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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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THE SIGNIFICANCE OF MODERN BROWN COAL PROCESSING TECHNOLOGIES FOR THE DEVELOPMENT OF AGRICULTURAL PRODUCTION AND PUBLIC HEAT POWER

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Abstract. The article discusses the technological aspects of the suitability of brown coal for processing to obtain environmentally friendly products for various purposes. A scientific justification is given for the use of technologies for obtaining preparations from coal — plant growth stimulants in agricultural production, as well as smokeless briquettes in municipal heat power engineering. The prerequisites for the development of this material are huge deposits of low-grade brown coal, which, due to their low calorific value and high ash content, are not in demand in production, not only for technological, but also for energy purposes. A new technology has been developed for obtaining humic

preparations from brown coal, which have polyfunctional properties that increase the yield and environmental sustainability of various agricultural crops. For the first time, a technology has been developed for obtaining smokeless briquettes, including using the fluidized bed technique. The socio-economic effect consists in obtaining demanded products from the substandard part of the coal, as well as improving the condition of the atmospheric air in the area of the coal mine and the nearest settlements, which ensures a decrease in the incidence of the local population.

Keywords*:* coal, processing, technologies, humic preparation, pyrolysis, briquettes

© Н. Жалғасұлы[1], А.А. Асанов[2], С.В. Ефремова[3], У.А. Бектибаев[1], А.А. Исмаилова[1*], 2023

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АУЫЛ ШАРУАШЫЛЫҒЫ ӨНДІРІСІН ЖӘНЕ ӘЛЕУМЕТТІК ЖЫЛУ ЭНЕРГИЯСЫН ДАМЫТУДА ҚОҢЫР КӨМІРДІ ҚАЙТА ӨҢДЕУ ТЕХНОЛОГИЯЛАРЫНЫҢ МАҢЫЗЫ

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Аннотация. Мақалада әртүрлі мақсаттағы экологиялық таза өнім алу үшін қоңыр көмірді қайта өңдеудің технологиялық аспектілері қарастырылған. Ауыл шаруашылығы өндірісінде сол көмірден өсімдіктердің өсу қарқындылығын қамтамасыз ететін препараттар алу технологияларының, сондай-ақ коммуналдық жылу энергетикасында түтінсіз брикеттерді де өндіретін ғылыми негіздемесі келтірілген. Біздің елімізде төмен сұрыпты көмірдің орасан зор кен орындары

ашылған, көбісінің төмен калориялы және күлділігі жоғары болғандықтан, өндірісте тек технологиялық ғана емес, сонымен қатар энергетикалық мақсатқа да пайдалану әсері төмен. Айта кетуіміз керек қоңыр көмірден әртүрлі ауыл шаруашылығы дақылдарының өнімділігін және экологиялық тұрақтылығын арттыратын полифункционалды қасиеттері жоғары гуминді препараттарды алудың жаңа технологиясы берілген. Техникалық қайнау қабаты әдісімен алғаш рет түтінсіз брикеттерді алу технологиясы әзірленді. Көмір кенішіне жақын орналасқан жергілікті тұрғындарға әртүрлі аурулар тарамас үшін, сондай-ақ атмосфералық ауаның бірқалыпты жағдайда тұруын қамтамасыз ететін технологиялары ұсынылған.

Түйін сөздер: көмір, қайта өңдеу, технологиялар, гумин препараттары, пиролиз, брикет

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ЗНАЧЕНИЕ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ ПЕРЕРАБОТКИ БУРЫХ УГЛЕЙ ДЛЯ РАЗВИТИЯ СЕЛЬХОЗПРОИЗВОДСТВА И КОММУНАЛЬНОЙ ТЕПЛОЭНЕРГЕТИКИ

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Аннотация. В статье рассмотрены технологические аспекты пригодности бурых углей к переработке для получения экологически чистых продуктов различного назначения. Дается научное обоснование применения технологий получения

из угля препаратов — стимуляторов роста растений в сельхозпроизводстве, а также бездымных брикетов в коммунальной теплоэнергетике. Предпосылками к разработке данного материала являются огромные залежи низкосортных бурых углей, которые из-за низкой калорийности и высокой зольности не востребованы в производстве не только для технологических, но и энергетических целей. Разработана новая технология для получения гуминовых препаратов из бурого угля, обладающих полифункциональными свойствами, повышающими урожайность и экологическую устойчивость различных сельскохозяйственных культур. Впервые разработана технология получения бездымных брикетов, в том числе с использованием техники кипящего слоя. Социально-экономический эффект состоит в получении востребованной продукции из некондиционной части угля, а также улучшения состояния атмосферного воздуха в районе угольного разреза и ближайших поселений, что обеспечивает снижение уровня заболеваемости местного населения.

Ключевые слова: уголь, переработка, технологии, гуминовый препарат, пиролиз, брикеты

Introduction

One of the priority directions of the economic development of the Republic of Kazakhstan is to increase the efficiency of the use of minerals, in particular coal. It is also known that the state of the energy industry is a determining factor in the successful socio-economic development of any country. The current global energy supply system is based largely on the use of non-renewable energy sources (oil, gas, coal, uranium), as well as hydro resources (Moshkarin et al., 2002) .

One of the main roles in the energy sector today is played by solid fuel - hard or brown coal, the total world reserves, which are estimated at 4.9 trillion tons (Linev et al., 2007). Currently, only 1–2 % of the coal mined is used directly by the chemical industry, 15–20 % is consumed by the metallurgical complex, and about 75-80% of the coal is used for energy production. From the above data, it follows that at the moment there are two main areas of application of fossil coals: technological and energy.

An integrated chemical-technological approach to the development of coals of different grades provides a wide range of chemicals that can be used in various industries. This circumstance causes increased interest in these types of solid fossil fuels not only as fuel, but also as a raw material for the production of various preparations of agricultural plant growth stimulants, for materials used in household chemicals, chemical technology and metallurgy (Burdukov et al., 2010).

However, the lack of investment and the inertial nature of the development of the energy industry impede the rapid restructuring of its generating capacities and the change in the balance of electricity generation at power plants, especially autonomous low-capacity thermal power plants. The construction of large thermal power plants requires a lot of time and large one-time costs. Therefore, in the coming years, in order to improve the situation in the country's energy sector, it is necessary to focus on creating a network of so-called small-scale energy, including small thermal power plants and updating the fleet of boiler equipment.

Materials and basic methods

Fossil coals form the basis of fuel energy in many countries. The major coal-producing countries in the world include Germany, Russia, the USA, Australia, Poland, Kazakhstan and China.

In the EAEU countries, Kazakhstan has an extensive raw material base of coal, second only to Russia in terms of their quantity. In Kazakhstan, the total coal reserves are more than 170 billion tons, and the explored ones reach more than 60 billion tons. Of these, about 12.1 billion tons are brown coals. A distinctive feature of such coals is their high content of volatile substances, high humidity and relatively low calorific value. Such products, with the exception of coking coal and anthracite, are not of interest to foreign consumers working in the field of metallurgy in terms of quality and economic criteria.

The high level of gas prices, the expected transition to new electricity tariffs, will certainly lead to the use of alternative energy sources, and coal, due to its huge reserves and ubiquity, will play a growing role in the diversification of electricity production.

Under the conditions of the current shortage of electricity, the gradual transition of boiler houses to local coal fuel with the use of modern boiler units is of great importance. With the modernization of boiler units, the demand for coal can increase dramatically. Part of the consumed coal is used in lump form (population, traditional boiler units), the other part is in the form of fine coal (TPPs, processing plants). In accordance with this, sorting of the mined coal is required, followed by briquetting of coal fines.

The organization of coal briquette production in the regions of the republic is connected with the development of modern technologies for coal briquetting. The production of effective coal briquettes is associated with the thermal treatment of the original coal and is of a complex energy-technological nature. Complex processing of coal fines in this case is the most acceptable means of increasing the efficiency of fuel use of low-grade coals, however, it is associated with the cost of additional energy resources. At the same time, for their wide implementation in practice, it is necessary to carry out further work on the development of technology for obtaining smokeless high-calorie fuel briquettes. This, in turn, implies energy-technological processing of the initial finely dispersed coal using high-speed methods of coal pyrolysis.

Until recently, the global coal market has been increasingly affected by the Paris Climate Agreement. One of its consequences was an irreversible increase in the requirements for the quality of coal products. Although it should be noted that this trend was formed regardless of climate theories - primarily, based on the technical and economic indicators of electricity production in the republic and the need for high-quality coal. All this led to the limitation of the use of coal for power generation based on the latest technologies, to the transition to other energy carriers, the reduction of funds for the modernization of outdated boiler equipment and the optimization of heat supply systems.

In the foreign market of solid fuel raw materials, coal with a competitive calorific value is in demand, which requires the restructuring of the coal industry in terms of increasing this indicator. The average calorie content of consumed coals in foreign

countries is about 5500 kcal/kg. In this regard, it becomes obvious that it is necessary to expand the extraction of high-calorific coal and coking coal and thermal processing of brown coal to obtain brown coal semi-coke — a product with new consumer properties for efficient use, both in energy and in metallurgical purposes. Such problems can be solved by modifying the treatment of coal, which improves the yield and quality of products (Asanov et al., 2018).

Pretreatment of coals with certain chemical reagents or the use of physical impact methods leads to a change in their composition, structure and an increase in the yield of low molecular weight products during their processing. There are a number of different physical methods for activating coals, for example, rolling, grinding and other effects with the application of shear forces, crushing, grinding as a result of a relatively high-frequency mechanical shock, ultrasonic vibrations in liquid media; phase transformations, electrohydraulic shock in liquid media, irradiation, etc. (Shkoller et al., 2001; Kim et al., 2010).

Another problem is related to the fact that in the territory of Kazakhstan during independence, communications created in the Soviet era were partially disrupted. Under these conditions, the restoration of past volumes of agricultural products requires a lot of money and time. In addition, the issues of providing regions with electricity and heat are the basis of the life support of the population, which for Kazakhstan is more associated with the efficient use of coal.

In the article of the Academician of the National Academy of Sciences of the Republic of Kazakhstan U.Baimuratov it is said: "... the state and role of integration the main problem in the system "society - nature" continues to be a historical imbalance, when the consumption of resources significantly outstrips the production of the total product. In Kazakhstan, the Resource Efficiency Ratio (RUE) was 31 %. This is less than in the most technologically advanced countries of the world: Japan – 36 %, USA – 34 %, Germany – 33 %. The country has a long way to go from a modern cost economy to a true Green Growth. The concept of "Green Growth" also implies the development of "green energy" and the transition to low-carbon technologies (Baimuratov, 2013 http: //www.myshared.ru/slide/490012).

In the light of the foregoing, it is possible to identify a number of options for solving the problems of improving the quality and competitiveness of local coals, as well as the energy efficiency of their use. They are associated with the implementation of well-known coal processing technologies, which are divided into four groups (Tonkeswar Das et al., 2015; Marzena Mikos-Szymanska et al., 2019; Patent RU 2473671, 2013; Zhalgassuly et al., 2018) according to the types of products obtained:

- technologies for improving the quality of coal fuel (grading, briquetting, thermal enrichment, thermal briquetting);
- technologies for the production of fuel products with new consumer properties and higher cost (pyrolysis, gasification, processing into liquid fuel);
- technologies for processing coal into non-fuel products (adsorbents, plant growth stimulants, fertilizers, reagents, etc.);
- technologies for the extraction of inorganic mineral impurities (rare metals, silicon, ferro- and carbosilicon, etc.) from coal, its processing wastes and coal ash.

The research, carried out jointly with Kyrgyz specialists, made it possible to develop a number of innovative technical and technological solutions related to increasing crop yields through the use of preparations from brown coal and the production of smokeless coal briquettes for domestic needs.

We have developed a technology for obtaining preparations of plant growth stimulants from brown coal of the Oi-Karagai deposit. The technological process is carried out as follows: the feedstock (lignite) is cleaned of impurities using a system of sieves and screens. Prepared coal with a particle size of 0–5 mm is treated with a 40 % solution of sodium hydroxide in a tub at the rate of 0.4 liters per 1 kg of coal, which is hermetically sealed and left for 12–15 hours. Then the resulting mass is unloaded onto a specially prepared site, leveled with a layer of 2–3 cm, dried in air to a moisture content of 18–22 %, then the finished product is weighed and packaged.

It is known that risk farming is carried out on most of the soils of Kazakhstan, due to the arid climate, lack of moisture, dust storms, etc. Therefore, the obtained sodium humate is enriched with solutions of salts of microelements (zinc, molybdenum, cobalt, copper) and macroelements (iron, potassium, phosphorus, nitrogen) with varying concentrations within the following limits (%): humic acids – 30.0–50.0;

Sodium - 15.0–20.0; potassium and phosphorus – 0.03–0.15; zinc and iron - 0.10–0.30; molybdenum - 0.05–0.21; cobalt and copper - 0.01–0.06 (the concentration of microimpurities was changed depending on their content in the feedstock, soil and plant needs).

The resulting preparation is a bioenergy-informational adaptogen that increases the environmental resistance of wheat and other crops to extreme environmental factors (soil salinization, pesticides, man-made environmental pollution, adverse weather conditions, etc.). Its mechanism of action is to increase the bioenergetics of seeds and plants in ontogenesis. The additional energy potential obtained by seeds at the stage of pre-sowing treatment with the drug is stably fixed by seedlings, transferred to adult plants and is the basis for increasing the environmental sustainability of grain crops on low-productive soils.

On the basis of the KR patent No. 1614, a design of a pyrolysis plant for semi-coking coal was developed. Its distinctive feature is that in this design, for the first time in Kyrgyzstan, the principle of thermal destruction of coal using the fluidized bed technique is implemented. A general view of the design of the pyrolysis plant is shown in fig. 1.

Figure 1- General view of the fluidized bed pyrolysis plant

The fractionated coal is loaded into the bunker by a skip hoist. The supply of coal to the reactor was carried out by a vertically mounted screw module, which made it possible to abandon a separate power unit for supplying fuel to the fluidized bed and moving it along the gas distribution grid and simplify the design.

A socially important product produced from lignite coke is smokeless briquette fuel. Thermal enrichment of brown coals, as well as coals of other grades with a high yield of volatile substances, provides the maximum level of environmental safety for the deep processing of coal for the production of smokeless fuel briquettes. Its use, according to the experience of foreign countries, can radically improve the atmosphere of polluted cities, where coal is burned in the public sector (Elishevich et al., 1989; Zhumaliev et al., 2012).

The main element of the technological equipment of the briquette line is molding presses, which can be made in various designs, they differ from each other in the principle of molding, productivity and power. Our choice is made in favor of roller presses, which, in combination with charge preparation devices, form briquette lines. According to the scheme shown in Figure 2, a typical production line for briquetting substandard coal or a coke product includes containers for coal and additives, it works as follows: raw materials from these containers in appropriate proportions go through batchers for drying.

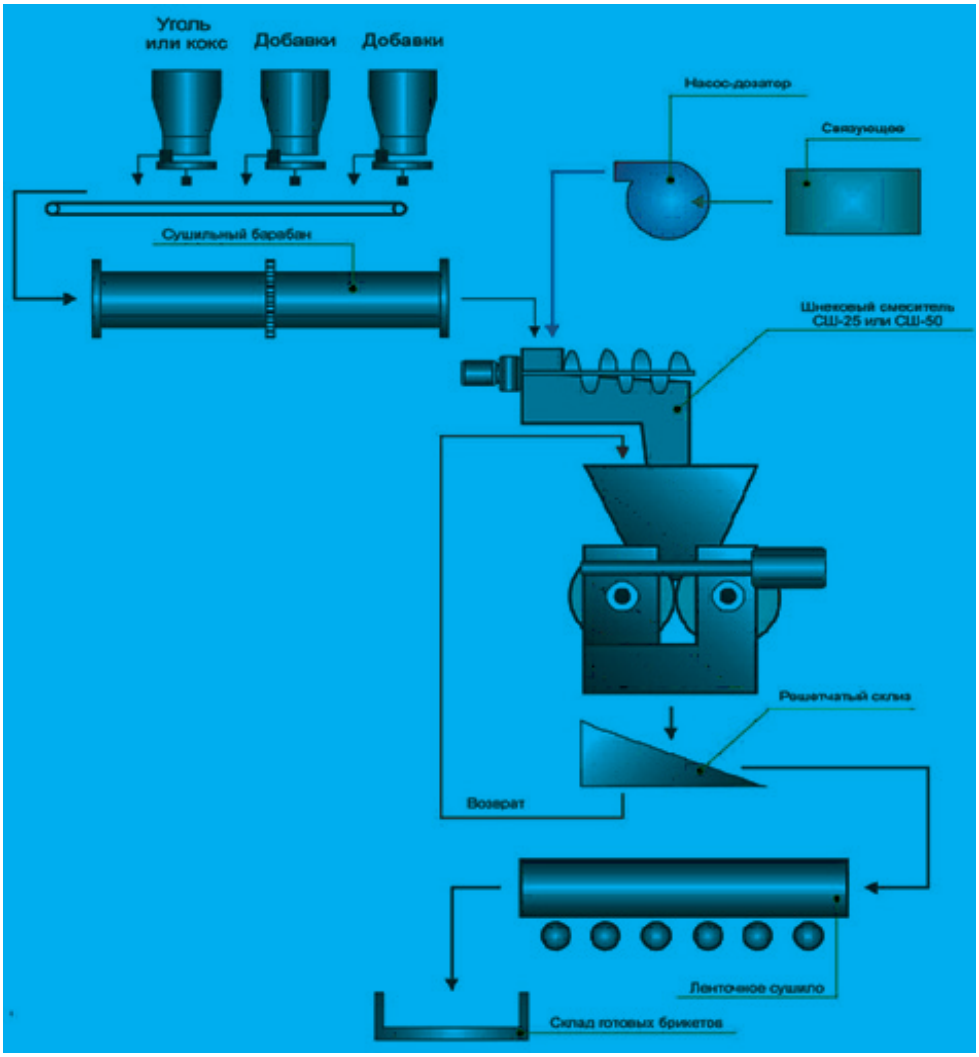

Figure 2 - Technological scheme of the line for briquetting coal coke breeze

Next, the mixture from the drying drum enters the mixer, where the binder is fed through a dosing pump. The mixture prepared in this way is briquetted on a press, which, after drying, are delivered to the warehouse of finished products, and the fines, after screening, are fed back to the mixer. The presence of substandard or uncompressed fines requires additional equipment — traditional crushers, mills and screens for separating fines from sorted coal or briquettes and transporting devices to return this fine to the briquetting cycle.

The capacity of the line with a roller press for coal briquetting is 4…6 t/h, the maximum pressing pressure is 300 MPa, the installed drive power of one press is 15 kW/h. In such presses, due to the use of removable bandages mounted on rolls, it is possible to produce briquettes of various shapes and sizes (Figure 3).

Figure 3 - Fuel briquettes of various shapes

When briquetting without a binder, the technological line can be simplified by eliminating individual stages.

One of the important elements of production lines is drying plants of various designs and operating principles. Drying is carried out in a suspended and transportable state of the medium in drum, screw, mine, tunnel and conveyor installations. The main raw materials are thermally refined fuel - semi-coke, obtained as a result of thermal destruction of coal, and known binders. The process of semi-coke briquetting, in contrast to the traditional coal briquette production, turned out to be rather complicated. The instrumentation of the process requires significant capital and operating costs. All these issues can be resolved with the complex processing of coal.

As a binder, it is possible to use bentonite clay, defecation, rice husk, starch, or molasses. Depending on the type, the binder dose does not exceed 5–12 % of the total mass. After thorough mixing of the mixture with the binder, the paste-like mass enters the roller press, where the molding process takes place.

Results and discussion

As a result of the work performed, the effectiveness of the drug obtained by the developed technology on low-productive soils with a salinity level of 0.8–2.2 % was established. The increase in the yield of grain crops reaches 24.2–42.1 %, rice 76.2–78.6 %, and soybeans - 34.8 %. The obtained preparation from brown coal is a highly effective prophylactic agent for disinfecting seed material from smut spores. The drug increases the energy of germination and germination of seeds, promotes enhanced growth of roots and aerial parts of plants, increases the utilization of nutrients from soils and applied fertilizers, accelerates the ripening of cereals by 7–9 days, increases the amount of raw gluten in the grain by 3–5 %.

Pre-sowing treatment of seeds is carried out 2–3 days after their preliminary dressing. Since spraying of vegetative plants with a 0.04 % aqueous solution of a plant growth stimulant preparation, which provides additional energy potential for their development

and crop formation, but is associated with production costs, this agricultural method should be used mainly in areas with low fertility. The most effective is a 0.04% aqueous solution of the drug mixed with urea (20–30 kg of urea-1000 l of water) at a working fluid consumption rate of 300–400 l/ha. Spraying of vegetative plants is carried out during the tillering period of cereals. To increase the energy capacity of the working solution of the drug in hard water, it is necessary to add, for example, liquid soap at the rate of 50 g per 1000 liters of water.

The authors tested an experimental sample of the drug and agricultural practices on various types of low-productive soils. The method of biotesting determined the optimal concentrations of aqueous solutions of a humic preparation for the treatment of seeds of agricultural crops, the optimal technological parameters for preparing seeds for sowing (duration of treatment with a humic preparation, seed soaking, etc.); the optimal conditions for sowing seeds into the soil (humidity, temperature, salinity) were determined.

The economic efficiency of using a humic preparation in the cultivation of crops on low-productive soils of Kazakhstan is shown in Table 1.

Table 1 - Economic efficiency of using a humic preparation

№	Indicators	Unit of measurement	Total
1	The consumption of the drug for 1 ton of seeds	кg	0.4
2	sown area	hectare	3500
3	Consumption rate of a 2% aqueous solution of the drug	liter per 1 ton	20
4	Quantity of preparation for presowing treatment	кг	350
5	Grain yield increase per 1 hectare	t	0,61
6	Total Additional Products	t	2135
7	The cost of the drug with VAT 15% + additional costs for its use	tenge	924500
8	The cost of additional products	tenge	29890000
9	balance sheet profit	tenge	28965500
10	Income tax + VAT (15%+10%)	tenge	7241375
11	Net profit	tenge	21724125
12	Profit from 1 hectare	tenge	6206
13	Additional costs from the cost of additional products	%	3,1

The table shows that the net income per 1 ha due to the increase in grain yield from the use of a humic preparation when growing spring wheat amounted to 6206, winter wheat - 8198, soybeans - 19454, rice - 63844, and corn - 18445 tenge per year.

Additional costs for the use of the drug in the cultivation of the studied crops are 0.42–3.3 % of the obtained increase in yield.

The results of preliminary tests of the pyrolysis plant are shown in Table 2. They show that the developed plant provides an operating mode that allows low-temperature coal pyrolysis to be carried out.

Table 2 - Main test results of the pyrolysis plant

Main characteristics	Unit of measurement	Value
1. Coal throughput	tenge/hour	2,0
2. Residence time of coal in the reactor	min	20
3. Average temperature in the pressure reactor in the pressure line	^{0}C	750
4. Calorific value of producer gas	kcal/m3	1200

As a result of the removal of moisture from brown coal, and then most of the volatile substances (Table 3), the indicators that determine the calorific value change. From the above data it can be seen that dried coal has a fairly high calorific value, however, the presence of a significant amount of volatile substances significantly increases its tendency to spontaneous combustion, and also sharply increases the explosiveness of its dust.

Table 3 - The structure of the calorific value of brown coal and products of its processing

Components that determine the calorific value of fuel	Partial heat of combustion of components, kcal/kg		
	ordinary coal	Dried coal	semi-coke
	A' = 5,8 % W' = 35 % V' =48 %	A' = 5,8 % W' = 5,0 % V' = 48 %	A' = 8,2 % W' = 2 % V' = 10 %
Carbon (C)	2535	3978	6573
Volatiles (V)	1596	2167	486
Moisture (W)	-190	-27	-11
Total	3940	6118	7050

From the results obtained, it can be seen that the experimental sample can serve as a prototype of a pyrolysis plant for the thermal enrichment of coal. Moreover, the output indicators of such an installation can vary over a very wide range. During this redistribution, the calorific value of brown coal increases up to 7000 kcal/kg (depending on the ash content of the initial coal). To implement the thermal enrichment scheme, various technological processes and installations can be used. The inclusion of an operation associated with the use of pneumatic separation in the scheme of technological stages will significantly reduce the ash content of the obtained refined fuel.

Briquetting of coal fines on roller presses with the use of a binder (starch) made it possible to achieve an improvement in the properties of run-of-mine coal. The results of the technical analysis of the feedstock and the briquettes obtained from them are characterized by the indicators summarized in Table 4. It is proposed to evaluate the types of fuel under consideration not by the cost of a unit of conventional heat contained in ordinary coal and agglomerated fuel, but by costs per 1 ton of c.u. tons of useful heat received by the consumer.

Table 4 - The results of the technical analysis of the original coal and fuel briquettes

Indicators	Ash content	Humidity, %	Sulfur total, %	Heat of combustion, ccal/kg
ordinary coal Briquettes	7,5 10,0	31,0 17,0	0,5 0,6	3750 5225
Smokeless thermal briquettes	9,4	2,0	0,6	6200

The consumer is not interested in how much heat is contained in the original fuel, it is important for him how much heat he will receive to meet his own needs when burning a unit of this or that coal fuel. It should be noted that such production should have its own specific consumer, since a fuel briquette in the form of a commercial product is in the same market niche with sized coal at a relatively higher cost. More attractive in this regard is the technique and technology for producing smokeless fuel briquettes with increased calorific value based on heat treatment of feedstock or lignite semi-coke.

In most of the world's coal-importing countries, the consumption of high-sulphur and low-calorie coals for power generation is being reduced. Thus, Russia for TPPs operating on Ekibastuz coal (ash content up to 46 %) stopped deliveries of low-grade coal from Kazakhstan. China and India imposed serious restrictions on the import of low-quality coal, where a significant increase in the quality of consumed coal can be expected in the coming years. To stimulate the growth of coal enrichment volumes in India, transportation of coal products with an ash content of more than 34 % over a distance of more than 750 km is limited.

The combined production of two types of energy (cogeneration) contributes to a more economical use of fuel compared to the separate generation of electricity at condensing power plants and heat energy at local boiler plants. An analysis of the characteristics of cogeneration plants shows that the cost of 1 kWh of electricity generated in the joint production of heat and electricity is significantly lower than the current tariffs of central energy systems. Particularly important is the fact that power plants become autonomous in the field of power supply, and therefore the reliability of their work ceases to depend on many third-party factors.

The following options for the implementation of coal-fired energy generation are possible:

1. Transfer of boiler plants to mini-CHP mode.

2. Construction of a mini - thermal power plant on the products of coal processing.

The first option can be implemented through the installation of steam turbines, for example, steam screw or steam piston machines, as a result of which the enterprise receives a tangible economic effect due to the transfer of boilers to year-round operation and supplying consumers with the necessary energy and heat.

The second is due to the construction of a new thermal power plant operating on generator gas or improved solid fuel. At first, the latter option is more acceptable for the conditions of Kyrgyzstan and Kazakhstan.

According to statistics, only in Kyrgyzstan the number of boiler installations reaches 1,500 units, of which 950 units. - work on coal, 500 units. - on electricity, 35 units. -

on gas and 15 units. - on oil. Changes in the tariff for electricity and purchased energy carriers necessitate an increase in the fleet of new coal-fired boiler equipment.

The main obstacle to the transition to burning local low-grade products is the complexity of organizing a sustainable combustion process. The simplest technology is the method of layered combustion on grates. However, waste and local coals, as a rule, do not burn in such furnaces. Many years of experience accumulated by the Biysk Boiler Plant and other organizations shows that practically all available standard furnaces and boilers are not suitable for burning low-quality fuels such as waterlogged brown and other types of local coals. Therefore, to implement the possibility of transferring boilers to the combustion of such fuels, new combustion devices and new combustion technologies are required.

Furnace processes using a low-temperature fluidized bed or circulating streams heavily loaded with inert particles (ash) create a multiple increase in the thermal inertia of the furnace due to the introduction of particles. This stabilizes the combustion process, ensures its isothermality and allows combustion at a relatively low temperature, on the order of 800–1000°C. The desire for low-temperature combustion is explained by the fundamental possibility of reducing harmful emissions in flue gases, compared with widely used high-temperature combustion processes. At the same time, stringent sanitary standards for sulfur and nitrogen oxides are met without the use of expensive gas cleaning schemes.

It should be noted that fluidized bed furnaces comply with the ever-tightening and expanding range of restrictions on emissions of a wide range of harmful substances. The amount of organic compounds formed such as carbon monoxide, benzapyrenes, dioxins, etc. is reduced due to uniform and highly efficient mixing and burning in the furnace volume. In addition, at a low temperature of the combustion process, the sublimation of the mineral part (ash) of the fuel is insignificant and, therefore, the pollution of heating surfaces is minimal, and sulfur oxides and "acid compounds" of other elements such as chlorine and fluorine can be suppressed by ash or sulfur absorbers, for example, crushed limestone.

Conclusion

Studies have shown that the humic preparation is a highly effective bioenergy-informational adaptogen that increases the ecological resistance of cultivated plants to extreme environmental factors, which allows increasing the yield of agricultural plants by an average of 20–65 % without increasing the area of crops with minimal dependence on adverse soil and climatic conditions.

The resulting preparations have multifunctional properties, since they not only increase the bioenergetics of seeds and plants in ontogeny, but also change the quality of the interaction of crops with the environment.

The use of the proposed preparation creates favorable conditions for reducing the reclamation period during the development of highly saline soils and the widespread use of weakly and moderately saline soils in agricultural production without their labor-intensive pre-washing to design standards (0.1–0.3 %).

A distinctive feature of the proposed pyrolysis technology using fluidized bed

technology from foreign ones is the possibility of using low-grade, including substandard (coal fines) raw materials for their low-temperature carbonization.

Smokeless briquettes obtained from brown coal by molding on roller presses using a binder have high quality indicators (calorie content - 6200 kcal / kg, mechanical strength) compared to the feedstock, which subsequently allows to increase the efficiency of layered furnaces and reduce harmful emissions into the atmosphere.

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