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Heat-Insulating Dry Mixes with Using of Diatomite

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Abstract

The results of evaluation of heat and humidity regime enclosing structure in the presence of heat-insulating finishing layer

Keywords: insulating layer, the temperature distribution, offset isotherms

Introduction

A trend toward a higher cost of fuel and energy resources leads to a need to improve the thermal protection of buildings. The use of thermal insulation materials can reduce heat loss to the environment. One way to improve the thermal protection of buildings is operated by additional external insulation of building envelopes through the use of thermal insulation finishing lay.

Results of the study

We have developed compositions of the heat-insulating dry building mixes (DBM) on the basis of diatomite, intended for decoration of building products and designs. When designing of a finish composition, a diatomite (modified by the silicic acid sol) was used as a filler of the dry blend [1, 2, 3].
By results of the researches, a recipe of a dry mix was chosen, containing hydrated lime, diatomite, modified silicic acid sol, sursky quartz sand of fractions

0,63-0,315mm and 0,315-0,14mm. The results of the conducted researches have confirmed operational stability of coverings on the basis of limy DBM with application of diatomite.

Table 1 shows the properties of the coverings on the basis of the proposed DBM.

Table 1
Technological and operational properties of the finishing structure

Indicator	Value
The adhesion strength, R_a, MPa	0,4…0,8
Viability, hour - when stored in open containers - when stored in closed containers	 8…10 40…48
Drying time at 20^0C to a degree of "5", minutes	No more 60
Water-holding capacity, %	95-96
The recommended thickness of a single layer, mm	до 5
Consumption of finishing structure when applied in one layer with a thickness of 0.5 mm, kg / m^2	0,4…0,6
Consumption of finishing structure when applied in one layer with a thickness of 10 mm, kg / m^2	0,8…1,2
The ability to apply	good
Cracks due to shrinkage	no
Frost resistance, cycles	35
Water resistance, the coefficient of softening	0,6
Shrink deformation, mm/m	0,35

For an estimation of influence of a plaster layer on the basis of developed DBM on change of the thermal and humidity mode of protecting designs of buildings, a thermal calculation of the wall was done. The wall constructive decision is resulted on fig. 1. As external climatic parameters for calculations – parameters of three cities, located in different climatic conditions (by the climatic zone maps according to SNIP 23-01), were chosen: Moscow, Yakutsk, Penza [4].
As a thermal insulation layer in work are accepted:

- Slabs from foam glass with density of ρ=260kg / m^3 and thermal conductivity of 0.098 W / (m • C);
- Slabs from polystyrene foam with density of ρ =100 kg / m^3 and thermal conductivity of 0.041 W / (m • C);
- Slabs from glass staple with fiber synthetic binding density of ρ= 60kg / m^3 and thermal conductivity of 0,06Vt / (m • C).

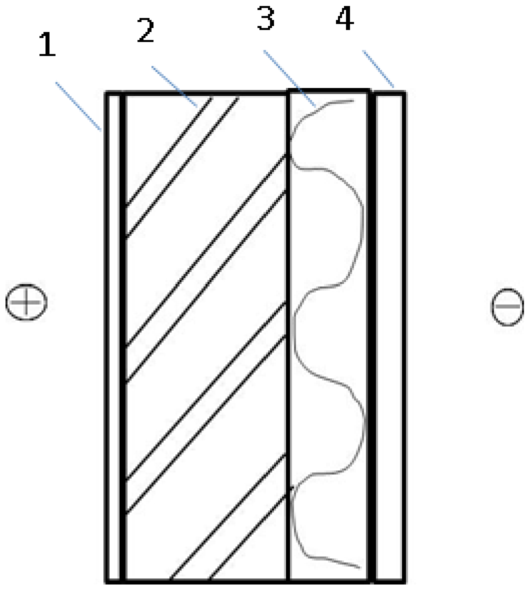

Fig. 1. The constructive solution of the wall

1 - bricklaying from a continuous brick silicate (GOST 379) on the cement-sandy solution, ρ=1800kg/m^3;
2 - heater;
3 - multilayered plaster;
4 - plaster.

Three variants of furnish were considered at calculations:
1 - internal and external surfaces of the wall design are trimmed with the cement-sandy solution with density of ρ=1800kg/m^3;
2-internal surface of the design is trimmed with the cement-sandy solution with density ρ=1800kg/m^3, the external surface of the wall design is trimmed with plaster on a basis of the limy-diatomite structure with density of ρ= 840 kg / m^3;
3 - internal and external surfaces of a design are trimmed with plaster on a basis of the limy-diatomite structure with density of ρ=840 kg / m^3.

At calculations as an outside air temperature was taken an average temperature in January as well as a temperature of the coldest five-day period with probability of 0.92.

The results of the calculations show that for the conditions, for example, of Penza for all types of heaters and plastering the outer and inner surface of the wall of cement-sandy, mortar density ρ is 1800kg/m^3, condensation may form in the thickness of the insulation. In the application of the proposed limy-diatomite plaster, the humidity condensation is missing. It was found that when used as a limy plaster the developed diatomite composition, a shift of the zero isotherm at lower temperatures is observed [5]. Table 2 shows the values of the boundaries of the zero isotherm in the insulating layer for the conditions of Penza according to the coldest five-day period and the average temperature in January.

Table 2
The position of the zero isotherm in the cross-sectional structure for the conditions of Penza

Variants of furnish	Distance from border of a heater to a zero isotherm, m	
	On the data of the coldest five-day period	According to the average temperature in January
Heat insulation of the slab from foam polystyrene		
1	0,012	0,042
2	0,015	0,045
3	0,016	0,049
Heat insulation of the slab from foam glass-ceramics		
1	0,060	0,118
2	0,061	0,125
3	0,065	0,127

It was established that during finishing of the construction (from the outside and inside) with the plaster on the basis of the developed lime-diatomite composition, a shift of the zero isotherm 4 -7 mm (heat insulation of the slab from foam polystyrene) and 5-9mm (heat insulation of the slab from foam glass-ceramics) is observed. It is observed that this shift moves in the direction of lower temperatures in comparison with the use of the plaster, based on the cement-sandy composition.

Conclusion

The displacement of the zero isotherm, at application of the proposed limy-diatomite composition, indicates that drying of the design will go more intensively. The proposed DBM was tested within approbation in LLC “Fakel Plus” in Penza. The project of the normative document, regulating the basic properties of coverings on the basis of DBM, has been developed.

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