



# Environmental Solutions for the Disposal of Fine White Marble Waste

I. Shadrunkova, T. Chekushina<sup>(✉)</sup>, and A. Proshlyakov

Academic N.V. Melnikov Institute of Problems of Comprehensive Exploitation of Mineral Resources, Russian Academy of Sciences, Moscow, Russia  
tvche.2016@gmail.com

**Abstract.** The article deals with environmental problems of formation of fine white marble wastes on the territory of Koelga deposit and total mining complex. An inventory analysis of marble waste was carried out, environmental assessment of fine marble waste and their impact on the ecology of the complex territory was carried out and theoretically justified. Planned and scientifically justified ways of large-scale utilization in the production of ceramic bricks.

**Keywords:** Formation of fine marble waste · Environmental assessment · Amount of waste · Waste disposal

## 1 Introduction

The growth of industrial and mining production, the progress of civilization increase environmental problems due to the increasing consumption of mineral and other resources from the bowels of the Earth, due to the rapid rise in the number of solid man-made wastes of different productions. These wastes can be used for the production of building materials and to improve the environmental safety of mining regions. Abandoned lands are exempted from waste dumps and territories have environmental and economic benefit (Oreshkin 2017).

## 2 Methods and Approaches

In the world and in the Russian Federation there are the technologies of extraction and processing of non-metallic mineral resources. During these technological processes man-made wastes are formed. Their queries and the surrounding areas are withdrawn from economic circulation, violate natural landscapes - their man-made options are created. It destroys the soil, changes modes of rivers, lakes, reservoirs, underground and surface groundwater and causes great damage to the environment (Mesheryakov et al. 2009).

Koelga deposit of white marble began the work from 1924. During this time in the dumps huge amounts of fine wastes of extraction and processing marble were accumulated (Tseytlin 2012).

Almost all kinds of new productions require new construction, materials and mineral resources. Therefore, to improve the environmental safety of the regions it is necessary to carry out comprehensive development of deposits, and also to utilize man-made wastes in the production of building materials. To solve the above problems a comprehensive environmental assessment of man-made waste requires. The assessment should include amount of accumulated volumes for large-scale utilization of man-made waste in the production of building materials, products (Khokhryakov et al. 2013).

The purpose of the article is the ecological assessment of formation of man-made waste products of mining production in the form of white marble with a decrease in the available subsoil mineral resources for the production of building materials and products.

To achieve the goal, it is necessary to justify the use of these wastes as raw materials for the production of building materials and products. This will simultaneously improve the environmental safety of the territories due to large-scale utilization of man-made waste marble and will free up the areas occupied by dumps.

### 3 Results and Discussion

It was calculated that in 2018 the total mass in the dumps is more than 25 million tons of fine marble wastes, and the area of dumps - more than 20 hectares. An important task was also the calculation of the environmental damage from the abandoned territories under the dumps of fine marble waste.

To calculate it was analyzed the environmental effect from their utilization by reducing the area under the dumps, and the pollution of the environment of mining complex territory (Fadeichev et al. 2012).

When calculating it was determined that for the Chelyabinsk region the damage to the environment from storage of fine marble waste in dumps is about 500 thousand rubles a year (in the prices of 2018). Taking into account the amount of wastes already placed in dumps of JSC "Koelgamramor", the environmental damage will amount to over 30 million rubles.

According to calculations the utilization of fine marble waste in brick production will significantly reduce the environmental load on the environment. It will take place by reducing waste mass in dumps, that will allow to reduce the abandoned areas under dumps and to return the land to use.

In the articles it was determined the amount of recyclable fine marble waste at 1 m<sup>3</sup> of molding mixture for the production of ceramic bricks of multiple colors: terracotta or dark brown; light red or pinkish; fawn or straw.

The analysis of the results of technical tests showed that, on the basis of fine marble wastes, it is possible to obtain ceramic bricks of danger class 4, which corresponds to state standard GOST of the Russian Federation. It was found that burning of over-moulded ceramic raw makes at temperature 850... 900 °C. It is proved that at that temperature, the particles of marble are not affected by the process of decarbonization. Therefore, there is no greenhouse gas emissions - carbon dioxide, i.e. ecology of this mining territory is not the subject to harmful effects. Moreover, as above stated, the level of danger of marble wastes was higher (class 3) by one step, than the level of

danger of the ceramic bricks produced (4 class) on the basis of these wastes. Also amounts of energy for manufacture of these ceramic bricks reduced significantly as compared to common ceramic brick (Moumouni et al. 2016).

## 4 Conclusions

Thus, the total mass accumulated fine marble wastes and environmental damage to mining area of Koelgo deposit were determined. The technology of improving the ecology of the region due to large-scale utilization of the above marble wastes in the production of ceramic bricks was elaborated. The possible number of bricks of different colors at full disposal of accumulated marble wastes was determined. Using environmental life cycle assessment of finished products based on fine marble wastes the possibility of obtaining an environmentally safe effective bricks was theoretically justified and the technology of their production was elaborated. The dependence of color products from fine marble waste was defined. So, at an amount of 20% of fine marble waste in the mixture by mass of clay rocks the ceramic brick has a dark brown color, and at 40% - has straw color. The influence of the elemental composition of the mixture on the color of the brick was determined (Merem et al. 2017).

It was proved that the most environmentally safe, resource-saving way of man-made waste disposal is their utilization in the production of building materials and products. This method releases territories abandoned for storing waste and provides environmental and economic effects from the elimination of dumps (Bilgin et al. 2012).

Thus, the environmental problems of the Russian Federation connected with rise of man-made waste of white marble with a decrease in available reserves of mineral resources for the production of building materials and products were specified. The scientific foundations of the integrated environmental assessment methodology of man-made wastes and their large-scale utilization in the production of building materials and products were elaborated (Hebhoub et al. 2011). The possibility to use these wastes as raw components for their production, while solving environmental problems of the territories due to large-scale utilization of man-made waste was justified. This extends the raw material base and contributes to the integrated development of bowels, their mineral and man-made resources. Utilization of man-made waste allows to get a huge environmental and economic effects on the territory of the Russian Federation.

## References

- Bilgin N, Yeprem HA, Arslan S, Bilgin A, Günay E, Mars MO (2012) Use of waste marble powder in brick industry. *Constr Build Mater* 29:449–457
- Fadeichev AF, Khokhryakov AV, Grevcev NV, Cejtlin EM (2012) Dynamics of negative impact on the environment at different stages of mining development. *News High Educ Inst Mountain Mag* 1:39–46
- Hebhoub H, Aoun H, Belachia M, Houari H Ghorbel E (2011) Use of waste marble aggregates in concrete. *Constr Build Mater* 25(3):1167–1171

- Khokhryakov AV, Fadeichev AF, Cejtin EM (2013) Application of an integral criterion for determining the environmental hazard of mining enterprises. *News Ural State Mining Univ* 1:25–31
- Merem EC et al (2017) Assessing the ecological effects of mining in West Africa: the case of Nigeria. *Int J Mining Eng Mineral Process* 6(1):1–19
- Mesheryakov YuG, Kolev NA, Fedorov CV, Suchkov VP (2009) *Stroymaterialy Production of granulated phosphogypsum for the cement industry and building products*, vol 5, pp 104–106
- Moumouni A, Goki NG, Chaanda MS (2016) *Natural Resources Geological exploration of marble deposits in Toto Area, Nasarawa State, Nigeria*, vol 7, pp 83–92
- Oreshkin DV (2017) *Stroymaterialy Environmental problems of integrated development of mineral resources in the large-scale utilization of man-made mineral resources and waste in the production of building materials*, vol 8, pp 55–63
- Tseytin EM (2012) *Features of environmental hazard assessment of mining enterprises Theses of the report of VII Krakow conference of young scientists. AGH University of Science and Technology, Krakow*, pp 809–819

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

