THERMAL CONDUCTIVITY OF CERAMSITE CONCRETE WITH A COMPLEX CHEMICAL ADDITIVE KJ-3

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ABSTRACT

The article examines the properties of energy saving and strength when studying the thermophysical properties of expanded clay concrete based on the complex chemical additive KDj-3.

Key words: Cement binder, lightweight concrete, fine and coarse aggregate, complex chemical additive, energy saving, strength, thermal conductivity.

INTRODUCTION

In recent years, the construction of energy-efficient houses has been expanding, where walls are erected from low-heat-conducting materials. In the conditions of our republic, it is effective to use lightweight concrete on expanded clay aggregate as a wall material for such houses. In the republic, the resumption and development of factories for the production of expanded clay concrete, and their activities will be useful for the development of housing construction to create energy-efficient houses.

The main qualities of expanded clay, which determine its use in the construction of energy-efficient houses, are low average density and low thermal conductivity. In practice, these properties must be ensured by the high structural quality of expanded clay concrete products, which is important for the construction of earthquake-resistant and durable buildings. Expanded clay concrete with high structural quality and low thermal conductivity can be most easily obtained from the technological point of view by using effective complex chemical additives in the composition of cement, which can not only expand the porous structure of the cement stone, but also strengthen this structure.

MATERIAL AND METHODS

It is well known that an increase in the porosity of a material leads to a decrease in its thermal conductivity and an increase in its heat-shielding properties. This is due to the fact that in the pores of the material there is air, a low-heat-conducting gas, and not liquid and solid substances. So, the specific thermal conductivity for air is only 0.026 W/(m K), while for water it is 0.559 W/(m K) [1]. This explains the fact that with an increase in the moisture content of the material, its thermal conductivity increases.

RESULTS AND DISCUSSION

In the previous sections of the work, the compositions of expanded clay concrete with a complex chemical additive KJ-3 were investigated. According to the experimentally obtained values of the average density and strength of expanded clay concrete after 28 days of hardening of the samples under natural conditions, the values of its Kcc and specific thermal conductivity were calculated.

The thermal conductivity of a material, other things being equal, depends on its average density, based on this, empirical equations are recommended for calculating the coefficient of thermal conductivity of lightweight concrete [2]: for dry concrete, the formula of BN Kaufman is used

$\lambda = 0.0935 (\gamma) 0.5\ 2.28\gamma +0.025$, (1)

and for wet lightweight concrete, use the formula of V.P. Nekrasov

$\lambda = 1.16 (0.0196 +0.22\ \gamma 2) 0.5 - 0.16$, (2)

λ - coefficient of thermal conductivity of lightweight concrete, W / (m · K); γ is the density of lightweight concrete (t / m3) under appropriate conditions. Since the used expanded clay concrete products during the operation of residential buildings have air-dry humidity, i.e. natural humidity, then formula (2) was used to calculate the value of λ.

Calculations were carried out for expanded clay concrete of different compositions. Table 1 shows the values of Kкк and λ of expanded clay concrete at a constant consumption of cement and different amounts of other components of its composition.

Table 1.

The composition of expanded clay concrete and the coefficient of its thermal conductivity

Lightweight concrete composition, kg / m^3				Additive SJ-1, %	*К кк, MPa* (kg/m^3)	λ, Wt/(m·K)
Cement	**Sand**	**Expanded clay**	**Water**			
322	456	373	200	-	0,0125	0.1850
			172	0.6	0,0183	0.1764
			160	1.0	0,0209	0.1630
			150	2.0	0,0189	0.1707

In compositions with a complex chemical additive, an increase in the value of CCC and a decrease in specific thermal conductivity occur. There is a certain relationship between the consumption of sand and the thermal conductivity of expanded clay concrete, the value of λ for compositions with a large specific consumption of sand is higher than with smaller amounts. This is due to the increase in the proportion of the solid component of the structure of the cement stone in the specific volume of concrete.

Figures 1 and 2 clearly show the data of column 7 depending on the data in column 5 of Table 1. This dependence also shows a decrease in the value of the thermal conductivity coefficient of expanded clay concrete with an increase in the consumption of the complex chemical additive KJ-3 in the composition of cement.

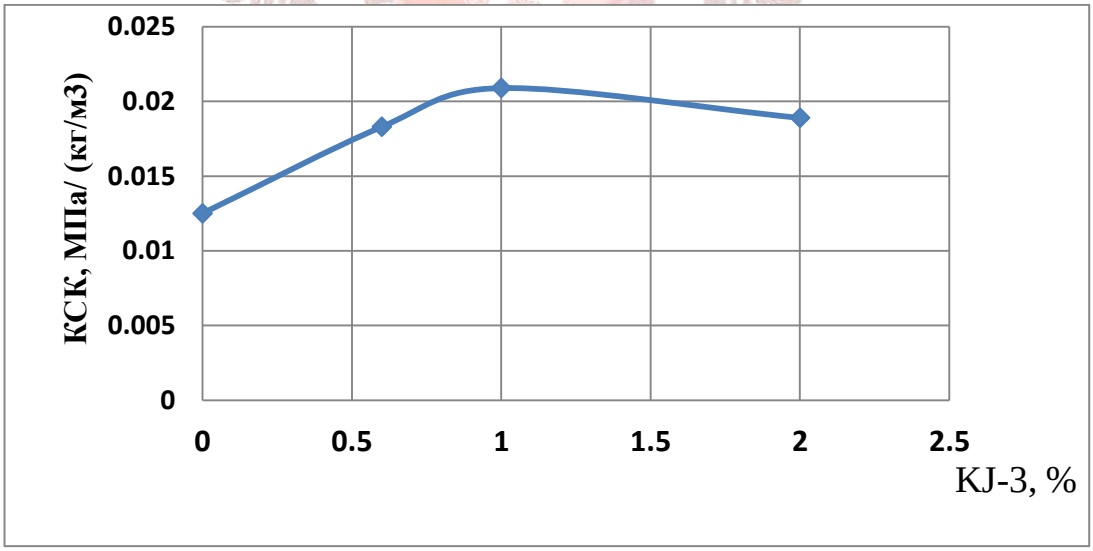

Figure 1. Influence of the addition of KJ-3 on the structure quality factor (KKK) of lightweight concrete.

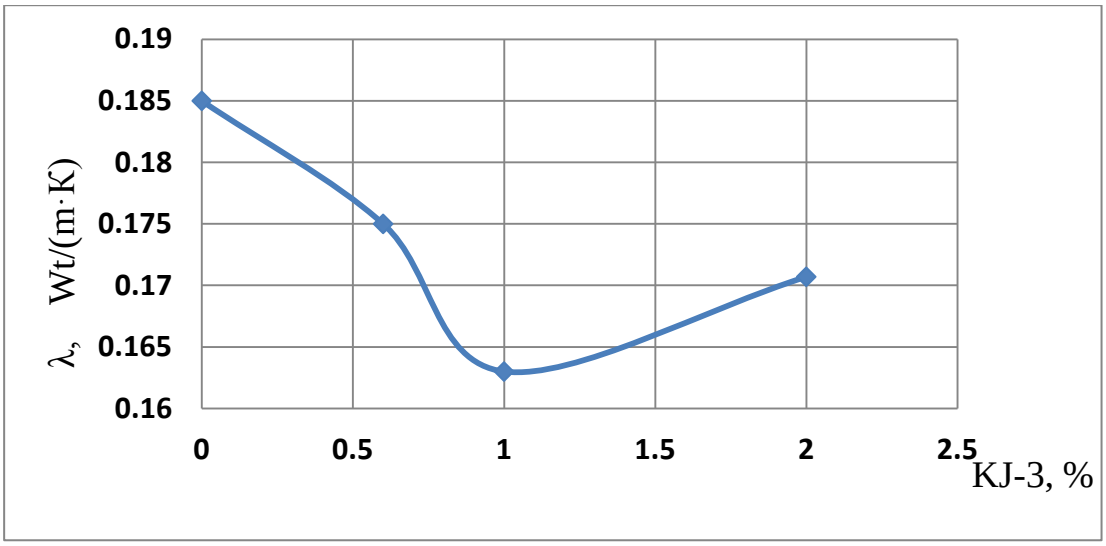

Figure 2. Influence of KJ-3 additive on thermal conductivity (λ) of expanded clay concrete.

As a conclusion, we can say that expanded clay concrete with high structural quality and low thermal conductivity can be most easily obtained from the technological point of view by using effective complex chemical additives in the composition of cement. And also, the thermal conductivity of expanded clay concrete, other things being equal, depends on its average density.

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