GOST CERTIFICATION SYSTEM
Test center «BGTU-Sertis»

308012 Russia, Belgorod, Kostyukova str., 46

Pro-rector for Research
of BSTU named after V.G. Shukhov
____________ E.I. Evtushenko
« » ____________ 2016.

Accreditation Certificate
№ ROSS RU.0001.22SL25
of September 17, 2012.
Valid until
September 17, 2017.

TEST PROTOCOL № 149
August 4, 2016.

Customer name: LLC «Omega», 308001, Belgorod, Grazhdansky avenue, 4, office 30.

Presenter of samples: director of LLC «Omega» A.V. Zapara.

Sample date: 11.07.2016. Sampling certificate of 11.07 2016.

Product name: Liquid heat-insulating energy-saving coating «PROTERM».

Sampling area: finished product store.

Samples description and identification: Liquid heat-insulating energy-saving coating «PROTERM».

Samples testing date: 11.07.2016 - 4.08.2016.

The tests were conducted for compliance with requirements: in thermal properties.

Test methodology: SP 50.13330.2012 Thermal performance of buildings. SP 131.13330.2012 Building climatology, SP 23-101-2004 Thermal performance design of buildings. GOST 7076-99. Building materials and products. Method of determination of steady-state thermal conductivity and thermal resistance.

The test results are presented in Appendix: №1 (six pages).

Deputy Director
of «BGTU-Sertis» test center D.M. Sopin

TEST RESULTS

Liquid heat-insulating energy-saving coating «PROTERM»

Test means. ITS-1 thermal conductivity meter. Metal ruler. Drying cabinet. Laboratory scales.

Table №1 – Determinations of a mineral wool sample heat conductivity

Sample parameters			Test results			Heat level of the sample, P, W	Effective heat conductivity, $\lambda eff = \frac{d}{R_u}$ W/m·C^0
Humidity during testing W,% by weight	Sample size, cm	Thickness d, m	Temperature difference of face sides, Δ T	Heat flow density, q, W/m^2	Thermal resistance, $R_u = \frac{\Delta_T}{q}$ m^2/W·K		
0,0	15.0x14.9	0.0238	22,7	80,95	0,3935	0,325	0,0605

Table №2 – Determinations of heat conductivity of a test sample with the applied coating «PROTERM» modifications Standard, Façade, Biocide, Anticor (1 mm thick)

Sample parameters			Test results			Heat level of the sample, P, W	Effective heat conductivity, $\lambda eff = \frac{d}{R_u}$ W/m·C^0
Humidity during testing W,% by weight	Sample size, cm	Thickness d, m	Temperature difference of face sides, Δ T	Heat flow density, q, W/m^2	Thermal resistance, $R_u = \frac{\Delta_T}{q}$ m^2/W·K		
0,0	15.0x14.9	0.0248	17,10	39,87	0,6998	0,143	0,0357

Conclusion: application of liquid heat-insulating energy-saving coating «PROTERM» (1 mm layer) reduces the heat conductivity coefficient by 0,0248 W/m·C^0.

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On the basis of the resulted data the thermo-technical calculation has been carried out in order to evaluate the efficiency of liquid heat-insulating energy-saving coating «PROTERM».

Thermo-technical calculation of a structure using mineral wool heat insulator.

1. Introduction:
The calculations are carried out in compliance with requirements of the following regulatory documents:
SP 50.13330.2012 Thermal performance of buildings.
SP 131.13330.2012 Building climatology.
SP 23-101-2004 Thermal performance design of buildings
2. Input data:
Construction area: Sochi
Relative air humidity: φ_i=75%
Type of building: Residential
Type of enclosing structure: Outer walls
Design average air temperature inside the building: t_i=35°C
3. Calculations:
According to table 1 of SP 50.13330.2012 at the inside air temperature t_{int}=35°C and relative air humidity φ_{int}=75% the humidity room conditions are defined as wet.
Let us determine the reference value of the required thermal resistance Ro^{req} on the basis of regulatory requirements to the indicated thermal resistance (5.2 of SP 50.13330.2012) according to the formula:

$$Ro^{req}=a\cdot HSDD+b$$

where *a* and *b*- are coefficients, the values of which are taken according to table 3 of SP 50.13330.2012 for the respective types of buildings.
Thus, for outer walls as type of enclosing structure and residential building as type of building a=0.00035;b=1.4
Let us determine the heating season degree-day (HSDD), ^{0}C·days according to the formula (5.2) of SP 50.13330.2012

$$HSDD=(t_i-t_{ot})z_h$$

where t_i - design average air temperature inside the building,°C

$$t_i=35°C$$

t_{ot} - average outside air temperature,°C taken according to table 1 of SP131.13330.2012 for the period of mean daily outside air temperature not above 8 °C for residential buildings

$$t_{ot}=6.6\ °C$$

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z_h – heating period duration, days, taken according to table 1 of SP131.13330.2012 for the period of mean daily outside air temperature not above 8 °C for residential buildings

$$z_h=94 \text{ days}$$

So,

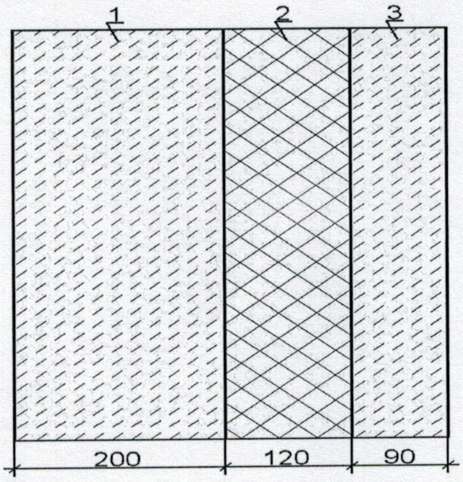
$$HSDD=(35-(6.6))94=2669.6 \text{ °C·days}$$

According to the formula in table 3 of SP 50.13330.2012 the reference value of the required thermal resistance Ro^{req} (m^2·°C/W) is determined.

$$Ro^{norm}=0.00035\cdot 2669.6+1.4=2.33 m^2 °C/W$$

As Sochi region belongs to humid zone and the humidity room conditions are defined as wet, so, according to table 2 of SP 50.13330.2012 the thermo-technical characteristics of materials for enclosing structures are taken for B operating conditions.

The structure diagram of the enclosing structure is shown in the figure:



1. Haydite-sand concrete (p=1800 kg/cub.m), thickness δ_1=0.2m, heat conductivity coefficient $\lambda_{Б1}$=0.92W/(m°C)
2. Mineral-wool boards GOST 9573(p=100 kg/cub.m), thickness δ_2=0.12m, heat conductivity coefficient $\lambda_{Б2}$=0.065W/(m°C)
3. Haydite-sand concrete (p=600 kg/ cub.m), thickness δ_3=0.09м, heat conductivity coefficient $\lambda_{Б3}$=0.26W/(m°C)

The conventional thermal resistance R_0^{con}, (m^2°C/W) is determined by the formula E.6 of SP 50.13330.2012:

$$R_0^{con}=1/\alpha_{int}+\delta_n/\lambda_n+1/\alpha_{ext}$$

where α_{int} – heat-transfer coefficient of the internal enclosing structure surface, W/(m^2°C), taken according to table 4 of SP 50.13330.2012

$$\alpha_{int}=8.7 \text{ W/(m}^2\text{°C)}$$

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α_{ext} - heat-transfer coefficient of the external enclosing structure surface for the cold period conditions, taken according to table 6 of SP 50.13330.2012

α_{ext}=23 W/(m^2°C) – according to1 of table 6 of SP 50.13330.2012 for outer walls.

$$R_0^{con}=1/8.7+0.2/0.92+0.12/0.065+0.09/0.26+1/23$$

$$R_0^{con}=2.57 m^2 {}^\circ C/W$$

The indicated thermal resistance R_0^{ind}, (m^2°C/W) is determined by the formula 11 of SP 23-101-2004:

$$R_0^{ind}=R_0^{con}\cdot r$$

r - heat transfer performance uniformity factor of the enclosing structure, which takes into account the influence of joints, reveals, openings, trims, flexible connections and other thermally conductive elements

$$r=0.92$$

So,

$$R_0^{ind}=2.57\cdot 0.92=2.36 m^2\cdot {}^\circ C/W$$

Conclusion: the indicated thermal resistance value R_0^{ind} is higher than the required R_0^{norm} (2.36>2.33), so the presented enclosing structure meets the thermal conductivity requirements.

Thermo-technical calculation of a structure using mineral wool heat insulator with the applied coating PROTERM (1 mm layer).

1. Introduction:
The calculations are carried out in compliance with requirements of the following regulatory documents:
SP 50.13330.2012 Thermal performance of buildings.
SP 131.13330.2012 Building climatology.
SP 23-101-2004 Thermal performance design of buildings
2. Input data:
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Let us determine the reference value of the required thermal resistance Ro^{req} on the basis of regulatory requirements to the indicated thermal resistance (5.2 of SP 50.13330.2012) according to the formula:

$$Ro^{req}=a\cdot HSDD+b$$

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where *a* and *b*- are coefficients, the values of which are taken according to table 3 of SP 50.13330.2012 for the respective types of buildings.
Thus, for outer walls as type of enclosing structure and residential building as type of building a=0.00035;b=1.4
Let us determine the heating season degree-day (HSDD), ^{0}C·days according to the formula (5.2) of SP 50.13330.2012

$$HSDD=(t_i-t_{ot})z_h$$

where t_i- design average air temperature inside the building,°C

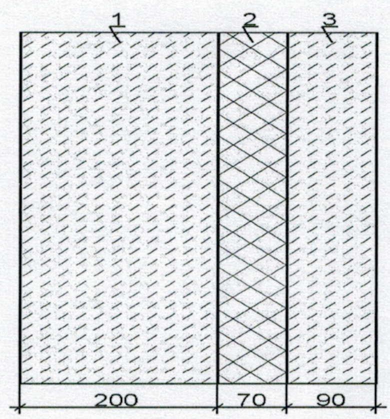
$$t_i=35°C$$

According to the formula in table 3 of SP 50.13330.2012 the reference value of the required thermal resistance Ro^{req} (m^2·°C/W) is determined.

$$Ro^{norm}=0.00035\cdot2669.6+1.4=2.33m^2°C/W$$

As Sochi region belongs to humid zone and the humidity room conditions are defined as wet, so, according to table 2 of SP50.13330.2012 the thermo-technical characteristics of materials for enclosing structures are taken for B operating conditions.

The structure diagram of the enclosing structure is shown in the figure:



1. Haydite-sand concrete (p=1800 kg/cub.m), thickness δ_1=0.2m, heat conductivity coefficient $\lambda_{Б1}$=0.92W/(m°C)
2. Mineral-wool boards GOST 9573(p=100 kg/cub.m) with the applied coating PROTERM, thickness δ_2=0.07m, heat conductivity coefficient $\lambda_{Б2}$=0.0374W/(m°C)
3. Haydite-sand concrete (p=600 kg/cub.m), thickness δ_3=0.09m, heat conductivity coefficient $\lambda_{Б3}$=0.26W/(m°C)

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The conventional thermal resistance R_0^{con}, (m^2°C/W) is determined by the formula E.6 of SP 50.13330.2012:

$$R_0^{con}=1/\alpha_{int}+\delta_n/\lambda_n+1/\alpha_{ext}$$

where α_{int} - heat-transfer coefficient of the internal enclosing structure surface, W/(m^2°C), taken according to table 4 of SP 50.13330.2012

$$\alpha_{int}=8.7\ W/(m^2°C)$$

α_{ext} - heat-transfer coefficient of the external enclosing structure surface for the cold period conditions, taken according to table 6 of SP 50.13330.2012

α_{ext}=23 W/(m^2°C) –according to1 of table 6 of SP 50.13330.2012 for outer walls.

$$R_0^{con}=1/8.7+0.2/0.92+0.07/0.0374+0.09/0.26+1/23$$

$$R_0^{con}=2.59m^2°C/W$$

The indicated thermal resistance R_0^{ind}, (m^2°C/W)) is determined by the formula 11 of SP 23-101-2004:

$$R_0^{ind}=R_0^{con}\cdot r$$

r- heat transfer performance uniformity factor of the enclosing structure, which takes into account the influence of joints, reveals, openings, trims, flexible connections and other thermally conductive elements

$$r=0.92$$

So,

$$R_0^{ind}=2.59\cdot 0.92=2.38m^2\cdot°C/W$$

Conclusion: the indicated thermal resistance value R_0^{ind} is higher than the required R_0^{norm}(2.38>2.33), so the presented enclosing structure meets the thermal conductivity requirements.

Based on the evaluated effective heat conductivity characteristics and the carried-out comparative thermo-technical calculation, it may be concluded that using liquid heat-insulating energy-saving coating «PROTERM» (1 mm layer) allows reducing the thickness of mineral-wool heat insulator layer by 50 mm.

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