduction of new efficient combustion technologies, which will ensure the timely and accurate supply of energy (Gao et al. 2022; Zhang et al. 2022; Yuan et al. 2023).

According to S.G. Polozhai et al. (2021), thermal energy and its difference in cost, which occurs when burning various fuels, causes great interest in replacing fuel oil and gas, which are traditionally used in the technology of burning lime and biofuel. The source of heat, which is the most accessible and cheapest, for the specified technologies, is considered to be solid fuel and a large amount of waste from wood processing enterprises in the regions. Therefore, the work aimed at their use as fuel is expedient, economically justified and progressive. According to O.V. Kolbasenko and B.V. Dymo (2022), the change in the parameters of a significant range, which formulate the efficiency of solid fuel combustion, is highlighted by various quality indicators of solid fuel and water, and first of all, the preparation technologies and the required final values of the properties of the prepared solid fuel, which can provide better indicators of the complex combustion efficiency solid fuel, namely: reliability, economy and environmental friendliness.

In the J.J. Jetter and P. Kariher's (2009) own words, in forested areas there is a large amount of wood and its residues that are not used. Combustion of wood residues, and solid fuel in general, in innovatively created equipment refers to ecological methods of using industrial residues. Therefore, the current energy problems and issues will be solved if all possible sources of fuel and energy are properly used, first of which are solid fuel and wood biomass. The use of fast-growing wood fuel is important today. S. Kim et al. (2015) point out that the dependence on obtaining natural gas, which has existed for years, provoked the energy crisis in Ukraine. The general need to use new types of fuel for conventional heat supply systems, as well as changing traditional systems to innovative ones, appeared in the country before the economic and gas crisis. Insufficient information on various energy sources, shortage of state support programs for solid and "green" fuels, partial supply of gas – these are all the main factors that have prevented the development of effective economically and socially justified programs that would help transfer mechanisms to convenient and profitable heat supply agricultural sector and industrial enterprises.

According to W. Liang et al. (2022), in the current innovative methods of reducing

gas concentrations in boilers in which the main solid fuel is burned, this method is quite effective and the least costly – the organization of staged combustion. Application of this method in industry confirmed the prospect of a large reduction of nitrogen oxides in flue gases. Looking at the extensive practice of using boilers, if the recovery zone is not supplied with natural gas, but, for example, with coal, which is burned in the main combustion zone, then the efficiency of boiler operation decreases, first of all, when using solid fuels with insufficient release of volatile substances. The need to use solid fuel has increased dramatically due to the lack of natural gas in the country and due to financial efficiency (Duan et al. 2023; Stupar et al. 2023).

The purpose of this study is to carry out an objective analysis to identify problems and shortcomings in effective preparation for burning solid fuel at the current stage of the development of this process. Completion of this task will provide an opportunity to develop effective methods for preparing a more accurate calculation, as well as minimize errors in the burning process.

2. MATERIALS AND METHODS

Conducting a scientific study in the field of determining the problems of improving the efficiency of preparation for burning solid fuel was carried out using methods that reveal the theoretical and practical meaning of the object and this process. The analytical method helped in highlighting the problems of using solid fuel, which is used as a source of energy in the process of combustion in boilers. With the help of a statistical method, indicators were considered that help to analyze the level of efficiency in preparation and the causes of errors that occur in this process, that occur during the burning of solid fuel, the implementation of improving energy supply to various enterprises, the prospects for the use of this facility and development in the energy industry countries. Using the functional method, the role and essence of solid fuel and the process of burning it in various fields, especially in the energy sector, its advantages and disadvantages, the impact on the national economy, ecology and energy were analyzed.

The structural-functional method helped in the analysis of trends, factors and efficiency models of preparation for solid fuel combustion, it was found that in order to solve the problems with the shortcomings of the development of effective methods of preparation, with the improvement of maintenance of boilers and their components, with the development of new technologies for high-quality extraction of solid fuel fuel and the determination and optimization of indicators at the stages of development of preparation methods, will require an increase in state funding, a new approach to the management system and the development of innovative boilers, and an increase in the quality of technologies in this field. The deduction method helped in revealing the concept of "burning solid fuel" through the prism of highlighting its characteristic

features for a full-fledged analysis of this process and the problems in preparing for it. Applying the synthesis method, the obtained results of a theoretical and practical nature were summarized to identify recommendations that contribute to solving problems and improving the efficiency of preparation, prospects for reducing problems in the process of burning solid fuel and in energy supply to users, development in modeling and development of constituent elements in boilers, prospects and benefits in the energy sector of the country.

Thus, this research was carried out in several stages. The first stage consisted in revealing the theoretical aspect of the work, namely, in defining the concept of "solid fuel combustion process", conducting an analysis of the characteristic features and principles of this process; especially in the economic, environmental and energy spheres of the country. The basis of the second stage was the study of the process and the problems of the effectiveness of the approach to it, as well as the development and use of innovative boilers, the advantages and disadvantages of solid fuel, the peculiarities of the operation of this process and the analysis of activities and prospects in various areas; an important step of this stage was the analysis of prospects for the use of solid fuel in various boiler units, the implementation of the development of new technologies to improve the process of preparation for burning solid fuel, ways to reduce problems in the use of this energy source, in the use of this energy to provide for the population, the impact on the national economy and energy in order to determine the effectiveness of the development and prospects of this process. The third stage, based on the revealed results of theoretical and practical content, provided an opportunity to identify problems and recommendations in the process of burning solid fuel, and more precisely, to increase the efficiency of preparation for burning solid fuel, which will contribute to the solution of these issues and development in various areas.

3. RESULTS

In order to provide the population of Ukraine with high-quality energy, the following are necessary: the development of solid fuel combustion in boiler plants, and it is also especially important to increase the efficiency of methods of preparation for solid fuel combustion, which are most often used. During the burning process of solid fuel in the boilers of heat generating stations, especially wood, carbon dioxide enters the atmosphere, it is present in the content of the combustion products, but the most important thing is that there is no sulfur oxide in this composition, as it is a toxic component. Obtaining energy by burning solid fuel is one of the popular and optimal ways to provide energy for many consumers, it is also beneficial to use to solve many issues of the country, because it has a small part of absorbing emissions in the environment, especially in the air. If, when using solid fuel, especially coal, which has

a low reaction, an error is made in reproducing the three-stage classic scheme, it can cause a sharp decline in the efficiency and economy of boiler mechanisms. In the operation of boiler plants based on the burning of solid fuel, it is necessary to find and solve the causes of the decrease in efficiency and damage to this object. A multi-fuel burner is a progressive and profitable mechanism for burning solid fuel.

In most cases, the use of these mechanisms makes it possible to significantly improve the quality of the received energy. It is also necessary to pay attention to the high-quality preparation of solid fuel and maintenance of boiler units. The development of new methods of solving the tasks of eliminating errors in preparation for burning solid fuel in the energy sector of Ukraine currently has enormous progress and prospects. During the process of burning solid fuel, especially at the initial stage, in many technologies, a large amount of nitrogen oxides is formed, which is a significant disadvantage for these technologies, since in the future it will be necessary to make a lot of effort to reduce them. If, in the process of improving the efficiency of preparation for burning solid fuel in boiler plants, we start using modern auxiliary devices and computerized effective methods of preparation, this will help to significantly increase the use of this energy source as a tool for providing energy to users. In the country, it is coal and wood that ensure the energy and economic independence of the energy sector, because they are mined in large quantities and this is the most important priority.

The task of effective preparation for burning solid fuel and quality management of the regimes of this process, their problems with the application and development of innovative methods, are gaining more and more relevance and practical value. Compared to oil, burning coal and wood is the best option because less carbon dioxide is produced during combustion, so the impact on the environment is lower. Combustion of solid fuel is economically beneficial and effective, if the environmental component is ensured at a high level. Only alternative energy sources, which are currently developing rapidly, compete with this, they have many advantages compared to other types of energy supply sources, but they also have quite a few disadvantages when used in many areas. It is necessary to carry out a special preparation of solid fuel before burning in order to obtain a better result without flaws and errors. In this complex process, reviewing the causes of errors in the preparation of solid fuel and boilers and their solution acquires special importance, since the development of this process in Ukraine is one of the urgent problems of our time. A large number of effective solid fuel preparation systems are known, an important task in which is to find a finely dispersed emulsion, which will help to make a permanent composition under storage conditions (Liang et al. 2022).

Very often, mistakes are made in the process of preparation for burning solid fuel and in the management of boilers, which worsens the efficiency of these systems and the quality of the received energy. It is necessary to keep the pulverized coal torch as long as possible in the reduction zone in order to have a more complete binding of

nitrogen oxides. In general, the problem of optimizing the elimination of deficiencies in the process of preparation for burning solid fuel has not been fully resolved. Currently, almost the entire world economy is switching to the use of alternative and environmentally friendly energy sources, as well as to organic waste and biomass, but still, burning solid fuel is the most common and economically beneficial option, and is in great demand in many countries. An important reason for the use of solid fuel burning energy in many organizations of the country was the possibility of long-term extraction of solid fuel, its cheapness, efficiency and ease of use. The process of burning solid fuel in fuel devices and mechanisms is efficient and ecological and is determined by the properties of the combustion regime, especially the kinetics of this process.

The country's energy supply in various areas depends on the process of burning solid fuel, therefore it is necessary to bring the preparation for this progress to a new level, which will be more effective. The main energy type of waste in the north-western region of Ukraine is wood, fuel wood chips of coniferous species, etc. In order for the quality of the process of obtaining energy by burning solid fuel to become higher, it is necessary to increase the efficiency of preparation and reduce the shortcomings in the management of boiler plants. The optimal parameters of the prepared solid fuel should be considered to be such values that help to ensure the proper parameters of the combustion process with high economic and ecological indicators and the efficiency of boiler installations. Currently, to provide the country with energy, the processes of burning fossil coal have become the most widespread and developed. At the moment, Ukraine has great opportunities for extraction and use of solid fuel as one of the types of fuel. One of the best options for increasing the efficiency of the operation of power plants of industrial enterprises is to transfer the equipment to burn solid fuels, including coal and biomass (Mykhaylovska and Bulgakov 2022), or to burn them simultaneously in optimal ratios. Also, the progress in the development of effective methods of preparation for burning solid fuel will allow to popularize and arouse interest in the use of this fuel in the country, the diagram (Fig.1) is presented for a better understanding of the share of solid fuel use in Ukraine.

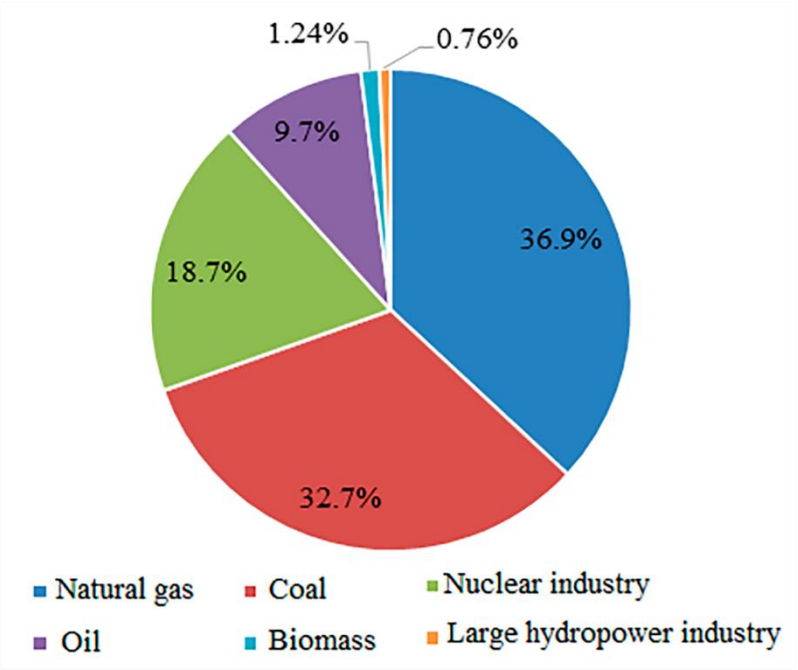

Fig.1 Diagram of the use of energy sources in Ukraine for 2021
Source: (Mykhaylovska and Bulgakov 2022).

A condition for the reliable operation of boiler plants designed to burn solid fuel is to ensure stable operation of both some elements and the plant as a whole. A significant number of power and industrial boiler plants located at thermal power stations are designed for the combustion of liquid or gas fuel and have a chamber furnace. You can choose one of the effective options for processing these boilers for burning solid fuel. The first method is the burning of pulverized coal fuel with a certain system of effective fuel preparation, grinding, and drying. The second method is the reconstruction of the furnace of a boiler for stratified combustion of fuel by installing a movable or fixed grate (Norchak 2022). Energy sources, namely solid fuel, in the country have a huge development potential and a long implementation practice compared to other alternative energy sources. Due to the uncertainty of the properties of coal and wood biomass, the choice of the best operating mode of the boiler plant is difficult. It is important to study the peculiarities of the use of modes of boiler mechanisms and their systems to identify shortcomings and errors in the process of burning solid fuel in order to avoid these shortcomings during the operation of this mechanism.

Wood chips, as one of the types of solid fuel, also require preliminary preparation for burning. Different opinions about the possible occurrence of micro-explosions in

the combustion chamber, their effect on combustion processes require the obligatory introduction of additional observations of the solid fuel combustion process, in which the economic consumption of clean fuel is ensured (Perez-Vega et al. 2018). The issue that deserves attention at the moment is the analysis of the technological and design features of the conversion of gas-oil steam boilers to solid fuel to improve the energy and economic efficiency of the processes of industrial enterprises. The problem of optimization and reduction of shortcomings in the process of preparation for burning solid fuel in boiler units remains open and unsolved, this is caused by insufficient attention to this issue. The kinetic parameters of the combustion process depend on the properties of the solid fuel. The study provides information on increasing the efficiency of boiler plants and preparation for burning solid fuel, this has a huge plus for the operation of this facility in various areas.

First of all, it is necessary to determine the parameters of solid fuel, which are required for its use in boiler units, and also to develop innovative – technological methods of fuel preparation. Therefore, it is necessary to develop the processes of preparation of solid fuel and its combustion in order to develop recommendations for determining the quality of the prepared solid fuel and its combustion, its combustion efficiency, regarding the decision of the maximum level of heat release in boiler plants (Wang et al. 2022). An increase in the temperature of gases at the exit from the boiler occurs only in the event of an outage, if the combustion process is delayed in time. Solving issues related to the reduction of shortcomings in the process of preparation for burning solid fuel requires the introduction of effective modeling tools for boiler plants and their elements. In order to obtain higher efficiency and reduce dangerous gas emissions, it is necessary to increase the volume of the firebox by modernizing boiler units or performing pre-burning furnaces for pre-combustion of solid fuel. Almost all boiler installations, which are used today at thermal power stations, need reconstruction to increase the efficiency of the furnace (Roskovshenko and Senchuk 2010).

For effective combustion of solid fuel, especially wood, it is necessary to carefully study the energy properties of solid fuel, the kinetic parameters of the combustion process of each type of this material, and to develop effective methods of preparation for considering the process of its combustion in boiler power plants. One of the promising ways of using solid fuel is the creation of new boilers (Senchuk 2020). Replacing natural gas with sawdust fuel, which is obtained from the waste of the wood processing industry in the north-western region of Ukraine, is a very promising and successful option (Ma et al. 2022). Work on solid fuels is economical, effective and optimal for energy-generating enterprises of Ukraine, which helps to obtain energy in a high-quality and fast manner and supply it to industrial enterprises and other consumers (Surina et al. 2022) A comprehensive positive solution to the problems of increasing the technical, economic efficiency and reliability of the operation of boiler plants due to the activation of solid fuel combustion can be obtained by creating an

environment of simultaneous multiple electrodeless pulse ignition of plasma in the flame volume at the end of the pre-flame processes and, of course, in the location of the flame I, as a result of micro-explosions of her liquid (Sankar et al. 2022). The rapid development of the development of effective methods of preparation for the burning of solid fuel at the moment will help in the effective solution of problems at a higher speed and will bring the quality of the results to a new modern level. If you make efforts and maximally extend the fuel ignition process, you need to maintain the efficiency of the operation of boiler plants due to the large amount of solid fuel burning and reducing the surface of the heating pollution.

4. DISCUSSION

The quality of research conducted to identify the effectiveness of preparation for burning solid fuel, which plays a large role in the country's energy supply, and their effectiveness is one of the most pressing issues of our time, and some issues require immediate resolution. The availability of modern preparation methods makes it possible to improve the devices used in combustion and increase the efficiency of the technical process of solid fuel combustion, and ultimately achieve high efficiency of combustion energy installations, as well as reduce their harmful impact on the environment. This study, conducted on the efficiency of preparation for burning solid fuel, made it possible to better understand the reasons for the appearance of shortcomings in the process of preparing for burning solid fuel, assess the possibility of solving these problems, and identify at what stage they may appear. During the study, the economic, energy and technical possibilities of using solid fuel were evaluated. Thanks to the design features and characteristics of some boiler units, it is possible to obtain a better result in the process of solid fuel combustion. It is possible to increase the ecological, technical and economic indicators of the efficiency and reliability of boiler installations during the burning of solid fuel due to the activation of plasma processes. It is worth noting that in the development of design and modeling of innovative boiler units designed for burning solid fuel, Ukraine has taken a powerful step forward over the past few years. If you simultaneously reduce the impact of three types of nitrogen oxides, thermal, fuel and fast, you can significantly reduce nitrogen oxide emissions.

When replacing solid fuel in pulverized coal boilers with fuel with higher moisture and ash content, in order to ensure the efficiency factor and environmental requirements at a high level, it is necessary to significantly reduce the steam productivity of the boilers. When designing boiler mechanisms and their elements in order to ensure a high-quality solid fuel burning process, boiler models should adequately describe the process and be simple and implementable. The progress of the use of chopped wood, and solid fuel in general, depends on the improvement of

fuel devices and the improvement of the efficiency of its preparation for burning. For boiler units of thermal power stations of Ukraine with the technology of burning coal in a pulverized coal torch, the process of fuel preparation for burning was investigated. Such boiler units are mainly equipped with sawdust systems with ball drum mills of the KBM 370/850 (Sh-50A) type. The preparation consisted in determining the influence of coal quality characteristics on the process of grinding it to the required fraction. As a result of the study, it was established that the main factor affecting grinding is coal moisture (Golyshev et al. 2001). For real operating conditions, when processing experimental data, the dependence of the productivity of grinding different types of coal in the KBM 370/850 type mill on the humidity of solid fuel was established, in particular:

1. For coal T of the Donetsk basin:

$$B = \frac{78}{10^{0.016 \cdot W^p}}. \quad (1)$$

2. For coal G of the Lviv-Volyn basin:

$$B = \frac{105}{10^{0.026 \cdot W^p}}. \quad (2)$$

3. For coal AK of the Donetsk basin:

$$B = \frac{92}{10^{0.035 \cdot W^p}}, \quad (3)$$

where: W^p is the moisture content of coal per working mass.

Dependencies of approximated values for different grades of coal according to equations (1), (2) and (3) are shown in Fig.2.

One of the indicators of efficiency and cost-effectiveness of using solid fuel as an energy source is that solid fuel is easier to extract and in Ukraine its reserves are sufficient to ensure energy independence. When carrying out work, especially on industrial equipment, it is necessary to determine the requirements for solid fuel in terms of its quality and degree of grinding. The majority of boiler units and some of their elements have an outdated design, because of this it turns out that the functioning of this device is not effective, which is a signal for reconstruction and development of new installations for further high-quality work.

It is necessary to constantly confirm the level of savings of solid fuel and clean fuel in the process of combustion during plasma reactions, as well as to show as much as possible the possibility of electrodeless pulse ignition in the processes of microexplosions and solid fuel combustion, so that as a result it is possible to propose the mechanism of operation of these processes and their efficiency. For a better understanding of combustion processes, it is necessary to identify and confirm the

impact of various options for introducing water into the solid fuel combustion zone on the quality of combustion and its ecological and economic level for one value. The first role in ensuring the efficiency of boiler installations at thermal power plants and in the process of preparation for burning solid fuel is played by the professionalism of the staff and timely diagnostics of the equipment. To reduce the emission of fuel oxides of nitrogen, it is necessary to start the process of burning solid fuel with excess air, which is equal to the release of volatile substances.

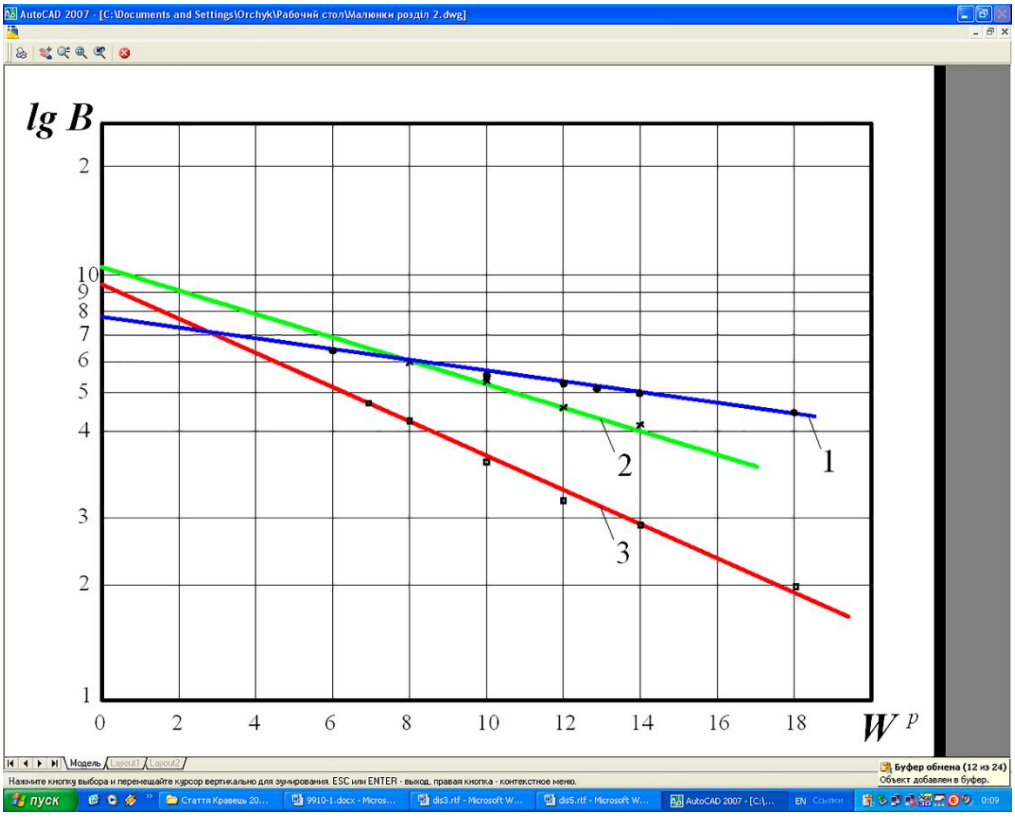

Fig.2 Dependence $lgB = f(W^P)$ for coal grades
Note: 1 – T of the Donetsk basin; 2 – G of the Lviv-Volyn basin; 3 – AK of the Donetsk basin.

According to the results of the latest research by P.R. Deshmukh et al. (2021), if we take into account the lack of the main types of fuel oil and natural gas in Ukraine, its dependence on the import of energy sources, as well as the current state of mechanisms of fuel and energy systems with a large amount of solid fuel, mainly coal, in obtaining thermal energy, it is necessary to increase financing of the energy sector for its development. In order to reduce energy dependence, the share of which is

approximately 40%, from the import of oil, uranium, and gas, looking at the economic feasibility of the state program, it is necessary to increase the fuel balance of own solid fuel resources. Among the country's own resources, coal and wood have a large share (more than 20%), according to forecasts.

The entire mechanism of fuel and energy systems in Ukraine was analyzed, as a result, it was decided that for the use of various boiler installations, it is necessary to have developed basic knowledge in order to determine the properties of these devices and their number, which will help to understand the process of operation of fuel and energy systems and transfer them to solid fuel burning process for energy independence. It is necessary to increase the production capacity of the coal industry in the country, this trend in the balance of the world consumption of solid fuel resources is to increase the amount of solid fuel, especially wood and coal. Some problems associated with insufficient professionalism of personnel can be solved with the use of special training programs, therefore training of working personnel is a priority in the training of specialists, which contributes to the professional development of communication workers and activates their regulatory framework for high-quality maintenance of boiler units.

Turning to the definition of M. Jach-Nocoń et al. (2021), the current problem is the harmful effect on the environment during the operation of heat-generating units, in particular those that burn solid fuel. It is possible to propose one way to increase the environmental performance of boilers during the combustion of solid fuel in a layer, which is often used in low-power heat generators, involving the system mechanism of jet secondary blowing to obtain effective combustion of superlayer gases. But it is necessary to provide better mixing of combustible gases over a layer of solid fuel with a variable amount of oxygen content per volume of the combustion chamber and to develop conditions for its complete combustion. This indicates that during the design and modeling of heat-generating units based on solid fuel combustion, it is necessary to take into account all factors affecting the quality of combustion and ensure the reduction of harmful emissions into the atmosphere. Therefore, it is necessary to develop a homogeneous gas-air mixture according to its combustion temperature. Also, it was not taken into account the fact that innovative heat generating plants contribute to the solution of multiple tasks of the country, for example, they help to generate more energy and provide it to users, which makes them profitable and efficient to use.

Researchers P. Tang et al. (2022) determined that the use of systems of combined combustion of solid fuel, in particular coal and wood waste from plants according to a low-temperature vortex scheme, is an effective modern method. During the simulation of the system of combined combustion of solid fuel, if the scheme of this class is applied, the work can be complicated, due to a significant number of receiving elements and a large number of parts involved in the process, therefore it is very important to take into account the peculiarities of using this type of scheme and

system, timely study of data and possible causes of problems, for the further prospective development of the application of a low-temperature vortex scheme in combined combustion systems. Therefore, the specified prospect of introducing these schemes and methods of solid fuel combustion has a small effect on reducing the efficiency of boiler plants, steam temperature and pressure. Analysis of the factors that determine errors and their causes of appearance in the processes of effective preparation for burning solid fuel revealed the stages in which the most shortcomings occur, which include the preparation of solid fuel.

M. Broumand et al. (2021) determined that in order to increase the efficiency of preparation for solid fuel combustion, it is necessary to carefully analyze boilers for solid fuel combustion of various types, specify the conditions for using a mathematical model of the operation of the solid fuel combustion process, observe the solid fuel combustion process, and also determine its kinetic constants, determine the parameters of the combustion process mode solid fuel to increase its efficiency, it is also necessary to improve the design of boiler devices to increase its energy efficiency. The results of this method of increasing the efficiency of fuel preparation were analyzed and studied, as a result, a conclusion can be drawn about the effectiveness of using innovative designs of boiler devices, which allows obtaining high-quality and economical energy. The progress of the energy technological processes of burning solid fuel and wood is gradually becoming noticeable in the country. The advantage of analyzing the reasons for the appearance of deficiencies in the process of preparation for burning solid fuel is that, thanks to it, it will be possible to design more resistant elements of boiler plants to various influences. The advantage of analyzing the reasons for the appearance of deficiencies in the process of preparation for burning solid fuel is that, thanks to it, it will be possible to design more resistant elements of boiler plants to various influences.

W. Pang et al. (2021) showed in his works that the quality of solid fuel is assessed by the completeness of its combustion, which in turn is determined by the amount of residual carbon in lime. These methods may have a certain modification, this happens due to the properties of the observed fuel. A feature of some enterprises is that they use chalk from the deposit of the same name as raw material. The current state and complexity, a significant number of errors in the process of preparing solid fuel combustion in boiler plants require employees to constantly understand modern tasks, dynamism and flexibility of their solutions, adjust to the situation during the operational process. As noted by A. Datta et al. (2021), the processes of burning diesel fuel, fuel oil, solid fuel or on their basis during the combustion of fuel oil with the injection of water into the core of the torch in large quantities, make it possible to obtain a separation of the concentration of chemical compounds along the length and in the center and near the walls cameras in boiler plants and evaluate the reaction of combustion in heat release processes in boiler units. On the basis of determination of consumption of solid fuel and clean fuel, it is possible to determine the contribution

of the recombination reaction to the amount of useful heat release in boiler plants.

Also, on the basis of additional studies, it is possible to obtain the dependence of the adiabatic temperature values on the water content in the combustion process. It is necessary to increase funding and improve the qualifications of employees, to start implementing new technologies to improve the design and modeling of boiler plants that are designed to burn solid fuel and to reduce deficiencies in its preparation for burning.

5. CONCLUSIONS

The main problems of improving the efficiency of preparation for burning solid fuel in boiler plants for the country's energy supply are mediocre training of personnel, problems of correct modeling and design of heat generator systems, numerous shortcomings in preparation for burning solid fuel. These problems are and will be relevant and require further research. The obtained results show that there is an important opportunity to eliminate uncertainties during the combustion process, if a certain scheme and rules are followed during the operation of boiler units. In this work, the goal of the research was achieved, namely, the analysis of the efficiency of preparation for combustion of solid fuel was carried out and effective tools were proposed for implementation, which can increase the efficiency of the process of preparation for combustion to a new level. In order to improve the country's energy independence, it is necessary to increase the use of solid fuel as an energy source. It is also necessary to pay attention to the quality of solid fuel and implement new developed methods for its high-quality preparation.

It was possible to fulfill all the tasks set before the research, namely to highlight the problems of operation of boiler plants in which the process of burning solid fuel takes place and to analyze them more precisely, methods of solving shortcomings in the preparation of these issues were also found and proposed for more efficient operation of this mechanism. Considered and analyzed the conditions, the implementation of which during the design of heat-generating mechanisms, allow to bring the issue of development of these objects to a new level and improve their maintenance. Modern approaches to the problems of preparation methods for burning solid fuel are analyzed. Further research will be aimed at the feasibility of using alternative energy sources and the development of a modern scheme of boiler installations in this area, as well as at reducing harmful emissions into the atmosphere due to the process of burning solid fuel. Analytical dependences of coal grinding productivity in the KBM 370/850 type mill on the moisture content of solid fuel brands: T of the Donetsk basin, G of the Lviv-Volyn basin, AK of the Donetsk basin are presented. The results of the research can be applied in practice to increase the efficiency of the preparation process and improve the country's energy independence.

Additionally, the proposed methods can contribute to reducing harmful emissions into the atmosphere during the burning of solid fuel.

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