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WATER ABSORPTION CAPACITY OF IRIND MINE PUMICE

Water absorption capacity of Irind mine pumice depending on the particle size and absorption time is presented in the paper. Irind pumice is an aluminosilicate rock, with well-developed porosity, mechanical strength, high buoyancy, chemically inert, eco-friendly and exhibits sufficient water absorption capacities. The examination of the pumice by X-ray diffractometry has shown that it is a volcanic rock and is composed of cristobalite and coesite. The following particle sizes were selected for the study: 1.5… 2.0 mm, 2.5 ... 5.0 mm. Water absorption capacity of pumice was determined depending on the absorption period. The maximum water absorption was observed for particle sizes ranging from 2.5 to 5.0 mm.

Keywords: *absorbent, pumice, water absorption, particle sizes, porosity.*

Introduction

Water pollution is becoming a major concern, because of the increasing numbers and concentrations of persistent and toxic anthropogenic pollutants in water resources. Many recent studies have considered new absorbents to remove these emerging contaminants from water resources.

There are number of water purification methods, but the adsorption is the simplest and effective. The development of low-cost absorbents has led to the rapid growth of research interests in this field. Many absorbents based on natural and waste materials and requiring minimal processing have been proposed. In this article solid absorbents such as Irind pumice has been discussed. Pumice is a type of extrusive volcanic rock, produced when lava with a very high content of water and gases is discharged from a volcano. As the gas bubbles escape, the lava becomes frothy. When this lava cools and hardens, the result is a very light rock material filled with tiny bubbles of gas. Commonly it is light-colored, indicating that it is a volcanic rock high in silica content.

The Republic of Armenia takes a lead in the world with abundance and diversity of non-metallic minerals. Nearly all types of mineral rocks well known all over the world exist in the territory of the country. Mountainous rocks formed as a result of volcanic processes in the territory of Armenia are of special value and significance, the most important of which are light rocks (tuffs, perlite, pumice-stone, zeolite, scoria, etc.). In this article the properties of Irind mine pumice is considered (Fig. 1).

a) b)

Fig. 1. *Sizes of Irind mine pumice grains. a) 1.5 to 2.0 mm, b) 2.5 to 5.0 mm*

Irind is located in Talin region. It is 46 *km* away from the regional center. There are perlite and pumice resources in the village, which are of industrial importance. In the Republic of Armenia pumices according to their physical-mechanical characteristics are divided into two types: Ani type and lithoid pumices.

The Irind mine pumice is one of the Ani type varieties. Ani-type pumice is mainly composed of glass non-crystalline (amorphous) particles: plagioclase, pyroxene and mineral crystals, pieces of old lava. The color is yellowish, somewhere yellow-brown, pink-yellow, the porosity is 35…44%. It has quite high thermal insulation properties. The bulk density of the pumice is 0.3…0.6 g/cm^3 [1,2].

Chemical composition of Irind pumice is presented in Table 1 [1].

Table 1. Chemical composition of Irind pumice, %

Region	SiO_2	MgO	TiO_2	Fe_2O_3	$K_2O + Na_2O$	Al_2O_3	SO_3	CaO	loss on Ignition
Irind mine pumice	61.54	1.13	0.43…1.00	3.99…4.99	8.18	16.58…17.49	-	3.78… 4.20	2.37

In Table 2 physical and mechanical properties of Irind mine pumice is presented.

Table 2. Physical and mechanical properties of Irind mine pumice

N	Bulk density, *g/cm^3*	Specific weight, *g/m^3*	Porosity, %	Tensile strength, *kg/cm^2*
Irind mine pumice	382…749	2.43…2.46	69.3…84.3	14…19

The examination of the pumice by X-ray diffractometry have shown that it is a volcanic rock and is composed of cristobalite and coesite (Fig. 2).

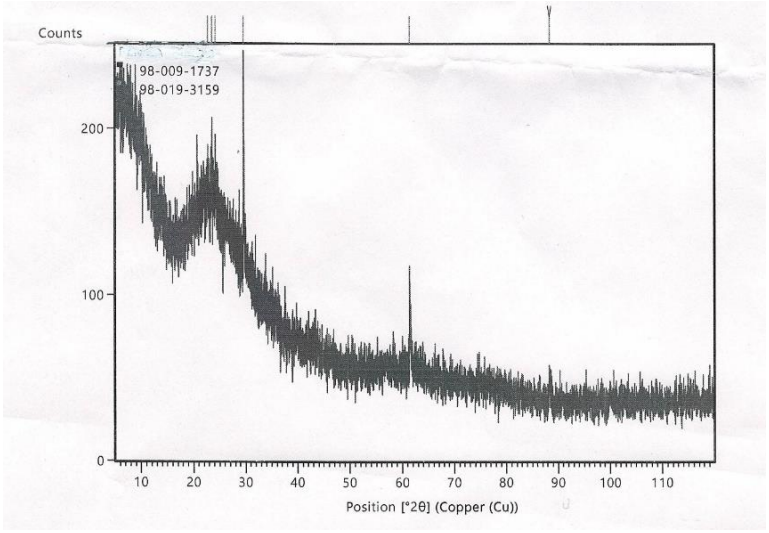

Fig. 2. *X-ray diffraction analysis*

Coesite and cristobalite are high-pressure polymorph (crystal form) of silica, silicon dioxide (SiO_2). They have the same composition but possess a different crystal structure.

In Table 3 the crystal structure of pumice is presented.

Table 3. Identified Patterns List

Visible	Ref. code	Score	Compound name	Displ. [°2θ]	Scale fac.	Chem. formula
*	98…009-1737	20	Cristobalite	0.222	0.498	SiO_2
*	98…019-3159	26	Coesite	- 0.217	0.630	SiO_2

The presented data show that Irind mine pumice is an aluminosilicate rock, with well-developed porosity, mechanical strength, high buoyancy, chemically inert and eco-friendly. Due to the above mentioned properties, the Irind pumice can be used as an oil absorbent, therefore it must exhibit certain water - and oil absorption capacities [3].

In this article the water absorption capacity of pumice is observed. Particles with sizes 1.5… 2.0 *mm* and 2.5…5.0 *mm* were selected for the study. In the beaker filling with 50 *ml* of the absorbate (oil and water) were put about 2 grams of the absorbents. The sorption process was calculated after 1, 2, 3, 5, 8, 10, 15, 20, 30, 60, 90, 120 *minutes* of the sorption time [3] and the absorbed amount of water was detected. The maximum water absorption was detected by particles with sizes ranging from 2.5 to 5.0 *mm*. The obtained water absorption values clearly suggest that the pores can be saturated with water under standard barometric pressure [4]*.

Fig. 3 shows the water absorption capacities of two different particles.

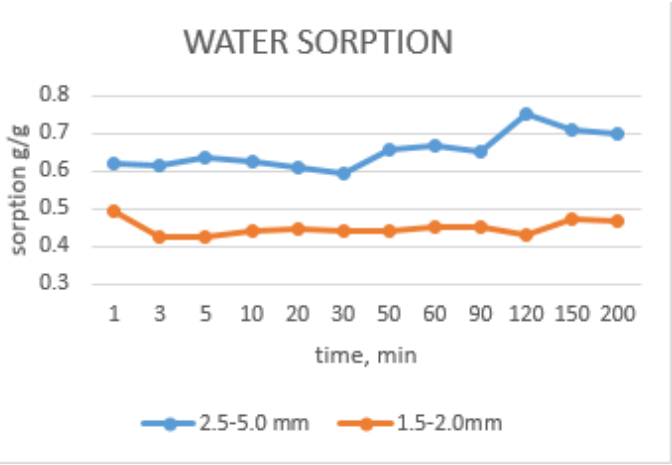

Fig. 3. *Water absorption capacity of 1.5…2.0 mm and 2.5…5.0 mm particles*

Conclusion

Studies have shown that the pumice has improved porosity and exhibits sufficient water absorption capacities. The results of the experimental runs for the adsorption of water on Irind pumice of two particle sizes are thus presented. The amount adsorbed on 2.5 … 5.0 *mm* particles was the highest, followed by 1.5…2.0 *mm* particles.

Water absorption has been studied for 2 *hours*. It can be seen from the graph that the maximum water absorption capacity is observed for 2.5…5.0 *mm* particles, which is 0.75 *g/g* after 2 *hours*. It is planned to carry out sorbent oil absorption capacities and sorbent surface modification in order to decrease water sorption and increase oil sorption capacities.

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* GOST 8269.0-97 Crushed stone and gravel made from dense rocks and industrial waste products for construction works. Methods of physical and mechanical tests.

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