

Characteristics of Materials that Increase the Heat Resistance of Walls

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Abstract:

In this article, in order to increase the energy efficiency of external walls, the results of theoretical thermophysical studies are presented to determine the average thermal conductivity coefficient and heat transfer resistance of a small block of foam concrete with through silk-like voids.

Keywords: *Energy efficiency, porosity, density, humidity, heat capacity, heat transfer resistance, sorption, vapor absorption.*

It is important to choose a thermal insulation material to increase the thermal protection of external barrier structures. To recommend a particular building material as an external barrier, you need to know its properties. Thermal conductivity of building materials; porosity and density; humidity, heat capacity; heat transfer resistance; sorption property; steam absorption. Building materials have different physical properties. Knowledge of these features is of great importance when performing engineering calculations of the heat and humidity conditions of external building envelopes. To accurately perform engineering calculations, it is necessary to correctly accept the thermophysical properties of the building materials that make up the external enclosing structures. This is far from the truth. The thermal properties of building materials depend on various conditions and environmental influences, so their implementation poses a number of difficulties.

- Most building materials consist of porous bodies.
- Porosity is the ratio of the volume of air space in a body (in %) to the volume of the body.

- -The density of building materials is defined as the mass of 1 m³ of material in kg. The unit of material density is kg/m³; this indicator should not be replaced by the specific gravity of the material.
- The specific gravity of a material is defined as the weight in kg of a non-porous body with a volume of 1 m³.
- The density of a material depends on its porosity. The density of gravel material depends not only on porosity, but also on its volume.
- For example, if the mass density of a brick made of sand and clay is 2600 kg/m³, then the volumetric weight of this brick is up to 1900 kg/m³. The density of bricks ranges from 600 kg/m³ to 1900 kg/m³.
- The thermal conductivity coefficient of building materials is directly proportional to the density of the material. The higher the density of the building material, the higher its heat transfer coefficient. In addition, the density of the material is used in a number of formulas and equations for engineering calculations of the thermal and moisture conditions of external barrier structures. Some artificial synthetic materials have a density of 20 kg/m³. Examples of such materials are polystyrene and expanded polystyrene. The specific gravity of inorganic materials is up to 2400-2800 kg/m³, and the density of organic materials is up to 1450-1560 kg/m³.
- If the specific gravity and density of a building material is known, its porosity is determined using the following formula:

$$P = \frac{q - \gamma}{q} \cdot 100,$$

Here; P – porosity, %; q - specific gravity, kg/m³; -density, kg/m³.

It is known that building materials and structures during operation have a certain moisture content and density. The density of the material in a dry state is given from the building codes and regulations. The density of the structure or material in it during operation is determined by the following formula:

$$\gamma_{\omega} = \gamma_{\kappa} \cdot \left(1 + \frac{\omega}{100}\right),$$

Here; - dry density of the material kg/m³;

ω - relative humidity of the building material during operation, %;

the greater the porosity of expanded polystyrene and mipore.

The porosity of silicate building material ranges from zero to 90%, and the porosity of polystyrene and mipora is up to 98%.

The body of building materials has a certain amount of chemically unbound (water) in its composition. Having a great influence on the heat transfer coefficient and heat capacity of the moisture of the material, external barrier structures are also large in size due to the moisture condition. There are two types of material moisture: the first is called relative humidity, and the second - volumetric humidity.

Relative humidity is the ratio of the mass of moisture in the body of a material to the mass of the material in a dry state. Relative humidity is measured in % and is determined by the following formula:

$$\omega_H = \frac{P_1 - P_2}{P_2} \cdot 100,$$

Here; P1 – mass of material before drying;

P2 – mass of material after drying;

ω n - relative humidity of the material, %.

Volumetric moisture is the ratio of the volume of moisture in the body of a material to the volume of the material. Volumetric humidity is determined using the following formula:

$$\omega_x = \frac{V_1}{V_2} \cdot 100,$$

ω x - relative humidity, %; V1 – volume of moisture in the material;

V2- is the volume of this material. The relative humidity of a building material with a high density is lower than the relative humidity of a material with a low density. In practice, relative humidity is used more often than absolute humidity because relative humidity is easier to determine than absolute humidity.

Conclusion.

Building materials have different physical properties. Knowledge of these features is of great importance when performing engineering calculations of the heat and humidity conditions of external building envelopes. To accurately perform engineering calculations, it is necessary to correctly assume the thermophysical properties of the building materials that make up the external barrier structures.

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