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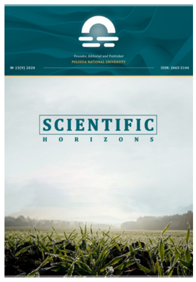

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The Study of the Effectiveness of the Use of Ash and Slag in the Construction of Road Pavement During Maintenance

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Abstract. There is a global problem of effective use of ash and slag waste for practical purposes. The relevance of the subject under study is conditioned by the prospects for the use of ash and slag in the design and planning of pavement structures during the road maintenance and, consequently, the need for the effectiveness of the practical use of such technologies in road construction and repair. The purpose of the presented article is to study the effectiveness of the use of ash and slag in the practical field in creating high-quality road pavement during roadway repair works. The leading method in this study is a systematic analysis, with the help of which a comprehensive assessment of the prospects of using ash and slag waste in the construction of road surfaces was carried out. In addition, the methods of generating statistical data and graphical modeling of the obtained results were applied. It was established that the road surface made with the use of ash slag had higher strength indicators compared to the surface made by traditional technologies. It was determined that an important factor in the use of ash and slag as composite additives was a significant reduction in the cost of the road surface repair process. In addition, it was determined that ash and slag mixtures could be successfully used as effective additives in the creation of new building materials. The effectiveness of the use of ash and slag waste in the construction of the road surface during repair work has been fully proven. The findings of this study are of considerable practical value for employees of road services, whose duties include solving issues of road surface repair, and for researchers involved in the practical development of alternative methods for improving the strength and quality of road pavement

Keywords: road surface, waste from thermal power plants, road repair, road construction, waste use

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INTRODUCTION

Road transport holds a leading place in the transport system of any state, providing the social and economic needs of society in the transportation of goods and passengers. The increase in traffic volumes, including international ones, requires the availability of roads with transport and operational characteristics that meet the traffic requirements. The current condition of roads in Ukraine, especially local ones (IV-V technical categories) does not always meet the current regulatory requirements. Therefore, it is urgent to carry out repair works aimed at improving the condition of roads to ensure optimal traffic conditions using modern materials and technologies (Indukuri *et al.*, 2020).

According to M. Salimi & A. Ghorbani (2020), in conditions of limited financing of the road industry, preference is given to economic technologies with maximum use of cheap local materials and industrial waste. The problem of using multi-tonnage industrial waste from various industries is of great environmental and economic importance for all developed countries of the world. T.M. Pavlenko (2017) admitted that accumulating in large quantities, waste occupies significant land areas that cannot be used for agricultural needs. In the road industry, waste from mine production is widely used – burnt rocks, limestone dust that remains after crushing limestone, cement dust – the residue of cement production, oil tar and others.

T. Poltue *et al.* (2020) estblished that due to the increase in construction and repair work on roads, the need for the use of secondary resources was constantly growing. One of such resources, which can be recommended for use in a mixture with traditional road-building materials for the repair and construction of roads, is the waste of energy enterprises: ash and slag mixtures. According to C. Sénquiz-Díaz (2021), ash and slag mixtures are formed in thermal power plants during the joint hydraulic removal of ash and slag during the combustion of pulverised coal. They are used as a component for the manufacture of building mortars, heavy, light and porous concretes for precast and monolithic concrete and reinforced concrete structures and products. H.A. Shahane & S. Patel (2021) established that fuel slags and pulverised fly ash of various thermal power plants could be used as an additive to strengthen uncemented clastic and sandy loam soils, for the construction of the foundation of road surfaces in a mixture with crushed stone materials, as a mineral powder in the preparation of asphalt concrete mixtures, etc. But all these works were not widely distributed. Currently, with a significant increase in the volume of repair and construction work on roads, much attention is being paid to the use of energy waste from thermal power plants (TPP) in various layers of road structures (Chomicz-Kowalska & Maciejewski, 2020). According to S.-L. Lin *et al.* (2021), the technical feasibility and economic efficiency of using ash and slag waste in the layers of road structures should be established based on laboratory studies, taking into account the peculiarities of the location of the object.

The scope of application of fly ash in construction is determined by DSTU V.2.7-205:2009. "Construction Materials. Fly ash from thermal power plants for concrete. Specifications" (2009). SOU 42.1-37641918-104: 2013 "Fly Ash and Ash Mixtures of Thermal Power Plants for Road Works. Specifications" (2013) establish technical requirements for fly ash and ash-slag mixtures that are used for construction, maintenance, capital and current repairs of public roads in all road-climatic zones of Ukraine according to DBN V.2.3-4 (2015) and are divided by physical and technical indicators into two types that can be used for cement-concrete mixtures in the construction of the base of road pavement; for gravel-sand mixtures reinforced with cement. According to DSTU B V.2.7-211 (2009), the main parameters and types of ash and slag mixtures are determined. Ash and slag mixtures with selection by hydraulic removal consist of an ash component (particles less than 0.315 mm) and a slag component (slag). The slag may include slag sand-grain size from 0.315 mm to 5 (3) mm and slag crushed stone – grain size of more than 5 (3) mm. According to SOU 42.1-37641918-104 (2013) by the type of slag component – ash-slag mixtures are divided into mixtures with dense slags (Sh), with an average grain density of more than 2.0 g/cm^3, and ash-slag mixtures with porous slags (Po), with an average grain density of less than 2.0 g/cm^3.

It can be seen that for the use of large-tonnage ash and slag waste, a sufficient number of regulatory documents have been developed regarding their use in the construction and road industries. But the question of the practical implementation of ash and slag mixtures has not yet been solved at a sufficient level. Thus, the aim of this article is to study the effectiveness of the use of ash and slag in the construction of road pavement during repair works remain relevant in the context of finding effective ways to create high-quality road pavement.

MATERIALS AND METHODS

In the course of the study, the system analysis was used, which allows performing a qualitative and comprehensive assessment of the prospects for the use of ash and slag in the construction of road pavements. This method involves conducting a study in the theoretical sphere, with the definition of the most important theoretical prerequisites and prospects for the practical use of industrial waste in repair works when creating a high-quality roadway, empirical studies involving the study of practical experience of specific repair operations, existing regulatory documentation and features of ensuring the proper level of quality of the road surface created with the introduction of industrial waste into its design. Furthermore, the methodology of this study includes methods for generating statistical data and graphical modelling of the results obtained.

This study is based on numerous papers dedicated to the practical use of ash and slag in the construction of road pavement and the creation of a high-quality road surface in general. For the sake of creating an objective picture of this study and to facilitate the perception of information, all the developments of researchers submitted for consideration of the issues cited in this study were translated into English.

The study was performed in three stages:

1. A theoretical study of research papers available within the framework of the subject matter was performed to identify the current opinions of researchers on the subject and the available practical methods for resolving the application issues of ash and slag in the construction of road pavement.

2. The effectiveness of ash and slag in the construction of road pavement during road maintenance and the prospects for expanding the range of applications of such technology were assessed from a practical standpoint. In addition, comparative studies were conducted to refine the results obtained and compare them with the results and conclusions of other researchers who were engaged in the study of issues included in the subject of the study, to form final conclusions based on them.

3. The final conclusions were formed based on the study results.

RESULTS AND DISCUSSION

According to the provisions of DSTU B V.2.7-211 (2009), ash and slag mixtures, depending on the grain composition, are divided into three types: coarse-grained, medium-grained, and fine-grained. The requirements for such mixtures are presented below (Table 1).

***Table 1**. Requirements for coarse-grained, medium-grained, and fine-grained ash and slag mixtures*

Indicator name	Indicator value for various types of ash and lag mixtures		
	Coarse-grained (C)	Medium-grained (M)	Fine-grained (F)
The maximum size of the slag grains of the slag component, mm, not above	40	20	5(3)
Content of the slag component, % by weight	From 50 to 90	From 10 to 50	From 0 to 10
The content of slag crushed stone in the slag component, % by weight	Over 20	Up to 20	–

***Note:** in ash and slag mixtures of various types, the content of slag grains exceeding the maximum grain size should be no more than 10% by weight*

According to SOU 42.1-37641918-104 (2013), ash and slag mixtures, depending on the amount of mass loss during calcination, are divided into three types: ash, slag with porous slag, slag with dense slag. The requirements for each type are listed below (Table 2).

***Table 2**. Requirements for ash, slag with porous slag, slag with dense slag mixtures*

Ash and slag mixture type	The component of the ash and slag mixture	Mass loss of the ash-slag mixture during calcination, % by weight, not above		
		Anthracitic	Carbonous	Lignitic
I	Ash	20	10	3
	Slag with porous slag	–	5	3
	Slag with dense slag	Not standardised		
II	Ash	25	15	5
	Slag with porous slag	–	7	3
	Slag with dense slag	Not standardised		
III	Ash	10	7	5

According to SOU 42.1-37641918-104 (2013), ash and slag mixtures, depending on the amount of ash in the mixture, are divided into three groups, the properties of which are presented below (Table 3).

***Table 3**. Properties of groups of ash and slag mixtures*

Indicator name	Ash and slag mixture group		
	I	II	III
Fly ash content, % by weight	Less than 25	From 25 to 50	Over 50
Humidity, % by weight, not above	7	10	15
Brand of the ash and slag component by strength	300	200	Not standardised
Brand of the ash and slag component by frost resistance	F50	F25	Not standardised

According to SOU 42.1-37641918-104 (2013), fly ash as an integral component, depending on the type (I, II), can be used in the preparation of a mixture of cement and concrete for the construction of the foundation of road pavement structures of rigid and non-rigid types and for gravel-sand mixtures reinforced with cement. Ash and slag mixtures of group I are intended for the construction of additional layers of the base of road coverings (drainage and frost-proof layers), and as an integral component of a mixture of crushed stone-sand or a mixture of soil. Ash and slag mixtures of this group, reinforced with inorganic binders, are suitable for the construction of the upper and lower layer of the base of road pavements. Ash and slag mixtures of group II can be used for the construction of a base only together with the addition of at least 50% of crushed stone or after their strengthening with inorganic binders. Ash and slag mixtures of group III can be used for the construction of embankments of the roadbed according to DBN V.2.3-4 (2015), VBN 2.3-218-171 (2002).

The road surfaces of public roads made of stone materials, industrial waste and their mixtures and soils reinforced with cement in all road-climatic zones of Ukraine should be designed, constructed, and repaired in accordance with DBN V.2.3-4 "Transport Structures. Motor Roads. Part I. Designing. PART II. Construction" (2015) and DSTU-N B V.2.3-39:2016. "Guidelines for the Installation of Layers of Pavement Made of Stone Materials" (2016).

The use of ash and slag mixture or slag mixed with stone materials, crushed stone or gravel, reinforced with a mineral binder is possible when selecting the grain composition meets the requirements of DSTU-N B V.2.3-39: 2016 (2016) (Table 3). The brand of the reinforced mixture used for the base layers should be assigned depending on the type of road surface, the intensity of automobile traffic and climatic conditions in accordance with the requirements of DSTU-N B V.2.3-39:2016 (2016).

Ash and slag materials of thermal power plants can be used in the preparation of asphalt concrete mixtures as an additive to mineral powder or as a substitute for small fractions of granite bran. Asphalt concrete mixes with ash and slag materials are used for the construction of the upper layer of the road surface of the lower technical categories, that is, IV-V or the lower layer of two-layer road coverings of the III-IV technical category. Studies to determine the properties of asphalt concrete mixtures using ash and slag materials of thermal power plants were carried out according to standard methods per the requirements of DSTU B V.2.7-119:2011 "Asphalt concrete mixes and asphalt concrete for roads and airfields" (2011).

The study was carried out with the following materials:

– asphalt concrete hot dense fine-grained type "B";
– crushed stone;
– stone screening dust according to DSTU B V.2.7-210 (2010);
– limestone mineral powder;
– petroleum bitumen of the BND 90/130 brand produced by CJSC Linik;
– polymer additives in bitumen: Butonal NS198;
– fly ash;
– ash and slag mixture;
– slag.

Determination of the composition of soil mixtures with the addition of fly ash is reduced to the choice of such a ratio between the constituent components, which most reliably and economically provides the mixtures with a given strength and frost resistance. (Bellum *et al.*, 2020). Soil mixtures with ash and slag materials reinforced with Portland cement or lime should have an optimal moisture content of no more than 0.75 WT (yield strength) for clay soils (clays and loams) (Fedje & Andersson, 2020). To determine the optimal amount of fly ash to be added to the soil, from the standpoint of studying the effectiveness of the practical use of ash and slag waste in the construction of road pavement, a study of the physical and mechanical properties of such mixtures was conducted. The results of the conducted studies are presented below (Table 4).

***Table 4**. Investigation of soil properties with the addition of fly ash and ash-slag mixture*

Name of the soil, sample No.	Quantity of introduced ash and slag materials	Indicator names					
		Particle density, g/cm^3	Density of the dry unit of mixture, g/cm^3	Optimal soil moisture with standard compaction, %	Point of yielding W_L (PL), %	Swinging limit (plasticity) Wp (Pp), %	Plasticity number, Ip (PL)
Fly ash (example No. 1)							
Sample No. 1	15	2.24	1.84	12.05	26.10	20.03	6.07
	20	2.29	1.86	11.94	25.82	20.01	5.81
	25	2.33	1.95	11.12	25.61	19.94	5.67
	30	2.45	2.04	11.03	25.54	19.90	5.64
Sample No. 2	15	2.26	2.06	12.51	26.93	20.12	6.75
	20	2.25	2.10	12.02	26.14	19.60	6.54
	25	2.38	2.14	11.84	25.92	19.43	6.49
	30	2.51	2.26	11.78	26.13	19.40	6.70
Fly ash (example No. 2)							
Sample No. 1	15	2.25	1.85	11.04	26.20	20.18	6.02
	20	2.27	1.88	11.16	25.74	19.80	5.94
	25	2.36	1.92	10.91	25.68	20.15	5.53
	30	2.48	1.96	10.56	25.36	20.08	5.28
Sample No. 2	15	2.22	1.81	11.76	25.89	19.68	6.21
	20	2.24	1.83	11.21	25.54	19.54	6.00
	25	2.39	1.92	10.75	29.12	20.38	5.74
	30	2.45	1.99	10.68	25.32	19.69	5.63
Ash and slag mixture							
Sample No. 1	10	2.22	1.84	12.90	26.44	19.54	6.9
	15	2.19	1.82	13.05	27.56	20.36	7.2
	20	2.09	1.81	13.15	28.02	20.62	7.4
Sample No. 2	10	2.26	1.74	12.96	27.19	19.99	7.2
	15	2.17	1.75	13.20	27.32	19.82	7.5
	20	2.16	1.74	-	28.01	20.41	7.6
Fly ash (example No. 3)							
Sample No. 1	15	2.22	1.79	9.3	18.3	13.1	5.2
	20	2.26	1.81	8.9	17.5	12.3	5.2
	25	2.35	1.86	8.8	17.3	12.2	5.1
	30	2.51	1.95	8.3	16.8	11.8	5.0
Sample No. 2	15	2.21	1.88	10.4	19.4	12.4	7.0
	20	2.27	1.93	9.2	18.8	11.9	6.9
	25	2.34	1.99	8.6	17.9	11.3	6.6
	30	2.48	2.06	8.1	17.2	11.7	6.5

The ash-slag mixture is not quite suitable for adding to the soil due to the fact that the grain composition does not have a sufficient number of small fractions. That is, a dense mixture is not created. In this regard, the soil density decreases and the optimal humidity increases, that is, the ash-slag mixture can be used in soils only together with Portland cement in an amount of up to 10-15% of the soil mass. Given that the traffic intensity of cars is constantly increasing, with the introduction of fly ash into the soil, it is also better to use cement, which will increase the strength and frost resistance of the mixture. The introduction of fly ash has a positive effect on the properties of the soil (samples 1 and 2), a greater reduction in the plasticity of the soil, that is, ensuring density and strength.

Ash and slag materials of thermal power plants (TPP) can be used in the preparation of asphalt concrete mixtures as an additive to mineral powder or as a substitute for small fractions of granite bran. Asphalt concrete mixtures with ash and slag materials are used for the construction of the upper layer of the road surface of the lower technical categories, that is, IV-V or the lower layer of two-layer road coverings of the III-IV technical category. When using fly ash (sample 2), fly ash can be fed into the mixer simultaneously with mineral materials. Mixing takes place after the bitumen is supplied. But the fly ash is better to be supplied by closed transport-like mineral powder, to prevent pollination.

Ash and slag concretes have higher strength properties compared to road surface materials, for the manufacture of which traditional methods were used. One of the effective methods of obtaining a high-quality coating should be considered the improvement of the technology of road construction with the use of industrial waste and cement concrete. The use of mixtures of special rigidity is more appropriate compared to conventional mixtures due to the lower cement consumption. The rolled concrete meets these requirements to the greatest extent. The use of this concrete requires low energy consumption, while providing less shrinkage, increasing the distance between the expansion joints, and most importantly, shortening the duration of construction work. The practical use of this kind of road surface in the construction of road pavement directly solves the actual problems of rational use of industrial waste. Thus, by combining two urgent problems – road paving and the practical use of industrial waste, it is possible to achieve a significant increase in road construction efficiency through the integrated use of waste from TPPs (fly ash), secondary raw materials (asphalt concrete granulate) and modern rolling technologies.

M. Miljković *et al*. (2019) expressed a reasonable thought, as according to researchers, the use of ash and slag waste from TPP activities for practical purposes contributes to the qualitative solution of numerous problems: environmental protection is ensured, the rational use of raw materials is ensured, the total energy intensity is significantly reduced, consequently, the prime cost of construction materials is reduced. This is despite the fact that the shortage of natural raw materials for the construction sector is increasing every year, while the practical use of ash and slag waste should be considered a good alternative to the use of expensive natural aggregates in road construction. F. Russo *et al*. (2021) convinced that the use of conventional stone structural materials in road construction works is often not widespread due to the high cost of materials of this kind and their relative scarcity. Therefore, recently, the practical application of multi-tonnage industrial waste in road construction has become an effective alternative solution to this problem.

In addition, G. Jing *et al*. (2020) think that such materials are often modified with various stabilising additives. The activities of modern industrial enterprises have gradually led to the accumulation of more than 1.5 billion tons of ash and slag waste in dumps, as well as about 120 million m^3 of crushing screenings, which in turn is the reason for the deterioration of the overall environmental situation in the region of industrial activity and significant soil grinding, and changes in the terrain (Murmu *et al.*, 2020). For this reason, the development of effective methods for creating effective composite materials in road construction based on the use of multi-tonnage industrial waste seems to be a particularly relevant and promising direction in the current economic situation (Chen *et al.*, 2020).

P. Shekhawat *et al*. (2020) consider that the most massive scale of the utilisation of such waste can be achieved with their practical application in road construction as aggregates for concrete. Nevertheless, it is necessary to take into account that ash and slag mixtures in TPP dumps do not have a constant grain composition, both in terms of the fine-grained fraction content and in terms of the slag contained in them. It is also essential that the optimal ratio between the fine-grained fraction and the slag in concrete with a change in the consumption of the binder element does not exist in practice, since these indicators are constantly changing (Dulaimi *et al.*, 2020). This should be considered the main reason for the excessive consumption of cement in the production of concrete of a given strength (class) on existing ash and slag mixtures in comparison with concretes of the optimal composition according to the parameter of the size of the filling elements. At the same time, TPP slags are already widely used in road construction today (Bakare *et al.*, 2019). The ash produced by TPPs is very well studied and is recommended to builders as an active mineral additive in the industrial manufacture of binders, and in the production of concrete and mortar, as a mineral powder in asphalt concrete. Ash is also actively used in the manufacture of silicate and ceramic products (Abdullah *et al.*, 2021).

The problem of effective use for practical purposes of industrial waste, which is formed when using such technologies – ash-slag mixtures, has been observed all over the world. In this context, it is necessary to explain that during the period under review, the volume of practical use of ash and slag mixtures of thermal power plants in road construction and repair, and in the industrial sector engaged in the creation of building materials, began to increase very rapidly (Mavi *et al.*, 2021). According to R.R. Pai *et al.* (2021), this is partly conditioned by mass engagement of numerous organisations in road repair and construction works who have become aware of the high efficiency of the practical use of waste from TPPs in creating a high-quality road surface, which causes the widespread use, in particular, of ash-slag mixtures in the creation of road coverings that have a longer period of practical operation compared to those that were created by more traditional methods.

Such statements are also reasonable, as long as ash-slag mixtures, ash and slag of thermal power stations may be of particular interest to the construction industry as an effective binder component of concrete. The reserves of this raw material, which are constantly increasing in the course of augmenting of the volume of industrial production, can significantly reduce the existing shortage of aggregates for high-quality concrete. According to B. Adhikari *et al.* (2021), it is necessary to take into account the variability of the grain composition of ash and slag mixtures in various places of the dump, which significantly complicates their practical application as effective aggregates. The multiplicity of components of such mixtures and the variability of their properties significantly complicate the choice of the optimal composition of the concrete mixture for road repair and construction works (Han *et al.*, 2020). Cement consumption during the use of ash and slag raw materials was often higher than in the manufacture of concretes of the same characteristics on familiar aggregates, and, as is known, this parameter is one of the determining criteria by which conclusions are made regarding the effectiveness of developments, including those aimed at using industrial waste in road construction and repair (Hoy *et al.*, 2018).

Today, fly ash is the most well-known of all industrial production wastes (Rezaei Lori *et al.*, 2021). Every year, millions of tons of coal and coal dust are burned at fuel and energy enterprises of any state, which leads to the accumulation of millions of tons of ash and slag waste in dumps (Sharma & Kumar, 2021; Edwin *et al.*, 2019). The detailed state of affairs allows formulating a conclusion that fly ash is, in fact, an inexhaustible source of raw materials that can only be obtained from industrial waste. This determines the prospects for the large-scale use of this raw material as a secondary component for creating effective road pavements, as well as during repair and construction work in the transport industry, and a number of other areas of the national economy of any state (Softić *et al.*, 2020).

Fly ash is an industrial waste remaining after the combustion of solid fuel (Susanto *et al.*, 2020). T. Wattez *et al.* (2021) found that most of fly ash of TPPs and boiler houses were characterised by a certain activity, which significantly affected the strength properties of the resulting concrete. The instability of the composition of fly ash removed from the TPP is a limiting factor for practical application and effective use in road construction and repair. In the industrialised countries of North America and in a number of EU countries, fly ash is the same commodity, and it is scarce, like heat and electric energy (Saha *et al.*, 2021). High-quality fly ash that meets all accepted standards and is suitable for use expands the possibility of effective construction of road surfaces from rigid concrete mixtures that are compacted by a roller. According to D. Foti *et al.* (2019), in developing and industrially developed countries, to improve this situation, options to improve the quality and strength characteristics of the road surface are being actively sought, and the latest modern technological solutions are neing developed and implemented. They can accelerate the repair of coatings of modern highways or perform the construction of layers of pavement with significantly increased strength characteristics that could ensure greater durability of the road surface and increase the efficiency of its operation.

Thus, the experience of many foreign countries in the practical application of composite materials (fly ash) in rolled concrete and the achieved result of the positive interaction of two components (fly ash and asphalt granulate) in the concrete mixture make it possible to preserve all the properties of concrete per the requirements of DSTU and effectively use this mixture in the construction of bases and road surfaces. The use of fly ash and asphalt-concrete granulate in rolled concrete reduces the cost by 2-2. 5 times due to energy consumption savings, which allows, with equal economic indicators, significantly increasing the length of roads and their operational characteristics. It should be considered that the high practical efficiency of use of ash and slag in road construction during repair work, since it has been experimentally proven to obtain higher, compared with conventional methods of preparing the construction of road pavement, indicators of the strength of the roadway, its frost resistance, and a longer period of practical operation. In general, the practical benefit and ultimate effectiveness of using ash-slag mixtures in the construction of road surfaces during repair and construction works can be considered fully proven, which makes it necessary to continue using these mixtures.

CONCLUSIONS

The use of ash and slag in the construction of road pavement during the repair should be considered effective from the standpoint of multi-aspect consideration of this issue. First of all, this is an effective method of practical use of multi-tonnage industrial waste, which contributes to the successful practical solution of a whole range of issues related to improving the overall environmental situation, due to the release of areas allocated for the storage of ash and slag waste of industry. The problems of preventing soil erosion in places of forced storage of such waste and changes in the terrain associated with this factor are being successfully solved. Furthermore, ash and slag mixtures can be successfully used as effective additives in the creation of new construction materials that qualitatively solve the problems of constructing a new roadbed to replace damaged road sections.

The high efficiency of the practical use of ash and slag as a component of the road surface design can be significantly higher by achieving a high-quality solution to the issues of storage of ash and slag and their timely transportation to the place of use in construction and repair works. This will significantly reduce the time of road works, which in general would contribute to improving their efficiency. In general, the effectiveness of the practical use of ash and slag should be considered fully proven, which determines the need for further study in this line, in order to find and implement effective methods for the practical use of ash and slag mixtures in road works.

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Дослідження ефективності використання золошлаків при будівництві дорожнього покриття під час ремонту

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Анотація. У всьому світі існує проблема ефективного використання золошлакових відходів для практичних цілей. Актуальність досліджуваної тематики обумовлена перспективами використання золошлаків при проектуванні та плануванні конструкцій дорожнього одягу під час утримання автомобільних доріг і, як наслідок, необхідністю ефективності практичного застосування таких технологій при будівництві та ремонті автомобільних доріг. Метою представленої статті є дослідження ефективності використання золошлаків у практичній сфері при створенні якісного дорожнього одягу при виконанні робіт з ремонту проїзної частини автомобільних доріг. Провідним методом в даному дослідженні є системний аналіз, за допомогою якого проведено комплексну оцінку перспектив використання золошлакових відходів при будівництві дорожніх покриттів. Крім того, застосовано методи формування статистичних даних та графічного моделювання отриманих результатів. Встановлено, що дорожнє покриття, виготовлене з використанням золошлаків, має більш високі показники міцності в порівнянні з покриттям, виготовленим за традиційними технологіями. Визначено, що важливим фактором використання золошлаків в якості композиційних добавок є значне здешевлення процесу ремонту дорожнього покриття. Крім того, визначено, що золошлакові суміші можуть бути успішно використані в якості ефективних добавок при створенні нових будівельних матеріалів. Повністю доведено ефективність використання золошлакових відходів у будівництві дорожнього покриття при проведенні ремонтних робіт. Результати даного дослідження мають значну практичну цінність для працівників дорожніх служб, в обов'язки яких входить вирішення питань ремонту дорожнього покриття, а також для науковців, які займаються практичною розробкою альтернативних методів підвищення міцності та якості дорожніх покриттів

Ключові слова: дорожнє покриття, відходи теплових електростанцій, ремонт доріг, будівництво доріг, використання відходів