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USING GRANITE SCREENINGS LIKE A FILLER FOR CONCRETE AND CONCRETE MIX

Natural stone is the most common resource used for the production of building materials. Today, both in Ukraine and in other countries, there is a problem of the release of large areas of agricultural land from granite refuse which is accumulated in dumps, outside the enterprises.

Granite is one of the most common among the igneous rocks used in construction. Granite is an acidic rock composed of quartz (20 - 40%), potassium feldspar - orthoclase (40 - 70%) and muskid mica, or more often biotite (5 - 20%). Due to high orthoclase content, the color of the granite is mostly gray, bluish gray, dark red. Granite has a granular-crystalline structure, density 2600 to 2700 kg/m^3, a compressive strength limit of 100 to 250 MPa and above. Granite, which is contained more than quartz and less of mica, has better construction properties.

Production of large fractions of broken stone forms screenings in the amount of up to 20 - 25% of the raw material. Production of cube-shaped broken stone of small fractions (5 - 15 mm) increases the amount of granite screenings to 40%. In general, granite screenings have a certain commercial value and this product is partly sold by enterprises to local consumers. At the same time, the full sale of granite screenings is limited by the high content of dust particles. Typical granite screenings at Ukrainian quarries contains up to 30% of particles of less than 140 μm in size, which have high water absorption and, therefore, do not allow the use of granite screenings in pure form for the manufacture of concrete.

One of the most promising directions of refuse utilization is its use in the production of various reinforced concrete structures. However, taking into account the cost of delivery, refuse utilization is possible only at a short distance to the consumer. The use of screenings for the production of asphalt concrete mixtures with a fine granular material content up to 50% inclusive would significantly reduce the volume of accumulated refuse. At the same time, increasing the concentration of screenings in the mixture leads to an increase in bitumen and rising costs of asphalt concrete. In addition, for fine-grained asphaltic concrete, a decrease in the strength limits is observed with the increase in the mineral content of screenings. It requires the introduction of fibrous polymer additives to a mixture. At the same time, small volumes of carrying out of road works, connected with the difficult economic situation in the state, do not allow to effectively utilize the refuse generated by crushed stone. Granite screenings can also be used as sintering intensifiers under high-speed modes of burning up of floor tiles and for brick production in exchange for chamotte and sand, for the production of ceramic products, component for roofing materials, filters for water treatment plants. In addition to the above-mentioned directions, the ways of disposal of waste are its use as a decoration, for the lining of tracks, sports and playgrounds. Granite screenings also can be successfully applied to create a landscape. It is planned to use it as a means to fight with slippery road for reducing the slip factor.

Granulated sand is a proven alternative to river and lingering sand. It is produced by crushing rocks and by washing equipment is divided into different fractions. It is used in the manufacture of concrete, mortar, plaster, borders, sidewalk tiles and other curly elements of paving.

Historically, the screenings were a by-product of the crushing-sorting process. Due to its layered form of particles and flakiness, high dust content of its application as a fine aggregate in most concrete was impossible. The consumption of water and in the future and the consumption of cement were very high to achieve the specified characteristics of concrete and cement mortar. These reasons forced the concrete manufacturers to avoid the use of screenings as filler.

Indicators of the granulometric composition of the washed granite sand is summarized in Table 1. From the table it is clear that the river and ravine sand is very small, but the granulometric curve of washed sand is as close as possible to the "ideal" curve of granulometric composition of the filler with a grain size limit of 2,5 mm (by Fuller), shown in Figure 4. This meets the requirements for the production of building materials, including concrete, building mortar and so on.

Table 1

Comparative table of granulometric composition granite washed

Sieve, mm	Granite washed sand, pass %
5 mm	100
2,5 mm	90
1,25 mm	68
630 μm	44
315 μm	20
140 μm	3
63 μm	1

Granulated granite sand must have some qualitative parameters. Sector standards for small fillers, such as European EN 206-1 or Ukrainian DSTU B V.2.7-210: 2010, allow only a limited amount of dust particles (0.063 - 0.112 mm) in wet sand. For high-quality concrete, the aggregate must contain less than 1% of dusty, muddy and clay particles to use as little cement and water as possible. Thus, pure granite sand with an "ideal granulometric curve" can be produced by washing. This allows making high-quality concrete and concrete products.

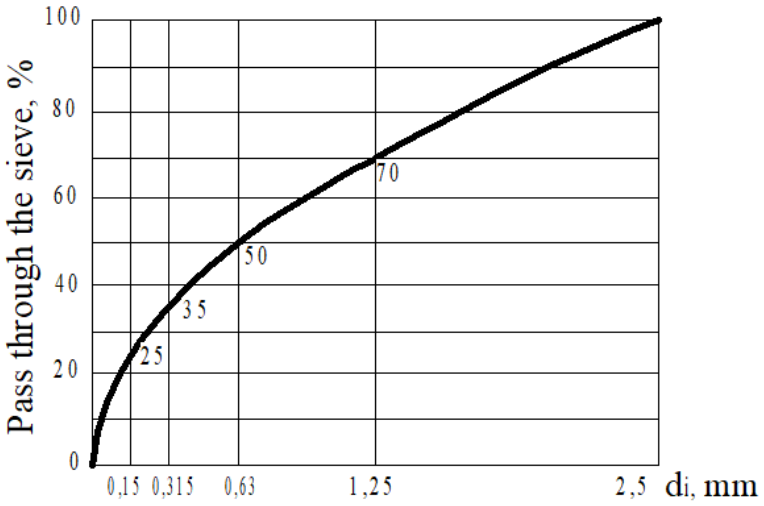

Fig. 1. "Ideal" curve of the granulometric composition of the filler with a grain size limit of 2.5 mm (by Fuller)

Therefore, in recent years, concrete producers, together with producers of crushed stone, have begun to look for alternative solutions to reduce the consumption of cement, with the preservation of a given concrete brand. So, since 1999, the group of companies "Unigran" has started making fractions 0.63 - 2 and 2 - 5 mm. Fractions 0.63 - 2 mm are successfully used by manufacturers of roofing materials, in particular for the manufacture of finishing materials, flexible and hard tile, roofing material, tiles, and a fraction of 2-5 mm, concrete producers, mixing it with river sand, are used to increase the module of size (M_k)

The next step was the production of fine sand 0.16 - 0.63 mm. Thus, due to a wide selection of small fillers of 0.16 - 0.63, 0.63 - 2 and 2 - 5 mm, manufacturers of concrete, building mortars and sidewalk tiles are able to choose the ideal granulometric composition for the production of products by mixing these fractions in a certain proportion. Such sand has fewer voids, which makes it more economically profitable raw materials, due to the reduction of the amount of cement in the mixture.

For making a mortar without sand, the ratio of cement and screenings in concrete should be as follows: cement brand 400 - 1 part, filler (best to apply granite screenings) - 8 parts, water is also needed, which should not be more than 20% of the total volume. The ratio is aimed at getting concrete M150. If the builder realizes that the strength of such mortar is too small, he should use quality cement

If the concrete producers confuse the complete lack of sand, they can replace it in part. This requires the addition of crushed stone. Consequently, if concrete is prepared from screenings, sand and cement, the proportions will be as follows: cement brand 400 - 1 part, screenings - 1 - 2 parts, broken stone - 3 parts, sand - 3 parts, water - maximum 20%.

At the same time, the ratio of screenings and other components almost does not affect the increase in the volume of the mixture, since the granules fill the gaps between the crushed stone, and also is a link between crushed stone and sand.

Also, it should be noted that for the manufacture of high-quality concrete only cement with no expiration date should be used, in addition the material should be free from admixtures. Water for the preparation of concrete should be clean (it is better to use drinking water).

Given the popularity of this filler in the manufacture of concrete mix, one can come to the conclusion that the use of crushed rock is a perfect solution. The debris is very in demand in the construction sector due to its undeniable advantages. The material is profitable from a financial point of view; in addition, it allows you to make durable and durable concrete. However, it should be borne in mind that all the benefits of dropping are lost if the wrong solution is taken into account when creating the solution. Today, the manufacturers of building materials, due to the wide range of small fillers, have the opportunity to choose such granulometric curve, which is ideal for the production of high-quality concrete, building solutions, curbs, sidewalk tiles and other curtain elements paving.

The granite screenings is characterized by a composition and properties variety and a wide range of applications, therefore, the next stage of research is the study of properties of fillers one of the components of which is the waste of broken stone enterprises.