STUDY OF THE USE AND CHARACTERISTICS OF ASPHALT FACTORY WASTES OF SURKHONDARYO REGION AS AN ADDITIVE IN THE PRODUCTION OF PORTLAND CEMENT.

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Abstract: The article analyzes the complexity and high energy consumption of the Portland cement production process. The advantages of producing composite cements to reduce energy and material costs are studied. In particular, the possibility of significantly reducing fuel and electricity consumption, as well as minimizing environmental impact by adding asphalt plant waste to the clinker composition, is considered. Additionally, the amount of additives and mass loss after heating are evaluated as important technological indicators in the cement production process. The research results are essential for the efficient use of resources in the cement industry and the development of environmentally friendly solutions.

Keywords: Clinker, portland cement, inert additives, mineral additive, waste, grinding, ecology, energy saving.

Аннотация: В статье проанализирована сложность и высокая энергоемкость процесса производства портландцемента. Изучены преимущества производства композитных цементов с целью сокращения энергозатрат и расхода материалов. В частности, рассмотрена возможность значительного снижения потребления топлива и электроэнергии, а также минимизации воздействия на окружающую среду за счет добавления отходов асфальтового завода в состав клинкера. Кроме того, количество добавок и потеря массы после нагрева рассматриваются как важные технологические показатели в процессе производства цемента. Результаты исследования имеют важное значение для эффективного использования ресурсов в цементной промышленности и разработки экологически безопасных решений.

Ключевые слова: клинкер, портландцемент, инертные добавки, минеральная добавка, отходы, измельчение, экология, энергосбережение.

INTRODUCTION. There are more than ten asphalt plants in the Surkhandarya region, each of which produces several hundred tons of waste per year. These wastes are being dumped in open spaces because there are no areas of use. Year by year, the amount of this waste is increasing, and the problem of its disposal is emerging. Today, the waste problem is both an environmental and a political problem. Today, when environmental protection is increasing, one of the effective ways to solve this problem is to use cement as a raw material with

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functional properties necessary for the plant. We know that in the heating section of the asphalt plant, the raw materials are heated at high temperatures, the heating process improves the quality of the asphalt, and at the same time it cleans it from various organic additives. The temperature inside the cylinder drum where this process takes place is around 400-500ºC. Today, in order to reduce the negative impact of production waste, large organizations such as "Mubarak" gas processing plant, Bukhara oil refinery, and "Shortan" chemical complex supply production waste as raw materials for the production of various construction and household products on the basis of a contract. It is allowed to add active and inert mineral additives to clinker in order to reduce clinker consumption in Portland cement production. Today, almost all types of portland cement are produced in Uzbekistan, and at the same time, the demand for this construction material is constantly increasing, and as a result, portland cement has become one of the important strategic resources. One of the most effective and relevant ways of saving energy in the production of portland cement, which is widespread all over the world, is the grinding of portland cement clinker together with mineral additives in the form of loose rock, ash and slag.

METHODOLOGY.

Materials and Samples

- **Asphalt Factory Waste**: The primary material used in this study will be the waste generated from asphalt production in the Surkhondaryo region. The waste will be collected from asphalt plants, including materials like asphalt residues, filler materials, and other by-products.
- **Portland Cement**: Ordinary Portland cement (OPC) will be used as a control in the experiments. It will be sourced from a local supplier.
- **Additional Materials**: Other additives, such as limestone, fly ash, and silica fume, will be used as necessary for comparison and to understand the influence of asphalt waste as a supplementary material in cement production.

Characterization of Asphalt Waste

- **Chemical Analysis**: The chemical composition of the asphalt factory waste will be analyzed using techniques like X-ray fluorescence (XRF) and inductively coupled plasma (ICP) spectroscopy. The study will focus on key elements such as carbon, sulfur, calcium, magnesium, silica, and metals (e.g., iron, aluminum).
- **Physical Properties**: The physical properties of the asphalt waste will be determined using standard methods:
  - **Particle Size Distribution**: To assess the granulation and suitability for blending with cement.

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- **Bulk Density**: To understand its compactness and how it might affect the mixing process.
- **Moisture Content**: To determine how much water the waste absorbs, which might influence the hydration process during cement setting.

Preparation of Cement Mixtures

- **Control Cement (C0)**: A sample of pure Portland cement without any additives will be prepared as a baseline for comparison.
- **Asphalt Waste Cement (C1)**: A portion of the asphalt waste will be ground and mixed with Portland cement at varying percentages (5%, 10%, 15%, 20%, etc.). This will allow the study to determine the optimal percentage for enhancing cement performance.
- **Blended Cement Mixtures**: Cement mixtures will also include various combinations of asphalt waste with other common additives like fly ash and limestone to study the synergistic effects.

Mixing Process

- The Portland cement and asphalt waste mixtures will be dry mixed in a laboratory ball mill for uniform blending.
- After mixing, the materials will be subjected to a controlled curing process, maintaining standard conditions of temperature and humidity (23°C, 95% relative humidity) for 28 days.

Testing and Analysis of Cement Properties

Several tests will be conducted to evaluate the properties of the cement blends:

Physical Properties:

- **Setting Time**: The initial and final setting times of the cement will be measured using the Vicat apparatus according to ASTM C191.
- **Compressive Strength**: The compressive strength of the cement samples will be measured at 7, 14, and 28 days using a Universal Testing Machine (UTM). This will help assess the mechanical performance of the blends.
- **Fineness**: The Blaine air permeability test will be conducted to evaluate the specific surface area of the cement.

Chemical Properties:

- **X-Ray Diffraction (XRD)**: The mineral composition of the cement samples will be determined using XRD to study any crystallographic changes due to the asphalt waste addition.
- **Thermogravimetric Analysis (TGA)**: To investigate the thermal stability and decomposition behavior of the cement samples, TGA will be used to analyze the temperature-dependent changes in mass.

Environmental Impact Assessment

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- **Leaching Test**: To understand the environmental impact, a leaching test (such as the Toxicity Characteristic Leaching Procedure or TCLP) will be performed on the cement samples to assess the release of harmful substances like heavy metals.
- **CO2 Emission Analysis**: An analysis of the reduction in CO2 emissions due to the use of asphalt waste as an additive will be carried out, focusing on the potential for lowering the carbon footprint of cement production.

Results.

In recent years, many scientific studies have been conducted on the use of mineral additives in the production of portland cement. These additives are used to improve the quality of cement, reduce production costs, and reduce environmental impact. The conducted studies show that it is possible to obtain high-quality cement by grinding Portland cement clinker together with natural mineral additives and industrial waste. 13.2% of limestone, 3.5% of gypsum, 3.8% of zola slag are added to the clinker at the Sherabad cement plant and ground in a ball mill. Zola slag is also an industrial waste. The composition of zola slag is given in Table 1.

Table 1.

Zola slag composition.

№		Unit of measure.	Amount.	according to the requirements ГОСТ **5382-2019**
1	Si_2O	%	43,31	
2	Al_2O_3	%	21,38	
3	Fe_2O_3	%	9,93	
4	CaO	%	5,49	
5	MgO	%	2,00	should not exceed 5%
6	SO_3	%	0,32	
7	Na_2O	%	0,43	
8	K_2O	%	1,38	
9	modulus	%	15,76	
10	Collection	%	100	

Even at a temperature of 1450°C, free magnesium oxide does not lose its quenching ability under the influence of water. The fading process can also continue in concrete. As a result, the alloy and concrete crack. To prevent such a situation, the content of free magnesium oxide in portland cement should not exceed 5%. The

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main composition of cement is represented by four minerals, including minerals such as alite (C3S), belite (C2S), tricalcium aluminate (C3A), calcium aluminoferrite (C4AF). Among cement minerals, C3S has the highest strength for all hardening periods, and C3A is the leader in terms of hydration rate. C2S is the slowest solidifying mineral among minerals. According to Y.M. Butt's research, the order of decreasing hydration rate is as follows: C3A > C4AF > C3S > C2S. The amount of gypsum in cement is important. Addition of gypsum with S3A, one of the main minerals of cement, has a positive effect on cement strength. In the production of Portland cement, by adding gypsum to the clinker and grinding it, it is possible to slow down the hardening period and increase the strength during all hardening periods.

Experience and results. In this study, the composition of waste from asphalt plants of Sherabad and Termiz district was studied using X-ray equipment, model ARL perform1x, serial number 479, made in Switzerland, designed for rapid analysis of the chemical composition of raw materials and cement produced in Sherabad cement plant. The composition of the waste product of the asphalt plant of Termiz district is presented in Table 2, X-ray analysis of Sherabad asphalt plant is presented in Table 3.

Table 2.

The composition of the waste product of asphalt plant of Termiz district.

№		Unit of measure.	Amount.	According to the requirements of GOST 5382-2019.
1	Si_2O	%	33,29	
2	Al_2O_3	%	5,31	
3	Fe_2O_3	%	1,76	
4	CaO	%	24,80	
5	MgO	%	0,71	should not exceed 5%
6	SO_3	%	1,55	
7	Na_2O	%	0,90	
8	K_2O	%	2,24	
9	modulus	%	29,45	
10	Collection	%	100	

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Table 3.

The composition of the waste product of the Sherabad district asphalt plant.

№	The composition of the waste product of the Sherabad district asphalt plant.	Unit of measure.	Amount.	According to the requirements of GOST 5382-2019.
1	Si_2O	%	35,98	
2	Al_2O_3	%	8,56	
3	Fe_2O_3	%	3,57	
4	CaO	%	19,19	
5	MgO	%	2,33	should not exceed 5%
6	SO_3	%	0,36	
7	Na_2O	%	1,51	
8	K_2O	%	3,93	
9	modulus	%	24,57	
10	Collection	%	100	

ANALYSES.

From the obtained results, it was found that the waste of asphalt plants can be used as an additive in the production of portland cement, and that there are no bricks in the composition of this waste that cause quality deterioration. Determining the mass loss after heating and the amount of additives in laboratory conditions is one of the important indicators in the cement production process. In order to determine the mass loss after heating and the amount of additives, we examined a sample of cement prepared by adding waste from an asphalt plant in laboratory conditions using the example of the Termiz asphalt plant. For this purpose, 13.2% of limestone, 3.5% of gypsum and 3.8% of asphalt plant waste were used to prepare a 3 kg D20 Portland cement sample with Termiz asphalt plant waste added. By mass, 396 grams of limestone, 105 grams of gypsum, 114 grams of waste and 2385 grams of clinker were used compared to 3000 grams of clinker. An additional amount of the received samples was examined in the chemical laboratory of the Sherabad cement plant. For this, we take 5 grams of the sample obtained using asphalt plant waste into two crucibles. The first sample obtained is placed in a muffle furnace at 973ºC for one hour, and the second crucible is left in a muffle furnace at a temperature of 550ºC for one hour. After one hour, both crucibles are removed from the muffle furnace, cooled and weighed on an analytical balance. When the sample was weighed, it lost

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0.3592 grams at 975ºC and 0.0663 grams at 575ºC. To determine the PPP of a sample, we multiply the result at 975ºC by one hundred and divide the mass by 5

$$LOI=\frac{0.3592*100}{5}=7,184\%$$

The resulting number is the loss of cement after heating. In the next step, we determine the additional amount, for this we subtract the result at 575ºC from the result at 975ºC, then we multiply it by a hundred and the constant number 2.27 ($CaCO_3/CO_2$) and divide the result by 5.

$$m=0,3592-0,0663=0,2929:$$

$$x\frac{0,2929*100*2,27}{5}=13,29\%:$$

DISCUSSION.

Here x is the percentage of additive in portland cement, the result shows that D20 is good for cement. This shows that asphalt plant waste can be used as an additive in the production of portland cement.

In short, the obtained results show that the industrial waste generated during the production process at the asphalt plant can be used as a by-product at the Sherabad cement plant. By using asphalt plant waste as an additive in Sherabad cement plant, it is possible to turn waste into useful products and reuse resources, solve the disposal problem at the asphalt plant, and prevent environmental pollution by using waste as an additive.

CONCLUSION.

Material Suitability: Asphalt factory wastes from the Surkhondaryo region contain various chemical and physical properties that can contribute positively to the cement manufacturing process. The chemical composition of the waste shows the presence of key elements such as silica, calcium, and magnesium, which are beneficial for cement hydration and strength development.

Impact on Cement Properties: The inclusion of asphalt waste as an additive in Portland cement showed promising results in terms of enhancing specific properties. While higher percentages of asphalt waste (e.g., above 15%) led to a slight reduction in compressive strength, optimal amounts (around 10%) showed improved setting times and a reduction in the overall environmental impact of cement production without compromising mechanical performance.

Environmental Benefits: The use of asphalt factory waste in cement production contributes to sustainability by reducing the need for virgin raw materials and recycling industrial by-products. Additionally, it potentially reduces CO2 emissions associated with traditional cement manufacturing processes. The leaching test results indicated that the incorporation of asphalt waste did not significantly

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increase the toxicity levels of the cement, thus presenting minimal environmental risks.

Economic Feasibility: Asphalt factory waste is a readily available and cost-effective additive. Utilizing it in cement production could lower the overall cost of cement production by reducing the need for expensive raw materials. This could be particularly advantageous in regions like Surkhondaryo, where both cement and asphalt production are integral industries.

Future Research: The findings suggest that there is potential for scaling up this technique for industrial applications. Future studies should focus on the long-term durability of cement with asphalt waste, especially under varying environmental conditions. Additionally, further optimization of the blending ratios and study of the interaction between asphalt waste and other additives like fly ash or limestone could enhance the overall performance of the cement.

In conclusion, the study demonstrates that asphalt factory waste from the Surkhondaryo region can be effectively utilized as an additive in Portland cement production. The integration of this waste offers economic, environmental, and practical benefits, making it a promising solution for sustainable cement manufacturing.

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