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RECYCLING OF OLD ASPHALT CONCRETE COATING MATERIALS AT ASPHALT CONCRETE PLANTS

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Abstract
This article highlights technologies for processing old asphalt concrete coating materials at asphalt concrete plants, the possibilities of using them in the production of new asphalt concrete mixtures, and the economic and environmental efficiency of the process. Additionally, based on the experience of foreign countries, the possibilities of saving natural resources, reducing the consumption of new raw materials, and effectively utilizing road construction waste through the use of recycled materials were analyzed. Based on the analysis obtained, the prospects for applying this technology in the conditions of Uzbekistan and the directions for increasing its effectiveness are outlined.

Keywords: Asphalt concrete granule, milling, processing, , ABZ-4, elevator, coating, physical and mechanical properties, economic efficiency, environmental protection, plants, material, mixer.

Introduction

Conserving natural resources and reducing the environmental burden during the construction and reconstruction of modern highways is considered one of the urgent tasks. The expansion of road infrastructure is sharply increasing the demand for materials such as crushed stone, sand, and bitumen. At the same time, tons of old asphalt concrete pavements generated during repair work are often thrown into landfills as waste. This is an inefficient approach, both economically and environmentally. The processing of old asphalt concrete materials at asphalt concrete plants (ABZs) fully complies with the principles of the "green economy." This technology allows for the re-involvement of inert materials and bitumen from the old coating into the production cycle. As a result, the cost of the new asphalt concrete mixture is significantly reduced, energy resources
will be saved and the amount of harmful emissions into the environment will be reduced. At the same time, in the conditions of Uzbekistan, along with the modernization of road infrastructure, it is determined by the need for the rational use of materials and the reduction of the environmental impa Asphalt granules obtained by milling old asphalt pavements are not waste, but a finished raw material containing precious bitumen and selected stone materials. Its processing at asphalt concrete plants (ABZ) significantly reduces the cost of road construction.

The processing of old asphalt concrete pavement at asphalt concrete plants is currently considered one of the most economical and environmentally friendly technologies in road construction. This process involves the recycling of old asphalt material, i.e., asphalt granules, scraped using specialized milling equipment during road repairs. Since the asphalt granule contains a certain amount of old bitumen and high-quality rocks, it serves as a ready-made raw material source for new asphalt mixtures.

Materials and Methods

In factory conditions, the processing of this material is primarily carried out in two ways: cold or hot. In the cold method, old asphalt blocks are fed directly into the factory mixer, and in this mode, it is possible to add an average of fifteen to twenty percent of old material to the new mixture. In the hot method, the plant is equipped with an additional parallel drying drum, and asphalt granules can be preheated to one hundred and forty degrees and added to the new mixture in an amount of up to sixty percent. In both methods, the material delivered to the plant is first stored in moisture-protected shelters, and then separated into fractions of the required size on screening equipment. [1]

The most important aspect of the technology is the restoration of the properties of aged and hardened bitumen in the old asphalt.

1. If a small amount of the old material is added to the new mixture, it is sufficient to simply replace the brand of the new bitumen with a slightly softer one. However, when the proportion of old material exceeds thirty percent, special chemical rejuvenating additives—namely plasticizers—are mandatory added to the composition to prevent the mortar from becoming brittle and the subsequent appearance of cracks on the road. These additives restore the lost oils in the old bitumen, bringing the quality and durability of the finished product to a completely new level of asphalt.

2.This practice will bring enormous economic and environmental benefits to the road sector. The consumption of bitumen, which is the most expensive component, will be saved almost by half, and the costs of extracting natural crushed stone and sand resources and transporting them over long distances will be drastically reduced. At the same time, the discharge of old asphalt into landfills will be eliminated, and the amount of harmful gases released into the atmosphere will be significantly reduced.

3.Research object and materials used.

The object of this study is the material formed as a result of milling the old asphalt concrete pavement of highways and used for processing. In international scientific literature, this material is referred to as RAP (Reclaimed Asphalt Pavement). RAP contains mineral fillers, crushed stone, sand, and aged bitumen. The study examines the possibility of using old asphalt concrete material, new mineral materials, new bitumen, and, if necessary, additives that restore bitumen properties. When selecting materials, their physico-mechanical properties, grain composition, and compliance with current regulatory requirements are taken into account. The properties of the old asphalt concrete material may depend on its source of origin, the service

life of the coating, previous repairs, and the milling process. Therefore, it is necessary to determine the composition and quality indicators of the material before processing.

4. Method for sampling and preliminary preparation

For the study, representative samples are taken from the old asphalt concrete material, taking into account its source of origin. When sampling, it is necessary to account for structural differences in different parts of the material. The resulting material is prepared in the following stages: Determination of foreign impurities in the material. Crushing the material if necessary. Separation of particles by size by sifting. Determining the moisture content of the material.

Preparation of samples for laboratory analysis. Grinding and sifting of RAP material makes it easier to control its grain composition, separate large pieces, and design the composition of a new asphalt concrete mix. In addition

during the repair and reconstruction of highways, the old asphalt concrete pavement is removed by milling. Instead of throwing away the resulting material, it can be recycled and used to prepare a new asphalt concrete mixture.

Old asphalt concrete contains mineral materials and bitumen, the reuse of which helps save natural resources and reduce the need for new materials. Before processing, the old asphalt concrete material is cleaned of foreign impurities, crushed if necessary, and sifted. After this, its grain composition, moisture content, and bitumen content are determined. Based on these indicators, it is determined how the material can be used in the production process. When processing old coating materials at asphalt concrete plants, existing production equipment and material properties are taken into account. For example, at batch asphalt concrete plants, materials are mixed in specific quantities. In drum units, the mixture is prepared continuously. In both cases, it is important to add the old asphalt concrete material evenly to the new mixture and ensure the quality of the finished product.

During the processing stage, the old asphalt concrete material is mixed with new mineral materials. New bitumen is also added as needed. The bitumen content in the old material must also be taken into account, as its quantity and properties affect the quality of the finished mixture. Therefore, it is not advisable to add any amount of old asphalt concrete material to the mixture without checking it. The use of recycled material has several economic and environmental advantages. In particular, it is possible to reduce the consumption of new mineral materials and bitumen, use waste generated during road repairs, and save natural resources. At the same time, certain expenses are required for the assembly, transportation, grinding, and preparation of the material. Therefore, all costs must be taken into account when evaluating the economic efficiency of processing.

To utilize old asphalt concrete materials effectively, it is necessary to verify their quality under laboratory conditions, select the correct mixture composition, and monitor the production process. The strength, density, and water resistance of the finished asphalt concrete mix are evaluated based on the relevant requirements. This will help obtain high-quality and long-lasting road surfaces through the use of recycled materials.

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1-Figure 1. Stages of asphalt concrete processing.

Results

As a result of the analysis of the processing of old asphalt concrete pavement materials at asphalt concrete plants, it was established that this technology possesses significant economic and environmental advantages. The reuse of old asphalt concrete material obtained during the road surface repair process allows for a reduction in the consumption of new mineral materials and bitumen. At the same time, the proper organization of the processing process is of great importance in ensuring the required quality indicators of the finished asphalt concrete mix. The effective use of old asphalt concrete material depends, first and foremost, on determining its composition and properties. The possibility of adding the material to the new asphalt concrete mix is evaluated by checking its grain composition, moisture content, and bitumen content. If the properties of the mineral aggregates and bitumen in the old material are determined, it will be possible to reasonably select the composition of the new mixture. This contributes to the rational use of raw materials and the quality control of finished products. Preliminary grinding, sifting, and sorting of old asphalt concrete material is an important stage in the recycling process. These works allow for the separation of large pieces within the material and the formation of the required grain composition. Furthermore, the separate storage of RAP material and the control of its moisture content help ensure the stability of the production process. The result of using old materials at asphalt concrete plants also depends on the chosen technology. In batch units, materials are mixed in specified quantities, while in drum units, the production process is carried out continuously. In both cases, it is necessary to take into account the even

mixing of the old asphalt concrete material with the new mineral materials and the amount of bitumen in its composition.

Proper organization of the technological process serves to minimize factors that may adversely affect the quality of the mixture. The processing of old asphalt concrete pavement material is widely used not only in Uzbekistan but also in foreign countries. For example, in foreign countries, the processing of old asphalt concrete pavement materials has become one of the important directions for the efficient use of natural resources in road construction. In particular, in Japan, the USA, and European countries, old asphalt concrete materials obtained during the repair of road surfaces are used to prepare new asphalt concrete mixtures. This experiment will reduce the consumption of new mineral materials and bitumen, as well as the reuse of road construction waste. The system for processing asphalt concrete materials is widely developed in Japan.

In the country, materials obtained from the recycling of old road surfaces are sorted at specialized enterprises and used in the production of new asphalt concrete mixtures. The international presentation published in 2026 notes that the recycling rate of asphalt concrete pavement materials in Japan has reached 99.5%. This indicator demonstrates the effective organization of the system for the collection, processing, and reuse of old asphalt concrete materials. The stages of processing old asphalt concrete materials are shown in the table below.

1-Schedule.

T\R	Stage of work	Equipment used
1.	Remove old finish	Milling machine
2.	Material grinding	Crusher
3.	Sort material	Vibratory sieve
4.	Material storage and delivery	Bunker, conveyor
5.	Mixing with new components	Asphalt mixer
6.	Testing of the finished mixture	Laboratory equipment

Stages of recycling old asphalt concrete materials.

Conclusion. Thus, the recycling of old asphalt concrete pavements is the most optimal way to implement the principles of the "green economy" and resource conservation in the road construction sector. The large-scale implementation of this technology in Uzbekistan will allow for the high-quality renewal of road infrastructure and the efficient expenditure of state budget funds. In modern asphalt concrete plants, the hardened properties of old bitumen are fully restored through the application of specialized regenerating additives and plasticizing agents. The resulting finished processed product is in no way inferior in strength, elasticity, and durability to asphalt concrete mixtures made from new materials. At the same time, the process will serve to reduce the negative impact on the environment, as the disposal of construction waste in landfills will be limited, and the volume of stone and petroleum product extraction from nature will be reduced.

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