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THE ROLE OF INDUSTRIAL WASTE IN INCREASING THE STRENGTH OF ROADS

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Abstract
In this article, the use of natural materials and traditional technologies in the construction of highways in the conditions of Uzbekistan is considered. Information is provided on the implementation of various technological processes to improve soil quality during the construction of the roadbed.

Keywords: Roadbed, automobile, road, highway, phosphogypsum, strength, structure, asphalt concrete, cement concrete, structure, asphalt, soil, foundation, pavement, lining.

Introduction

Phosphogypsum is calcium sulfate hydrate, formed as a by-product in the production of fertilizers from phosphorite rock. It is primarily composed of gypsum ($CaSO_4 \cdot 2H_2O$). Although gypsum is widely used in the construction industry, phosphogypsum is rarely utilized. Due to its low radioactivity, most phosphogypsum is placed in dumps for long-term storage. The radioactivity of phosphogypsum is attributed to the presence of natural radionuclides and their daughter isotopes in its composition. The long-term storage of phosphogypsum and the accumulation of waste are causing debates[1], but currently, there are no economically viable technologies for processing phosphogypsum[2]. Approximately five tons of phosphogypsum are generated for every ton of phosphoric acid produced. Worldwide, the annual production of phosphogypsum is estimated to range from 100 to 280 Mt.

Phosphogypsum is an industrial waste generated during the production of phosphate fertilizers, containing calcium sulfate dihydrate. Insufficient work has been done on its application in the construction of highway foundations. In Uzbekistan, natural materials and traditional technologies are mainly used in the construction and reconstruction of highways. For example, when constructing a roadbed, various technological processes are carried out to improve soil quality. Although scientific research on the use of phosphogypsum in the construction of the roadbed (base) is limited, it has some potential advantages and problems[3].

Russia: In some studies, the possibilities of using phosphogypsum in road construction have been studied. For example, there is experience in using phosphogypsum as an additional material for soil stabilization or road foundation construction. However, scientific data in this area are limited and require further research.

China: Research has been conducted on the use of phosphogypsum as a building material. In particular, the possibilities of using phosphogypsum-based materials in road construction were

studied. However, information in this area is limited and additional scientific research is needed.

European countries: In some European countries, there are studies on the use of phosphogypsum in building materials. For example, the possibilities of using phosphogypsum in road construction by mixing it with cement or other binding materials have been studied. However, scientific data on this matter are limited and additional research is required[4]. In general, international experience in the application of phosphogypsum on highways is limited and requires further scientific research. If phosphogypsum is planned to be used in road construction, then, first of all, it is necessary to conduct detailed research on its environmental safety, mechanical properties, and long-term stability[5].

RESULTS AND DISCUSSION

Possibilities for the use of phosphogypsum on the roadbed:

1. Binding properties - Phosphogypsum contains calcium sulfate dihydrate, which can be used to increase soil strength.
2. Cheap material - Phosphogypsum is considered industrial waste, therefore its use in road construction can reduce the cost of construction materials.
3. Reducing environmental impact - Using phosphogypsum waste in road construction helps reduce its harmful effects.

Problems with using phosphogypsum:

1. Moisture - Phosphogypsum can lose its structural properties under the influence of water, which reduces road stability.
2. Chemical composition - Some phosphogypsum may contain radioactive or harmful impurities, which requires environmental safety measures.
3. Necessity of mechanization and additional processing - Special processing may be required to adapt the physical and chemical properties of phosphogypsum for road construction. In this study, the following industrial waste was studied:

• metallurgical slags are materials with high heat resistance and strength.
• Coal ash and waste - used as an additional material to increase the strength of concrete and asphalt mixtures.
• Rubber and plastic residues - increase elasticity and improve the resistance of road surfaces to cracking. During laboratory studies, these wastes were added to asphalt concrete and concrete mixtures in various ratios. The tests were carried out according to the following criteria:
• Pressure resistance - determining how materials react under load.
• Elasticity - testing how well it can withstand temperature and load changes.
• Water resistance - assessment of the degree of material deterioration under the influence of rain and snow.

Laboratory tests have shown that the addition of a certain percentage of industrial waste increases the strength of road surfaces:

• Asphalt mixture enriched with metallurgical slags showed resistance to 15-20% higher pressure compared to traditional asphalt.

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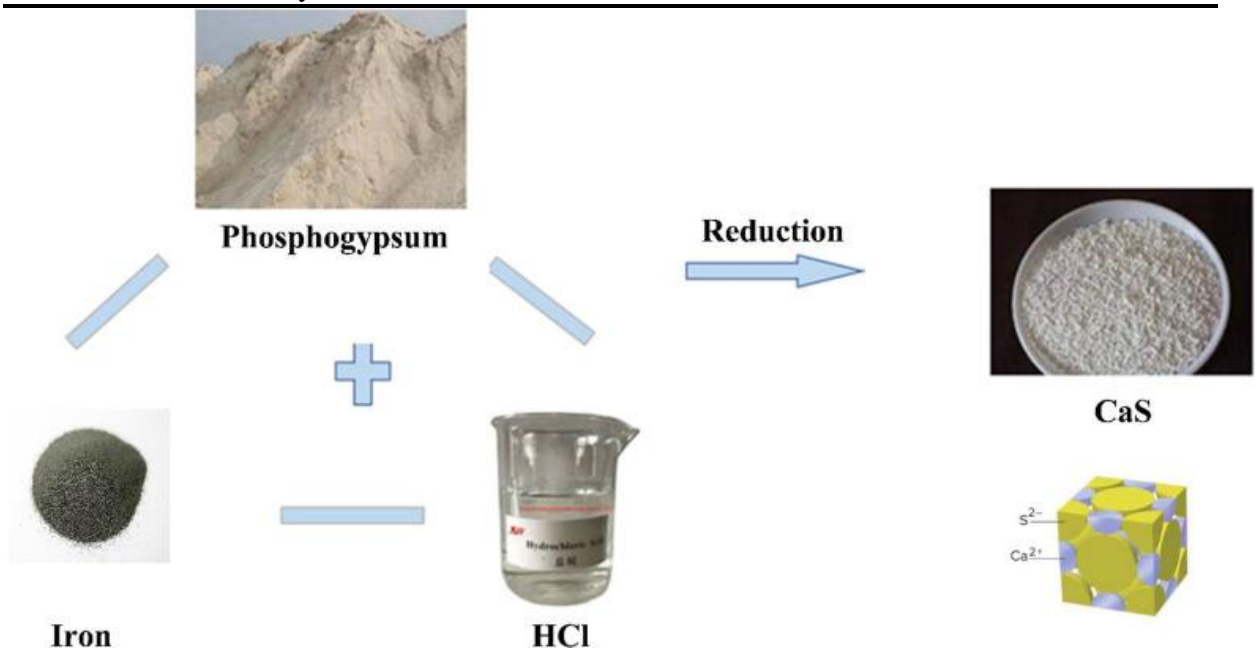
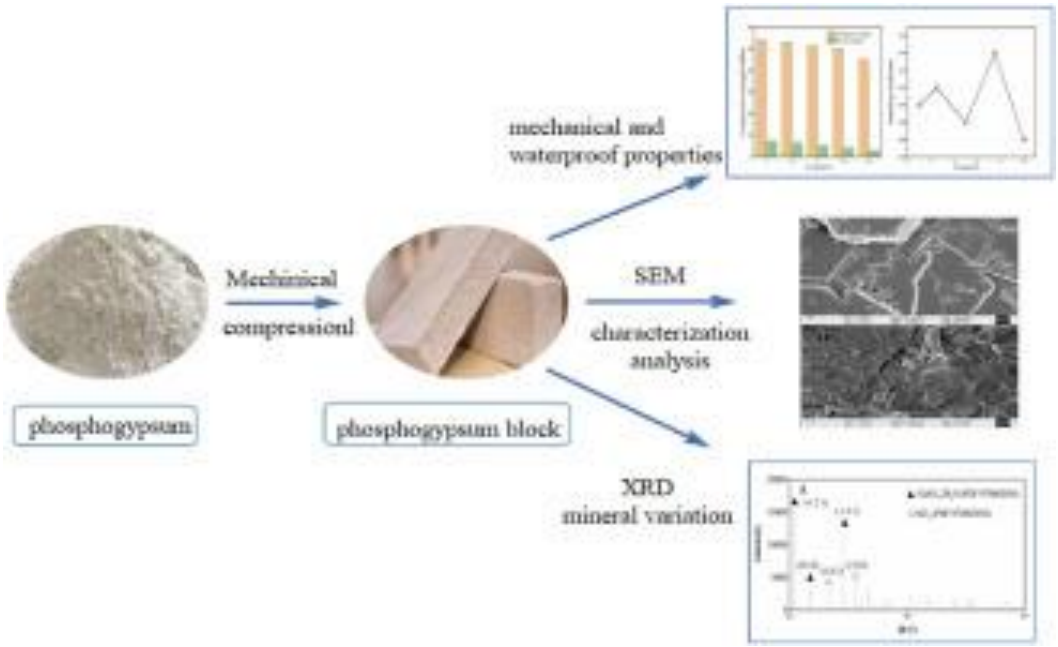


Concrete roads reinforced with coal ash and waste have received significant improvements in hardness and water resistance.

• Asphalt roads with the addition of rubber and plastic waste increased the degree of elasticity and reduced the formation of cracks and fissures. Based on the results, it was established that these waste mixtures significantly improve the quality of road surfaces and have a positive effect on them.



CONCLUSION

The research results showed that the use of industrial waste increases the durability of roads, extends their service life, and reduces environmental problems. For wider practical application of this method in the future, the following recommendations are given:

• In-depth study of the suitability of industrial waste for road construction.
• Determination of optimal ratios of mixtures of various wastes.
• Stimulating the production of road materials based on industrial waste. In general, the use of industrial waste is one of the modern and environmentally efficient ways to increase the durability of highways, which plays an important role in road construction and environmental protection.

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