



To Produce an Effective Composition of Vermiculite Plita and to Study the Coefficient of Thermal Conductivity

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Abstract: This paper discusses the development of an effective composition of extra-light concretes based on foamed vermiculite and its thermal conductivity coefficient.

Keywords: Foamed vermiculite, thermal conductivity coefficient, thermal conductivity resistance, foaming coefficient, pressing, drying.

Introduction: the issues of rational use of resources, saving energy and energy are becoming increasingly important in the modern world. Saving the resources of building materials, increasing the efficiency of thermal protection of buildings and structures, industrial facilities, the introduction of energy-saving technologies and materials are the priority directions of development of the Russian and world economy.

At a time when the need for thermal insulation materials is increasing year by year, the production of high-efficiency composite materials based on local raw materials can be one of the solutions to this problem. One type of these materials is this multicolored vermiculite.

In Uzbekistan there is a deposit "Tebinbulak", which is located on the territory of the Republic of Karakalpakstan, Karaozak District of vermiculite. The reserve of the identified vermiculite ore reserve is 3 944 thousand tons. In the case of January 1, 2021, the right to use the vermiculite field "Tebinbulak" was legalized 6 units and licenses belonging to 3 local entrepreneurs for geological exploration works. According to calculations, the concentration of vermiculite can be obtained 592 thousand tons (3 million 944 thousand tons or 15 percent) from the existing reserve identified [1].

Heat-retaining plates on the basis of non-flammable multilayer vermiculite are a highly effective fire-resistant building material, which is produced on the basis of natural mineral raw materials.

After the independence of our country, radical changes are carried out in all spheres of society, in particular in accordance with the decree of the president of the Republic of Uzbekistan "On measures for the radical improvement and development of the building materials industry" № PP-4198 dated 20.02.2019 and "On additional measures to promote the production of energy-efficient and modern building materials" special attention is paid. [10].

The identified stock of vermiculite raw materials around the world is estimated to reach 100 million dollars. It is estimated that more than a ton, according to calculations, geological exploration reserves amounted to 200 million US dollars. It weighs more than a ton. The countries of South Africa, the USA, Russia, Uganda and China have large reserves on vermiculite. Also, vermiculite



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reserves are available in Argentina, Australia, Canada, Brazil, Egypt, India, Japan, Kenya, Zimbabwe, Kazakhstan and Uzbekistan.

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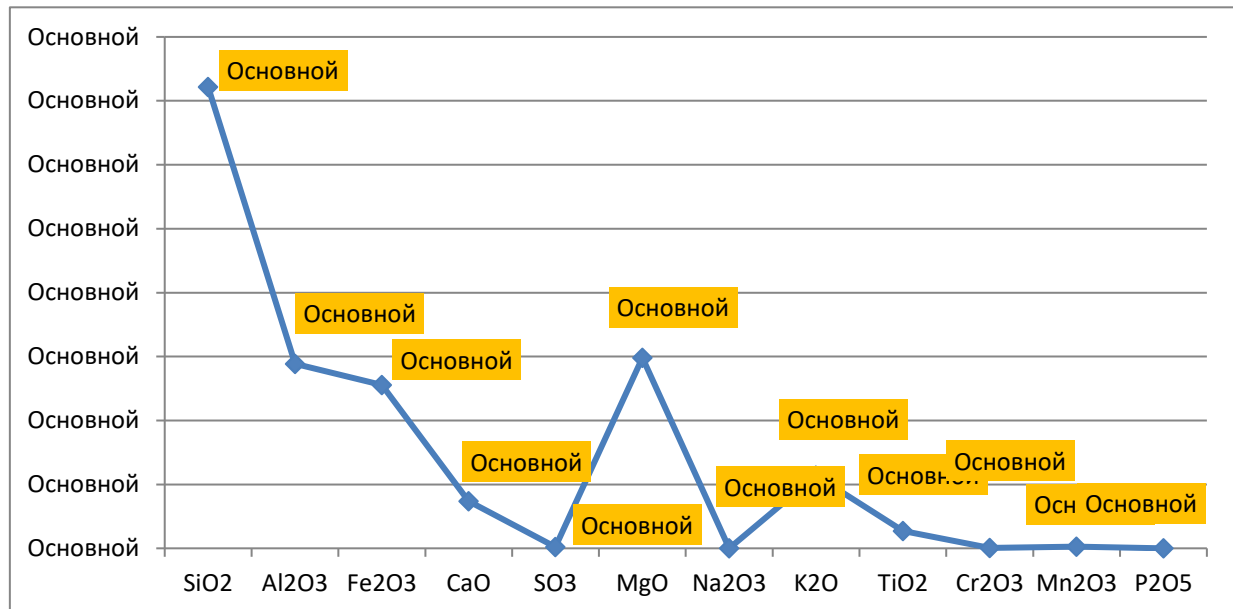
Applied Materials and methods: experimental and testing works were carried out using the vermiculite ore extracted by industrial method from the excavation site allocated on the basis of license in accordance with the established procedure of “TRIUMF-GORNYAK” OAJ from the Tebinbulak vermiculite field in the Republic of Karakalpakstan. [3].

Experimental and testing works were carried out using the vermiculite ore extracted by industrial method from the excavation site allocated on the basis of license in accordance with the procedure established in “TRIUMF-GORNYAK” OAJ from the Tebinbulak vermiculite field in the Republic of Karakalpakstan. The chemical composition of the vermiculite sample, which was used as a raw material in the test works, is presented in Table 1.

Chemical composition of vermiculite concentrate

Table 1

№	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	Ca O	Mg O	SO ₃	Na ₂ O	K ₂ O	TiO ₂	Cr ₂ O ₃	Mn ₂ O ₃	P ₂ O ₅	П.П. П.
1.	36,08	14,43	12,77	3,69	14,90	0,11	0,00	5,69	1,35	0,0287	0,1404	0,00	4,75



1-picture. Chemical composition of vermiculite concentrate.

According to the size of the grains of multicolored vermiculite is divided into 2 fractions: finely – from 0,15-0,25 to 3mm, and large – from 5 to 6-8mm. Multiplicated vermiculite by volume weight is divided into the following brands: 100, 150, 200, 250 and 300. The grains of the multivariate vermiculite have a large deformability: they are slightly compressed, as a result of which the vermiculite becomes dense. Accordingly, the multilayer vermiculite is in a calm state, as a rule, does not sink in heat-insulating construction structures. [2, 4].

The fine and large-fractured vermiculite ore obtained from the tebinbulak vermiculite deposit was crushed in a conveyor oven in an accelerated mode at a temperature of 870-900 °C (the action speed of the hook of the conveyor belt is 10-20 m/s). The process of dehydration of vermiculite ore when heated can be divided into 3 Stages: 1-stage 200 °C – hygroscopic moisture is lost, that is, it dries in essence; 2-stage 200-275 °C package at the border characteristic of water loss, which is associated with strong swelling; 3-th stage 700-900 °C at the border - the water of the Constitution disappears, which leads to a further increase in the volume of vermiculite grains [2, 5].

Weight of vermiculite by volume and consistency of grains depends on the conditions of its cooking and cooling: when vermiculite is heated to 800-950 °C, the consistency of grains decreases. Multicolored vermiculite is a heat-insulating material, characterized by its high porosity, lightness and to some extent temperature resistance. Experimental-test works were conducted on GOST 7076-99 [7].

Materials and equipment for laboratory work “Heat-retaining coefficient of thermal conductivity of building materials” determination of laboratory work is carried out using the equipment available in the laboratory:

- experience-extremely light concrete samples for testing;
- which determines the coefficient of thermal conductivity (Russian machine XND-2-30303C);



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- shtangentsirkul flip-25 250;
- metal lineplate MS;
- electronic scales CZ-3.

Results of experimental work: Thermal conductivity. If one surface of the material is hot and the other surface is cold, a hot current begins to pass through it. The thermal conductivity coefficient λ represents whether the materials transmit heat more or less [4]. The heat transfer coefficient is expressed by the amount of heat transferred from one surface to another surface of a sample with a thickness of 1 m and a surface area of 1 m², with a temperature difference (t_1-t_2) 1°C Therefore, the amount of heat passing through the wall in τ hours is determined by the following.

$$Q=\lambda \cdot [S \cdot (t_1-t_2) \cdot \tau] / a$$

The technological parameters of experimental plates with multilayer vermiculite are presented in Table 2.

No	Technological parameters	Unit of measurement	Indicator
1.	Gabarite dimensions in the pressing of experimental plates: Height Width Thickness	mm	1200 2400 20
2.	Pressing method		In a semi-dry, one-stage cold method
3.	Pressure on pressing (1 бар =1,02 tn)	tn	132,5 (130 bar)
4.	Duration of holding under pressure when pressing	minut	1
5.	Drying method	Camera	electric dryer
6.	Drying temperature	°C	150
7.	Drying duration	Hour	10

For the preparation of test samples of fire-resistant, heat-insulating and sound-insulating plates based on expanded vermiculite, samples of plates measuring 1200x2400x20 mm were prepared by semi-dry pressing (cold) pressing. Pressing was performed in a 400 tn hydraulic press in one-step pressing mode at a pressure of 130 bar (132.5 tn) with a technological mode of holding for 3 minutes. [8,12].



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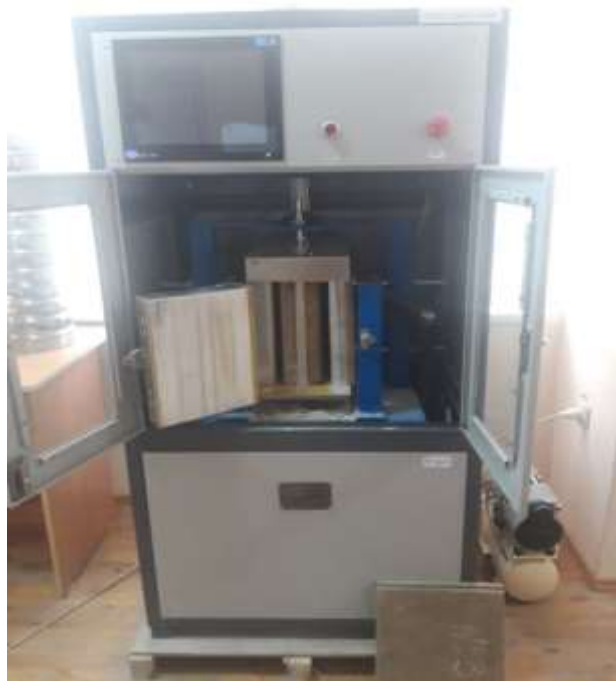
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2-picture. Vermiculite plate made on the basis of multiplied vermiculite prepared on the basis of experimental works .



3-picture. Determination of heat transfer coefficient of vermiculite plate obtained on the basis of multiplied vermiculite (on XND-2-3030C machine).



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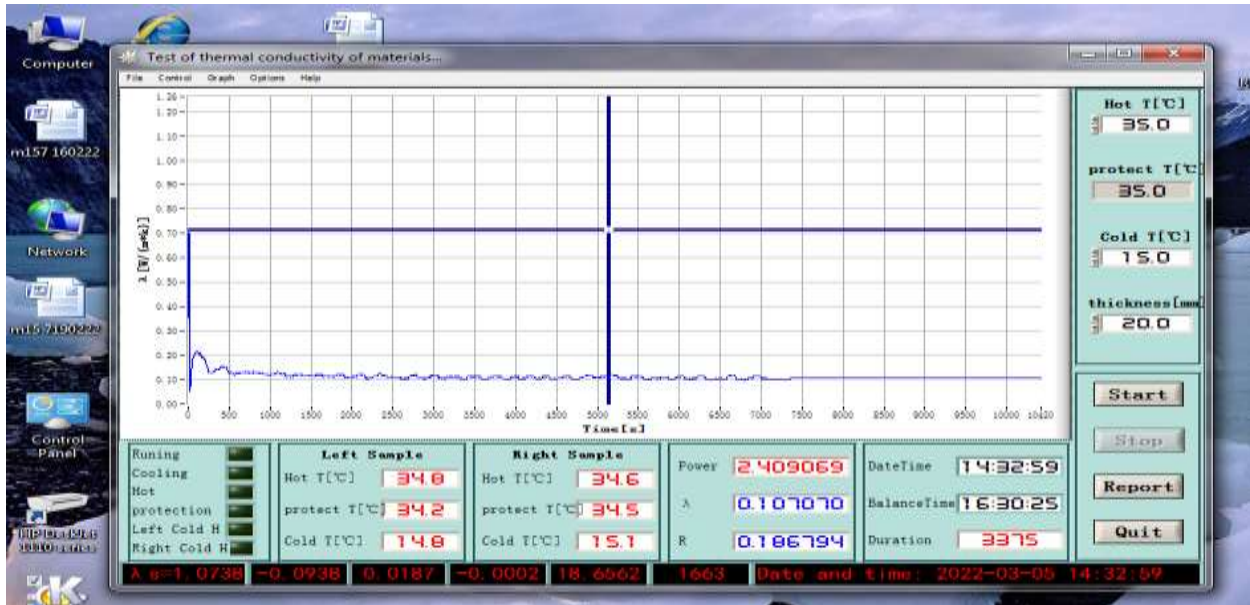
As the temperature rises, the λ of most materials increases, but those of some materials (metals, magnesite refractories) decreases. The heat transfer coefficient and heat transfer resistance are given in Table 3.

Table 3.

No	Sample dimensions, (mm)	Heat transfer coefficient λ , W/m ² *°C	Heat conduction resistance R, m ² *K/W
1	300x300x20	0.102167	0.195758
2	300x300x20	0.107070	0.186797
3	300x300x20	0.112875	0.177187
4	300x300x20	0.112518	0.177750



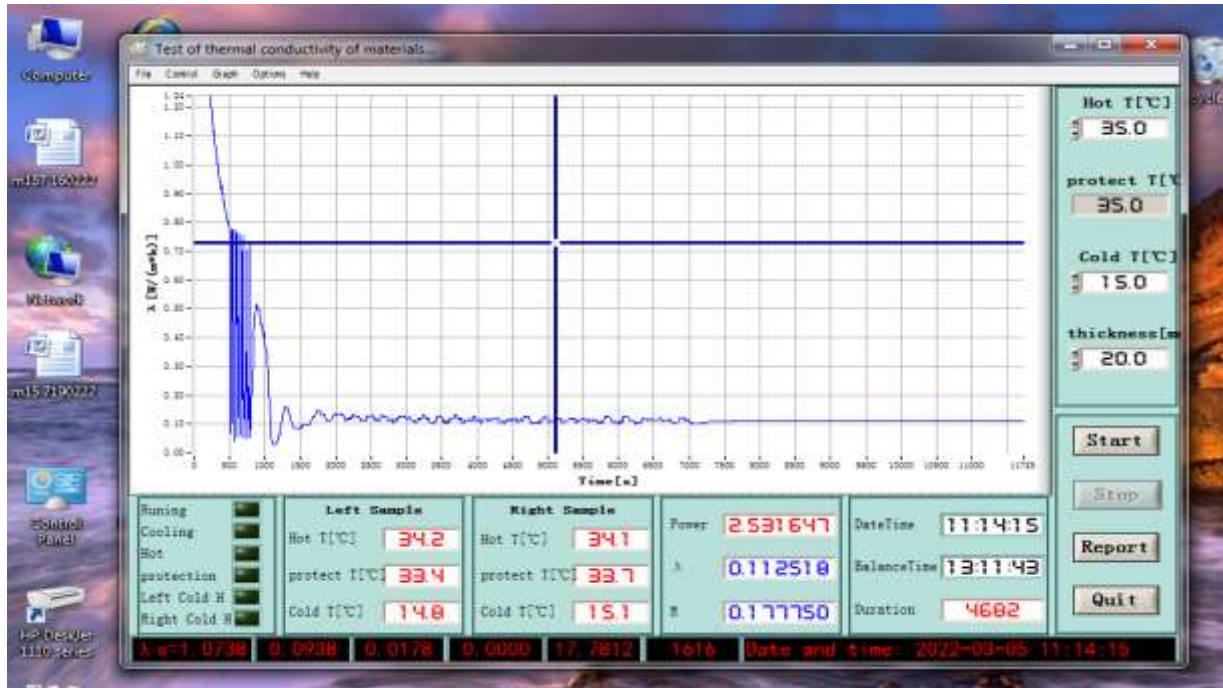
4-picture. Determination of heat transfer coefficient of vermiculite plate obtained on the basis of multiplied vermiculite (on XND-2-3030C machine).



5-picture. Determination of heat transfer coefficient of vermiculite plate obtained on the basis of multiplied vermiculite (on XND-2-3030C machine).



6-picture. Determination of heat transfer coefficient of vermiculite plate obtained on the basis of multiplied vermiculite (on XND-2-3030C machine).



7-picture. Determination of heat transfer coefficient of vermiculite plate obtained on the basis of multiplied vermiculite (on XND-2-3030C machine).

The vermiculite sheet production line allows movement through the initial components and binder, mixer, distributors for batch production of components and binder, forming block, pressing, drying chamber, re-edge trimming device, and the finished product is produced.

Conclusion: The conducted scientific research shows that it is possible to recommend the appearance and durability of the sample vermiculite plates obtained as a result of the experiments, to be tested on the production conveyor line of this composition in the industrial-class size. The thermal conductivity coefficient of the vermiculite plate obtained as a result of the experiments is between $\lambda = 0.10 \text{ W/m}^{\circ}\text{C}$ to $\lambda = 0.11 \text{ W/m}^{\circ}\text{C}$, heat conduction resistance $R = 0.17 \text{ m}^2\text{K/W}$ and $R = 0.19 \text{ m}^2\text{K/W}$ gave a result in the range. Experimental samples were tested in laboratory conditions for their physical, mechanical and technical parameters in accordance with the requirements specified in the current normative documents.

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