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Resource Center

Method for determination of heat conductivity coefficient of Bronya® liquid heat insulation

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Testing method

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Introduction

This method is applied for Bronya® liquid ceramic heat insulation intended for heat insulation of industrial equipment, pipelines, buildings and structures and allows to determine their effective heat conductivity at the average temperature of a sample between -40 and +40 °C.

1. General provisions

1.1 The essence of the method is in determination of heat conductivity coefficient by means of a continuous heat flux going through a flat sample with a certain thickness, directed perpendicularly to the face (larger) side of the sample, as well as in measurement of the temperature of the opposite face sides and thickness of the sample.

1.2 The number of samples necessary for determination of effective heat conductivity should be at least 3.

1.3 Temperature and relative humidity of the air in the room where measurements take place should be accordingly 20°C and (50 $\pm$ 10) %.

2. Measuring means

The following measuring means should be used for testing:

- climatic chamber for achievement of the temperature difference between 2 sections:
  - temperature difference between the chamber sections should be +30°C in the warm section and -20°C in the cold section;
  - dimensions of a chamber: 4600x2400x2000 mm (LxWxH), chamber wall thickness: at least 200 mm
  - material of a chamber wall: structure of sandwich panels, including at least 200 mm of heat insulation materials (polystyrene foam, fibrous materials etc.)
  - the chamber shield should have the same structure as the walls, but with a compulsory hole of 1500x1000 mm for placement of a sample for testing.
  - In order to exclude the effect of external factors on temperature measurement, Elcometer 319 should be installed on a support and adjusted to sensor's reach of the Bronya® surface. It excludes human influence on the temperature mode in the chamber.
  - Elcometer 319 is connected to a computer with a cable for recording.
- Elcometer 319, device for temperature measurement of the surface;
- destructive thickness gauge for measurement of thickness of paint materials;
- vernier caliper according to GOST 166;
- metal measuring scale according to GOST 427 with an upper range value of 1000 mm, with a permissible limit of variation from the nominal values of scale length and space between any stroke and the scale beginning or end of 0.2 mm;

3. Preparation for testing

3.1 A sample is made in a form of a rectangular parallelepiped, the larger (face) sides of which have a shape of a rectangle with sedges equal to the dimensions of a hole between the cold and warm sections. The sample is a gypsum plasterboard with a thickness of 10 mm with an applied Bronya® heat insulation coating with a thickness of 1-2 mm.

3.2 The sides of the sample which are in contact with the work surface should be flat and parallel. Variation of the face sides of the sample from parallelism should not be more than 0.5 mm.

3.3 The thickness of the parallelepiped sample is measured with a vernier caliper with an accuracy of at least 0.1 mm in four angles at a distance of (100.0 $\pm$ 5.0) mm from the angular vertex and at the middle of each side.

The sample thickness is considered as the arithmetic mean value of results of all the measurements.

3.4 Length and width of the sample are measured with a scale with an accuracy of 0.5 mm.

3.5 Bronya® liquid ceramic heat insulation is applied with a flat brush with a natural hair brush with a width of at least 75 mm.

3.6 Preparation of Bronya® liquid ceramic heat insulation is carried out according to the flowsheet of the manufacturer with the following remarks:

- Heat insulation is stirred by hand without mechanical mixers;
- Coating is applied without adding water;
- Coating is applied with a thickness up to 300 micron per 1 layer;
- Period for drying between layers is at least 24 hours;

- The last technological layer should be dried for at least 48 hours.

3.7 Error of measurement should not exceed 0.5 %.

4. Testing

4.1 Testing should be carried out with precalibrated Elcometer 319, device for temperature measurement. Procedure and periodicity of calibration are determined in accordance with the state standards.

4.2 The sample subject to testing is placed in a shield between the sections of the climatic chamber. Position of the sample is vertical. During testing the temperature difference of the sections of the climatic chamber should be at least 40°C.

4.3 The given temperature values of the climatic chamber sections are set and the following measurements are carried out every 10 minutes:
- sample surface temperature from the cold and warm sides of the chamber;
- air temperature in the cold and warm sections of the chamber;
- air humidity in the cold and warm sections of the chamber.

4.4. The heat flux through the sample being tested is considered steady (stationary), if the values of five successive measurements acc.to it.4.3 vary from each other less than 1% and the values do not increase and decrease monotonically.

4.5 All measurement values are recorded in a table.

5. Processing of results

5.1 The results are processed according to the heat conductivity formula.

5.2 The formula for determination of the heat conductivity coefficient is as follows:

$$\lambda = \frac{\delta}{\frac{t_{warm\ air} - t_{cold\ air}}{\alpha_H \cdot \left(t_{cold\ surf} - t_{cold\ air}\right)} - \left(\frac{1}{\alpha_{int}} + \frac{\delta_{gpb}}{\lambda_{gpb}}\right)}$$

where

δ = Bronya® coating thickness, m

$t_{warm\ air}$ = air temperature in the warm chamber, °C

$t_{cold\ air}$ = air temperature in the cold chamber, °C

α_H = heat transfer coefficient of Bronya® coating, = 1.38 Watt/m2 °C (experimental value from the test report of VolgGASU is applied);

α_{int} = heat transfer coefficient of the surface from the warm side, =8.7 Watt/m2 °C (norms SNiP 23-02-2003);

δ_{gpb} = thickness of gypsum plasterboard, m;

λ_{gpb} = heat conductivity of gypsum plasterboard, Watt/m2 °C.

5.3 The arithmetic mean value of testing of 3 samples is considered as the final result.

6. Test report

The test report should include the following data:

- name of material or an article;
- designation and title of the normative document according to which material or an article were made;
- manufacturer;
- serial number;
- date of production;
- total number of tested samples;
- dimensions of each sample;
- thickness of each sample;
- average temperature of each sample;
- effective heat conductivity of material of each sample;
- arithmetic mean value of effective heat conductivity of all tested samples;
- date of testing;
- calibration date, validity period of calibration, organization which carried out calibration for the temperature measurement device;
- processing of results with indication of all given data;
- conclusion.