

The proposed classification in the first place, will help the consumer to adequately assess the risk of unsafe use of a product. For these purposes it is necessary to use symbols and icons. These funds can be of a contrasting colour and has necessarily uniform and standardized. For producers of goods identification of potential dangers creates an information resource to improve product quality and minimize risks to consumers. The type and degree of danger of the product allow you to analyze its production causes. They can be design flaws or component part of the product, technology, application and maintenance and other reasons.

The experience of Russian specialists in the field of standardization of goods classification by severity deserves attention. The project developer is an independent non-profit organization "Russian Institute for consumer tests", specializing in comparative studies of goods, consumer protection and other activities. This organization has a good reputation for objective, independent entity.

Interest is the introduction of the developed system in the conditions of the Belarusian consumer market that will help to systematize approaches to the assessment of danger of goods and will improve the protection of domestic consumers.

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UDC 691

### PAVING SLABS WITH ADDITIVES OF INORGANIC IRON-CONTAINING WASTE ТРОТУАРНАЯ ПЛИТКА С ДОБАВКАМИ НЕОРГАНИЧЕСКИХ ЖЕЛЕЗОСОДЕРЖАЩИХ ОТХОДОВ

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*Key words: inorganic waste, slimes, combined heat and power plants, deironing stations, paving slabs*

*Ключевые слова: Неорганические отходы, иламы, теплоэлектроцентрали, станции обезжелезивания, тротуарная плитка*

*Abstract. Waste deironing stations and combined heat and power plants represent a certain danger to the environment, and, therefore, economic problems. However, such waste perhaps contains substances to use which expediently to use for production of products of construction and finishing materials and products. The open statistical material of the presence of waste in the regions of Belarus is presented, showing the urgency of utilization. The monitoring of the qualitative and quantitative chemical composition of iron-containing inorganic wastes for water pumping stations in Vitebsk was carried out. The possibility of use of waste in production of paving slabs for replacement of a part of initial raw materials is shown. The results of the scientific publication can be used for further research on the introduction into production of technological processes for the manufacture of paving slabs from waste.*

*Аннотация. Отходы станций обезжелезивания и теплоэлектростанций представляют собой определенную опасность для окружающей среды, а, следовательно, и экономические проблемы. Однако в таких отходах, возможно содержатся вещества использовать которые целесообразно использовать для производства изделий строительно-отделочных материалов и изделий. Представлен открытый статистический материал наличия отходов по регионам Беларуси, показывающий актуальность утилизации. Проведен мониторинг качественного и количественного химического состава железосодержащих неорганических отходов проводился для водонасосных станций г. Витебска. Показана возможность использования отходов в производстве тротуарной плитки для замены части исходного сырья. Результаты научной публикации могут быть использованы для дальнейших исследований по внедрению в производство технологических процессов изготовления тротуарной плитки из отходов.*

At present rational usage of natural resources has particular significance. Development of effective waste-free technologies offers the solution of this current economic problem due to complex use of raw materials that at the same time leads to elimination of the huge ecological damage rendered by storages of waste. Data on quantity of iron-containing waste in the regions of Republic of Belarus show the following: the Gomel region – 1176.89 tons; the Vitebsk region – 114 138.54 tons; the Minsk region – 3910.54 tons; Minsk – 7193.85 tons. These data is received throughout the country for the following types of waste: iron-containing slime, code 3551800; slime of iron oxide in the reduction processes, code 3551801; precipitation of water treatment, code 8410500; sediment after leaching of deironing filters, code 8420300; dehydrated sediment of deironing stations, code 8420500. The maximum quantity of waste is accumulated in the Vitebsk region [1]. The most rational direction of utilization of industrial wastes is their use as a technogenic raw material in obtaining various types of products and, first of all, for building purposes.

The purpose of the presented work is the research of compositions of inorganic iron-containing waste of deironing stations and combined heat and power plant, identification of a possibility of using waste in production of paving slabs.

Monitoring of qualitative and quantitative chemical composition of iron-containing inorganic wastes was carried out for water pump stations No. 1 - No. 4 in the city of

Vitebsk. Similar studies were conducted in 2008, 2010, and 2014. The table shows the results of the studies: the content of iron ions in weight percent (in terms of dry substance).

Table 1 – Content of iron ions in weight percent in waste

Год	Water pump stations of Vitebsk.			
	№ 1	№ 2	№ 3	№ 4
2008	32 – 33	38 – 39	36 – 38	41 – 43
2010	36 – 38	39 – 40	34 – 36	40 – 41
2014	33 – 35	38 – 39	35 – 36	42 – 44
2016	32 – 32,5	39 – 40	34 – 36	43 – 45

Wastes from the deironing stations in Vitebsk have the following composition. Station № 1:  $\text{SiO}_2$  – 45–47 %;  $\text{Fe}^{3+}$  – 31–32 %;  $\text{Ca}^{2+}$  – 4.5–5.5 %;  $\text{Mg}^{2+}$  – 1.5–2.5 %; anions – the rest. Station № 2:  $\text{SiO}_2$  – 48–49 %;  $\text{Fe}^{3+}$  – 30.5–31.5 %;  $\text{Ca}^{2+}$  – 4.5–5.2 %;  $\text{Mg}^{2+}$  – 2.0–2.5 %; anions – the rest. Also determined the chemical composition of inorganic waste combined heat and power plants (slime water treatment), in terms of dry substance, mass. %:  $\text{Fe}_2(\text{SO}_4)_2$  – 12.8–14.2;  $\text{SiO}_2$  – 41.9–44.5;  $\text{CaSO}_4$  – 2.4–2.6; organic substances – the rest. At a research of the chemical composition of slimes possible fluctuations in the content of the basic compounds are established (%):  $\text{SiO}_2$  – 0.5–4.9;  $\text{Fe}(\text{OH})_3$  – 5.8–10.5;  $\text{CaCO}_3$  – 62.8–68.2;  $\text{CaSiO}_3$  – 3.9–6.6; organic substances – 5.2–8.9. Fluctuations in the slurry composition in a narrow range suggest a sufficient stability of its component ratios of components [2,3]. Monitoring content of the iron-containing waste microelements (heavy metals) are also held. The studies were conducted in 2008, 2010, 2014, and 2016 by means atomic emission analysis on the PGS-2 spectrograph. As a result of the executed researches it is established that the content of heavy metals (minerals) doesn't exceed admissible sanitary standards. Analyzing the chemical composition of sludge from deironing stations and combined heat and power plants, the content of heavy metals (microelements) in them, it was concluded that these wastes can be used for the manufacture of paving slabs.

For the manufacture of paving slabs can be used as a method of vibrocompression, and the method of vibratory casting, as well as a plastic method (for ceramic tiles for exterior decoration).

Vibrocompression method is based on the use of a special mold (matrix) located on constantly vibrating bed. From above on solution in mold presses a punch – the compound detail of a vibropress, densely entering into it, like a piston into a cylinder. After the mold, is raised on the pallet, the finished block remains.

The method of vibrocasting provides consolidation of mixture on constantly functioning vibrotable. The solution, in this case, is placed in rubber or plastic molds of various configurations, carefully monitoring the correctness of their filling. Surplus of the concrete mixture is cut off, and after vibration treatment of the products, the molds transferred to a warm place for drying for two days, after which the finished tiles being removed.

As raw materials for production of paving slabs, by methods of vibropressing or vibrocasting are used: cement, sand, water and inorganic iron-containing waste.

Inorganic waste from deironing stations and combined heat and power plants can be replaced by a part of the sand in the mixture. Colored paving slabs can be manufactured by methods vibropressing or vibration casting, coating a colored layer 2-2.5 cm thick on the previously formed gray tile, replacing inorganic waste pigment color layer.

Ceramic tiles for exterior decoration (streets, facades) produce by plastic method (from the dough-like mass by heat treatment - under pressure, clay is crushed, then sent to a clay mixer where it is mixed with additives before obtaining homogeneous plastic). In the manufacture of ceramic tiles for exterior decoration (streets, facades) by plastic method, as a raw material used clay feedstock and attenuating additives. Inorganic waste from deironing stations and combined heat and power plants can be replaced by a part of the raw material or attenuating additives in the mixture [3].

For a research the physical-mechanical and physical-chemical properties of gray paving slabs, series of gray paving slabs with percentage attachment of inorganic iron-containing waste from 5 to 30% were prepared. The research of physical-mechanical properties of gray paving slabs was carried out in accordance with STB 1071–2007 “Concrete and reinforced concrete slabs for footways and roads” and STB 1152–99 “Vibropression concrete pavement slabs and vibropression concrete border stones”.

For a research the physical-mechanical and physical-chemical properties of colored paving slabs, series of colored paving slabs with different layer heights were prepared, as well, series of ceramic terracotta tiles. Physical and chemical properties of gray and color paving slabs are investigated. It is established that the effectiveness of the action of additives depends on their dispersion and grain composition.

In the production laboratory of the JSC "Obolsky Ceramic Plant" tests of gray paving slabs (compressive strength, flexural strength, frost resistance, water absorption).

Annually at the deironing stations and combined heat and power plants of the Republic of Belarus thousands of tons of slimes are formed, which mainly consist of oxides, hydroxides, iron, calcium, magnesium, aluminum carbonates, and, are valuable chemical raw materials. Their chemical, phase, the particulate composition may vary widely depending on the composition and water purification methods. As a result of the research the possibility of their use for production of paving slabs is established. The developed compositions for the manufacture of paving slabs with additives of inorganic iron-containing waste meet the urgent tasks of obtaining high-quality building materials and can significantly improve the ecological situation in the territory of water pump stations and heat and power plants.

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UDC 677.024.1: 004

**REVIVAL OF TECHNOLOGIES AND  
TRADITIONS OF MANUFACTURING SLUTSK  
BELTS AND DEVELOPMENT OF PRODUCTION  
OF NATIONAL SOUVENIR PRODUCTS**  
**ВОЗРОЖДЕНИЕ ТЕХНОЛОГИЙ И ТРАДИЦИЙ  
ИЗГОТОВЛЕНИЯ СЛУЦКИХ ПОЯСОВ И  
РАЗВИТИЯ ПРОИЗВОДСТВА НАЦИОНАЛЬНОЙ  
СУВЕНИРНОЙ ПРОДУКЦИИ**

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*Key words:* *Slutsk belts, weaving, jacquard machine, technical drawing, souvenirs, national brand.*

*Ключевые слова:* *слуцкие пояса, ткачество, жаккардовая машина, технический рисунок, сувениры, национальный бренд.*

*Abstract.* *The main subject of this research is the development of authentic Slutsk belts, piece products based on the artistic concept of authentic Slutsk belts, as well as technological developments related to the reconstruction of historical Slutsk belts on modern weaving equipment of RUE “Slutsk Belts”. The developed products are aimed at creating Belarusian national cultural brand and reconstructing the historical Slutsk belts.*

*Аннотация.* *Основным предметом этого исследования является развитие аутентичных слуцких поясов, штучных изделий, основанных на художественной концепции аутентичных Слуцких поясов, а также технологических разработок, связанных с реконструкцией исторических слуцких поясов на современном ткацком оборудовании РУП «Слуцкие пояса». Разработанные изделия направлены на создание белорусского национального культурного бренда и реконструкцию исторических слуцких поясов.*

The President of the Republic of Belarus A.G. Lukashenko set the task of reviving a unique phenomenon of Belarusian folk art – the Slutsk belts in his Appeal to the Belarusian People and the Parliament of the Republic of Belarus.