ANNOTATION

to the dissertation for the degree of Doctor of Philosophy (PhD) in the specialty 6D060800 - "Ecology" Shanbayev Maxat on the topic "The development of integrated technology recycling waste industry"

Relevance of the topic: In the Zhambyl region, a massive amount of artificial waste from the chemical industry has accumulated on the territory of the LLP «Kazphosphate» NDPP (Novodzhambul Phosphorus Plant) phosphorus plant, making the problem of their disposal urgent.

Production of yellow phosphorus and its compounds are sources of environmental pollution with harmful substances. This production is characterized by the formation of man-made waste - phosphorus slag, boiler dust and gaseous compounds. Despite the recent decline in phosphorus production, the state of the environment remains tense. Thus, research aimed at processing man-made waste is of great environmental importance.

Due to intense air pollution, the main attention is paid to restoring the original state of the environment and introducing new technologies to improve the economic efficiency of industrial waste.

Complex waste processing technologies should strive to produce finished industrial products. The main goal is to expand the range of products to support the domestic market.

The development of technologies involved in road construction, in particular, waste from the phosphorus industry (granulated phosphorus slag, phosphogypsum overburden formed during the extraction of phosphorites, etc.), will solve the problem of recycling large-tonnage waste and provide road construction with cheap and high-quality materials. Replacing natural raw materials with waste from the phosphorus industry will allow:

- dispose of large-tonnage waste;
- improve the environmental situation in the Zhambyl region;
- expand the raw material base for road construction;
- provide the road industry with affordable materials.

At the beginning of this century, due to changes in traffic composition and an increase in the load capacity of vehicles to 12-13 tons per axle, the service life of road surfaces of highways has sharply decreased: the durability of asphalt concrete pavements has reduced to 5-6 years, and cement concrete pavements to 20-25 years. This served as an impetus for the development of new concepts: 1) the concept of "road pavements with a long service life" (LPL) according to European terminology; 2) the concept of "eternal road pavements" following the terminology adopted in the USA.

Experts have established the basic principles and conditions for ensuring the durability of roads according to the concepts of the USA and the EU:

- ensuring the comfort and safety of traffic on roads;
- road stability under the influence of transport and climate change;
- increasing bearing capacity of road pavement layers from the bottom up;

– increased compressive strength of pavement materials to withstand high loads from above.

In accordance with the conditions of road durability according to modern concepts, in order to increase the service life of roads to 50 years or more, it is necessary that the bearing capacity of the layers of road pavement increases from the bottom up, i.e. it is necessary to create stronger road bases than the pavement itself. However, the cost of road construction increases significantly, since the standards recommend using expensive high-grade Portland cements and high-quality stone fillers to obtain cement concrete, which requires significant financial and material costs. This is further aggravated by the annual increase in the deficit of traditional road-building materials - bitumen, cement, road mastic, crushed stone, mineral powder and the increase in the cost of land allocation.

The chemical industry is characterized by a significant volume of waste of interest for the production of road construction materials. Taking into account that in the initial state, the waste of the phosphorus industry has binding properties, but which without additional activation are insufficient for use as an independent binding substance, there is a need to use these man-made wastes as the main components of road mixtures with the addition of various activators.

Phosphorus granulated slags, which are a local material and have binding properties under certain conditions, can serve to expand the use of reinforced local stone materials in the construction of road surfaces in Kazakhstan.

The use of binders ensures the quality of the resulting structural layers and the reliability of their operation in road pavement in various natural and climatic conditions, taking into account the growth of not only traffic intensity, but also transport loads.

Consequently, it is important to solve a complex problem, taking into account the conditions of world concepts of durable roads.

The object of the study is the waste of the phosphorus industry.

Subject of the study: technology of road construction from industrial waste.

The purpose of the work is to involve the waste of the phosphorus industry in the raw material base of road construction materials.

Research objectives: to achieve the stated goal, it is necessary to solve the following objectives:

– Assessment of the environmental impact of man-made waste from phosphorus production accumulated in dumps in the Zhambyl region;

– Study of the technical condition of existing roads in the Republic of Kazakhstan and the possibilities of using waste in road construction;

– Conduct theoretical and experimental studies of waste properties;

– Study of optimal compositions for obtaining binder road mixtures based on phosphorus production waste;

– Development of technology for the construction of structural soil layers of road surfaces from these wastes;

– Construction of a pilot road section based on slag minerals.

Scientific novelty of the study: The scientific novelty of the obtained results

lies in the utilization of large-tonnage technogenic waste from the phosphorus industry with the production of road materials on their basis that have properties and characteristics similar to those of materials obtained from natural raw materials.

The possibilities of using slag-mineral mixtures in year-round road construction were studied based on a comprehensive study of the physicochemical processes of hardening and formation of the structure of slag-mineral materials at negative temperatures. Such studies have not been conducted before.

The possibility of obtaining road binders based on phosphorus industry waste (90-92% granulated phosphorus slag + 8-10% cement as an activator) for the construction of durable and economical road pavement structures was theoretically substantiated.

To increase the volume of phosphorus industry waste recycling and expand the raw material base of road building materials, new, unparalleled binder road mixtures were created. The main directions of application of road mixtures based on wastes of the phosphorus industry for the purposes of road construction have been developed: construction of structural layers of road pavements; construction of layers of the road bed. Technological modes of construction of roads of various technical categories from slag binders, reformed after their long-term freezing, have been established. A technology for construction of motorways using technogenic wastes of the phosphorus industry has been developed. Construction of a pilot section of the road has been carried out.

Method or methodology of the work. The methodological basis was the provisions of chemical materials science, methods of theoretical and experimental optimization, laboratory research.

Research methods modern technologies of road pavement construction using inorganic binders (cements, slag and other binders) provide for the use of the following mechanized works: mixers for the preparation of road mixtures, transportation and laying of mixtures on the road surface, compaction of the mixture materials by pressing with rollers or vibrating presses of the paver to the required density of the road pavement layer. Then maintenance work is carried out to exclude moisture evaporation from the laid layer and the flow of hydration and hardening of the monolithic layer. In laboratory conditions, all the specified technologies are observed to obtain high-quality material. The optimality of the technological modes of construction is assessed by the quality of the obtained road binders.

Thesis submitted for defense:

– Study of the ecological state of the Zhambyl region;

– Analysis of the properties of industrial technogenic waste of the phosphorus industry of the Zhambyl region;

– Study of the features of the construction of the roadbed from phosphorus production waste during road construction;

– Development of a road construction technology from industrial technogenic waste of the phosphorus industry and construction of a pilot section of the road.

The practical significance lies in expanding the raw material base for the production of building materials through the use of phosphorus industry waste.

Results of the assessment of the technical and economic efficiency of the

development. The use of large-tonnage technogenic waste of the phosphorus industry in road construction will contribute to their widespread recycling and, as a result, reduce the cost of road construction and increase the efficiency of environmental protection, which corresponds to the priorities of the "Green Economy".

Connection of the dissertation topic with the plans of scientific research work. The dissertation work was completed within the framework of grant research projects of the Ministry of Education and Science of the Republic of Kazakhstan No. 1016/GF4 “Development of technology for the production of binders and road mixtures from waste of the phosphorus industry” and under the program of the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan No. BR24992882 “Development of new technologies for improving the environmental situation in the region for the processing of man-made waste”.

Publications. On the topic of the dissertation, the author published 2 patents and more than 20 works, including 3 articles that participated in the defense in indexed publications with the Scopus and Web of Science databases, 1 article was published in a journal recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan and 1 article was published in a collection of articles of the international scientific and practical conference:

1. Method for producing a composite for building materials. Turgumbaeva H.H., Beisekova T.I., Lapshina I.Z., Shanbayev M.Zh. Innovative patent of the Republic of Kazakhstan No. 29401. Published on 25.12.2014.

2. Binder. Turgumbaeva H.H., Beisekova T.I., Lapshina I.Z., Shanbayev M.Zh., Kerimbaeva I.N. Innovative patent of the Republic of Kazakhstan No. 93928. Published on 06.01.2016.

3. Evaluation of polymer matrix composite waste recycling methods. I.Delvere, M.Iltina, M.Shanbayev, A.Abildayeva, S.Kuzhamberdieva, D. Blumberga. Environmental and Climate Technologies, 23(1), 2019, pp. 168–187. (Scopus: Percentile – 64%, Q2).

4. Features of the technology of application of industrial waste in the construction of constructive layers of roadwear. Maxat Shanbayev, Khalima Turgumbayeva, Dagnija Blumberga, Tuleuzhan Beysekova. Environmental and Climate Technologies, – 2021, – vol. 25, no. 1, – pp. 965–977. (Scopus: Percentile – 47%, Q3).

5. Environmental and economic advantages of disposal of phosphoric industry waste. Maxat Shanbayev, Khalima Turgumbayeva, Dagnija Blumberga, Aziza Aipenova. Environmental and Climate Technologies, – 2022, – vol. 26, no. 1, – pp.143–154. (Scopus: Percentile – 49%, Q3).

6. Study of the possibility of obtaining binders from waste of the phosphorus industry. Beisekova T.I., Zhandauletova F.R., Shanbayev M.Zh. Scientific and technical journal "University of Engineering - University Works" of the NAO "Karaganda Technical University named after A.Saginov", - 2024, - No. 4, - P.147-153.

7. Innovative technology for producing road composites based on waste of the phosphorus industry. Turgumbaeva H.Kh., Abildaeva A.Zh., Blumberg D. Shanbayev

M.Zh. Collection of works of the International scientific and practical conference "Rational use of mineral and technogenic raw materials in the context of Industry 4.0", - 2019. - P. 341-347.

Structure and volume. The dissertation consists of an introduction, 5 sections, general conclusions and a list of references. The main text of the dissertation is presented on 71 pages, includes 11 figures, 19 tables, a list of references consisting of 105 titles and 8 appendices.