

# STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF GRANITE CRUSHED STONE MATERIALS MINED IN AKCHA QUARRY OF ANGREN DISTRICT OF TASHKENT REGION

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**Abstract.** *Considering that physical and mechanical properties of stone materials used in the construction of road pavements of highways are important, their physical and mechanical properties (crushability and abrasion level) were simultaneously checked for compliance with GOST requirements, and the obtained results were analyzed.*

**Keywords:** *crushed stone, granite, quarry, grain composition, crushability grade, abrasion grades.*

## INTRODUCTION

Crushed stone is a material obtained by crushing large pieces of rock. The indicators that evaluate the suitability of road-building material to certain conditions and its interaction with the environment are diverse and based on mechanical, physical and chemical laws, such as physical properties of crushed stone: density, porosity and others. Chemical properties: molecular bonding, crystallization [1]. Currently in the Republic of Uzbekistan for the device of asphalt concrete pavements mainly use crushed stone and gravel from igneous, metamorphic and sedimentary rocks [2].

The Decree of the President of the Republic of Uzbekistan No. PF-5890 dated December 9, 2019 “On measures on deep reforming of the system of road economy of the Republic of Uzbekistan” The Ministry of Transport is transformed into the Ministry of Economy and Industry, the Ministry of Finance, the Cabinet of Ministers of the Republic of Uzbekistan together with the Ministry of Investment and Foreign Trade is tasked to develop a strategy for the development of highways until 2030 with the involvement of leading foreign experts and consultants [3]. Therefore, the choice of road construction materials with high properties for asphalt and cement concrete roads is the main task of road builders. It is not a secret that crushed stone plays an important role in the construction of asphalt concrete roads, and crushed stone is one of the main components of asphalt concrete mixes. The importance of crushed stone in asphalt concrete is due to its properties and contribution to the overall performance and durability of the road surface. They help to resist deterioration caused by weather and environmental factors. For this purpose, we conducted research work on the topic “Study of physical and mechanical properties of granite crushed stone materials extracted in the quarry AKCHA of Angren district of Tashkent region”.

## METHODS

### **Methods of physical and mechanical testing: Definition of crushability.**

Required tools: Hydraulic press with a maximum force of up to 500 kN according to GOST 28840, steel cylinders with a diameter of 75 and 150 mm and height of 75 and 150 mm respectively with a removable base and plunger, Scales upper according to GOST 29329 or laboratory on demand GOST 24104, sieves as standard, drying cabinet, washing tank.

### **Test preparation procedures.**

1. crushed stone (gravel) fractions from 5 mm to 10 mm, from 10 mm to 20 or from 20 to 40 mm pass through two sieves with holes  $d$  and  $D$ , respectively.

2. In a cylinder with a diameter of 75 mm from a sieve with holes  $d$  take 2 samples weighing 0.5 kg, respectively for a cylinder with a diameter of 150 mm take a sample weighing at least 4 kg. Samples of crushed stone size more than 40 mm are repeatedly crushed and tested on samples with sizes from 10 to 20 mm and from 20 to 40 mm.

3. analytical test specimens in dry condition are dried to constant weight, test specimens in water-saturated condition are immersed in water for 2 hours.

4. After soaking in water, the flint samples are wiped with a soft cloth.

**Test procedure.**

1. A cylinder with a diameter of 150 mm is used to determine the grade of crushed stone. Cylinder with a diameter of 75 mm is used to control the acceptance quality of crushed stone samples with sizes from 5 to 10 mm and from 10 to 20 mm.

2. The crushed stone sample is poured into the cylinder from a height of 50 mm, with the top level of material poured approximately 15 mm to the top edge of the cylinder. The plunger is then inserted in such a way as to hold the plunger level with the top edge of the crushed stone sample cylinder.

3. Increase the clamping force by 1-2 kN/s (100-200 KGF) and test it on a 75 mm diameter cylinder to 50 kN (5000 KGF) on a 150 mm diameter cylinder, while transferring it to 200 kN(20,000 KGF).

4. After compression, the test sample is removed from the cylinder and weighed. Then, depending on the size of the test fraction, it is sieved through a sieve with holes as follows:

1.25 mil – for crushed stone(gravel) with fraction from 5 to 10 mil

2.5 mil – for crushed stone(gravel) with fraction from 10 to 20 mil

5.0 mil – for crushed stone(gravel) with fraction from 20 to 40 mil

5. The samples remaining on the sieve are weighed.

**Processing of test results**

Crushability of crushed stone samples  $\Delta_p$  is determined in % by the following formula.

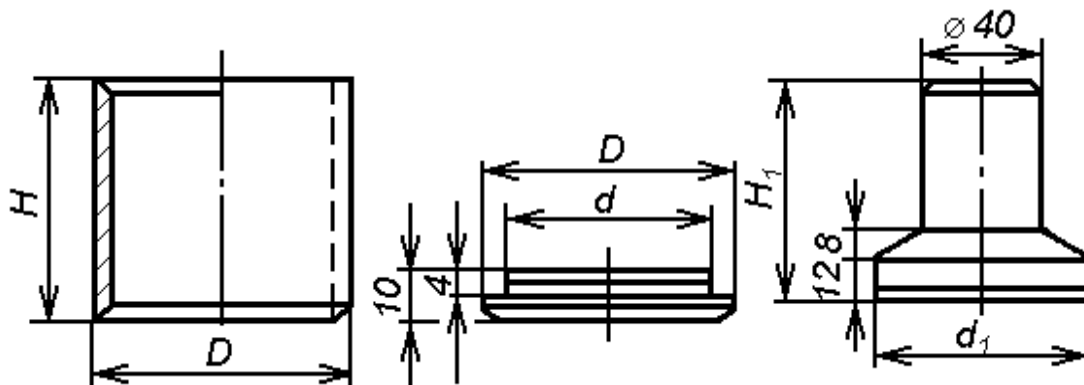
$$\Delta_p = \frac{m - m_1}{m} 100$$

Where:

$m_1$ - weight of the sample on the sieve, g,

$m$ - weight of the sample, g

The result is the arithmetic mean of two parallel tests.



<i>D</i>	<i>d</i>	<i>d</i> <sub>1</sub>	<i>H</i>	<i>H</i> <sub>1</sub>
87	75	73	75	70
170	150	148	150	120

**Figure 1: Steel cylinder with removable bottom (in millimetre(mil)).**

Laboratory work is performed in accordance with the requirements of GOST 8269.0-97 [4].

$$\Delta_P = \frac{m-m_1}{m} 100\% = \Delta_P = \frac{2546,5-2083,9}{2546,5} 100\% = 18,17\%$$

$$\Delta_P = \frac{m-m_1}{m} 100\% = \Delta_P = \frac{2472,9-2041,4}{2472,9} 100\% = 17,45\%$$

$$\Delta_{P \text{ срн}} = \frac{18,17+17,45}{2} = 17,81\%$$

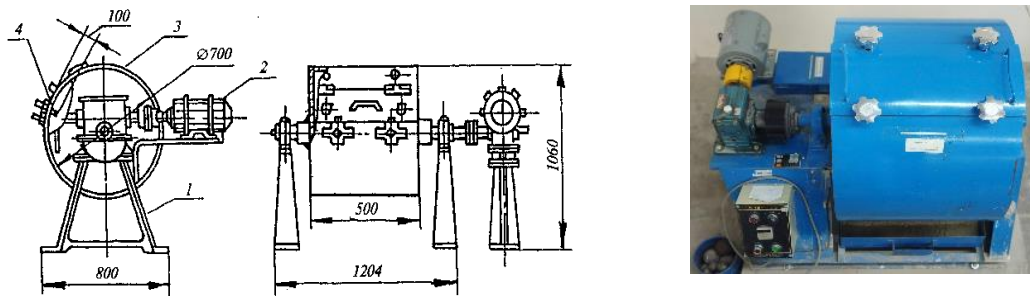


**Figure 2: Crushed stone screening situation**

The test is conducted twice and the crushability index of crushed stone (gravel) is determined as the arithmetic mean of the results obtained as a result of two tests. According to the requirements of the international standard GOST 8267-93 (tables 3, 4 and 5) crushed stone (gravel) is divided into grades [5, 6]. These requirements are reflected in the tables.

**Determination of abrasion resistance in a shelf drum**

Irritability (wear) of crushed stone (gravel) is determined by the loss of mass of grains when testing a sample in a shelf drum with balls.



**Figure 3. Shelf drum.**

Fracturability of crushed stone  $I$ , %, is determined by the formula.

$$I = \frac{m - m_1}{m} 100$$

where  $m$  - mass of crushed stone (gravel) sample, g.

$m_1$  - total mass of residues on the sieve with holes of 5 mm diameter and the control sieve, g.

$$I = \frac{m - m_1}{m} 100\% = I = \frac{5000 - 3328}{5000} 100\% = 33,44\%$$

$$I = \frac{m - m_1}{m} 100\% = I = \frac{5000 - 3311}{5000} 100\% = 33,78\%$$

$$I_{cpH} = \frac{33,44 + 33,78}{2} = 33,61\%$$

## RESULTS

The tests were carried out in laboratory conditions based on the above-mentioned methods and the test results were as follows. The tests carried out in laboratory conditions were mainly carried out on crushed stone of fraction 10-20.

**Table 1**

Name of the test performed.	Execution status			
	Dry		It's saturated with water	
Crushability grade	17,81%	600	19%	600

**Table 2**

Crushability grade of crushed stone from sedimentary and metamorphic rocks	Loss of weight at testing of crushed stone, %	
	dry	water saturated
1200	Up to 11 inclusive.	Up to and including 11
1000	>11>13	>11>13
800	>13>15	>13>15
600	>15>19	>15>20
400	>19>24	>20>28
300	>24>28	>28>38
200	>28>35	>38>54

**Table 3**

Name of the test performed	Weight loss during testing %			
	crushed stone		gravel	
Abrasion grade of crushed stone and gravel	33,61	$I_2$	-	-

*Table 4*

Abrasion grade of crushed stone and gravel	Weight loss during testing, %	
	crushed stone	gravel
И1	Up to 25 inclusive.	Up to 20 inclusive.
И2	>25>35	>20>30
И3	>35>45	>30>40
И4	>45>60	>40>40

### CONCLUSIONS

Summarizing the results of the test, as a result of "Study of physical and mechanical properties of granite crushed stone materials mined in the quarry AKCHA Angren district of Tashkent region" we tested these crushed stones with 10-20 fractions, Crushability grade 600, Abrasion grade И2. We will be able to use these materials directly in road pavement construction in the following places without further processing. If we use it in the covering part of highways, that is, in the preparation of asphalt concrete mixtures, if you look at Table 10 of GOST 9128-2013, when using igneous and metamorphic rocks: they can be used in hot asphalt concrete mixtures grade III, in cold asphalt concrete mixtures grade II.

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