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Laboratory tests for thermal insulation coatings:

Bronya Anticor
Bronya Facade
Bronya Classic

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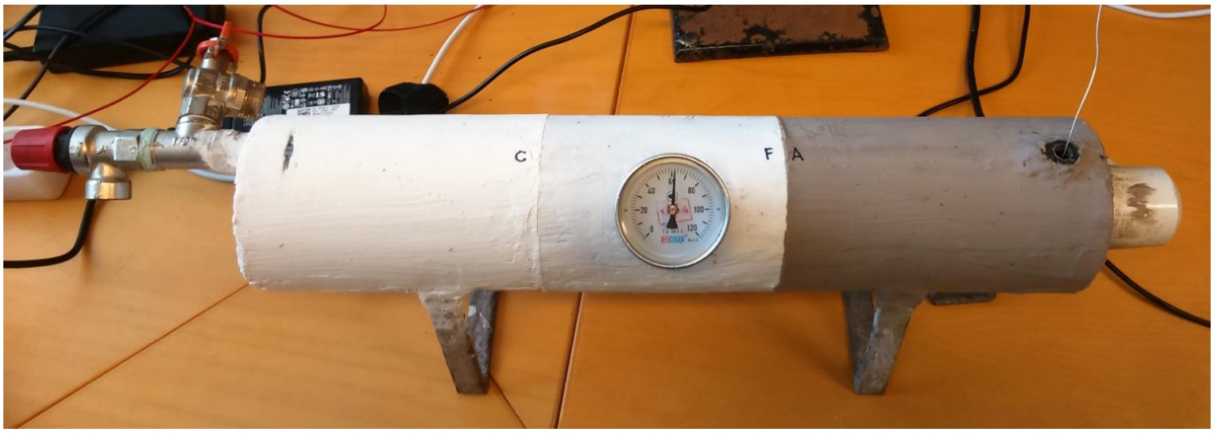
Laboratory tests were performed for thermal insulation coatings:

Bronya Anticor (A)
Bronya Facade (F)
Bronya Classic (C)

Experimental setup:

Water filled tube (Figure 1) was heated with internal heat source. Temperature was controlled with external controller unit that was connected to thermocouple in the tube (on the right side of the tube). Temperature of tube metal was measured with thermometer installed into the tube. Room temperature and surface temperature on Bronya coating were measured with Elcometer G319-S temperature gauge.



Calculations:

The following equation is adopted from a patent *Method of determining thermal conductivity coefficient of liquid heat-insulating coatings* (patent RU 2478936, published 10.04.2013).

$$\lambda = \frac{\delta \cdot \alpha \cdot (T - T_{int})}{T_{in} - T}$$

λ = thermal conductivity, W/(m·K)

δ = thickness of the coating, m

α = heat transfer coefficient, W/(m^2·K)

T = surface temperature, °C

T_{int} = room temperature, °C

T_{in} = non-coated surface temperature, °C

α = 1,38 W/(m²·K) value given by the manufacturer

Example of calculations

$$\lambda = \frac{0{,}6 \cdot 10^{-3} \cdot 1{,}38 \cdot (46{,}2 - 21)}{64 - 46{,}2} = 0{,}0012$$

Results:

T_{in} = 64 °C

measurement	**thickness of the coating (mm)**	**surface temperature (°C)**	**thermal conductivity (W/(m·K))** α = 1,38 W/(m²·K)
Anticor1	0,6	46,2	0,0012
Anticor2	0,7	40,6	0,0008
Anticor3	0,7	42	0,0009
Anticor4	0,9	42,2	0,0012
Anticor5	0,6	41,1	0,0007
average			**0,0010**
Facade1	2	29,7	0,0007
Facade2	2	28,2	0,0006
Facade3	0,9	38,6	0,0009
Facade4	1,1	36,1	0,0008
Facade5	1	38,7	0,0010
average			**0,0008**
Classic1	0,9	38,5	0,0008
Classic2	0,8	39,1	0,0008
Classic3	1,3	35,3	0,0009
Classic4	0,8	40,3	0,0009
Classic5	0,7	40,6	0,0008
average			**0,0008**

T_{in} = 77 °C

measurement	thickness of the coating (mm)	surface temperature (°C)	thermal conductivity (W/(m·K)) α = 1,38 W/(m^2·K)
Anticor1	0,4	54,3	0,0008
Anticor2	1,7	38,7	0,0011
Anticor3	0,6	47,7	0,0007
Anticor4	0,6	51,1	0,0010
Anticor5	0,6	50,3	0,0009
average			**0,0009**
Facade1	2	37,2	0,0011
Facade2	2	36,2	0,0010
Facade3	0,8	49,1	0,0011
Facade4	1,1	42,1	0,0009
Facade5	1	44,1	0,0010
average			**0,0010**
Classic1	0,9	40	0,0006
Classic2	0,8	43	0,0007
Classic3	1	40,9	0,0008
Classic4	0,9	43,2	0,0008
Classic5	0,7	46,5	0,0008
average			**0,0007**

T_{in} = 90 °C

measurement	thickness of the coating (mm)	surface temperature (°C)	thermal conductivity (W/(m·K)) α = 1,38 W/(m²·K)
Anticor1	0,4	64	0,0009
Anticor2	1,7	44,9	0,0012
Anticor3	0,8	52,7	0,0009
Anticor4	0,7	55,1	0,0009
Anticor5	0,8	55,5	0,0011
average			**0,0010**
Facade1	1,9	37,6	0,0008
Facade2	2	36,3	0,0008
Facade3	0,7	51,3	0,0008
Facade4	0,9	49,1	0,0008
Facade5	1,2	46	0,0009
average			**0,0008**
Classic1	0,9	45,6	0,0007
Classic2	0,8	49,2	0,0008
Classic3	1	47,9	0,0009
Classic4	0,6	54,7	0,0008
Classic5	0,8	49,2	0,0008
average			**0,0008**

T_{in} = 95 °C

measurement	thickness of the coating (mm)	surface temperature (°C)	thermal conductivity (W/(m·K)) α = 1,38 W/(m^2·K)
Anticor1	0,6	68,1	0,0014
Anticor2	0,6	64,5	0,0012
Anticor3	0,7	60,4	0,0011
Anticor4	1,5	48,9	0,0012
Anticor5	0,5	62,5	0,0009
average			**0,0012**
Facade1	2	45,1	0,0013
Facade2	2	43,6	0,0012
Facade3	0,8	58,6	0,0009
Facade4	1,2	52,7	0,0012
Facade5	1	54,9	0,0012
average			**0,0012**
Classic1	0,9	58,2	0,0013
Classic2	0,9	58,8	0,0013
Classic3	1,1	60,1	0,0017
Classic4	0,7	61,5	0,0012
Classic5	1	56,9	0,0008
average			**0,0013**

T_{in} = 97 °C

measurement	thickness of the coating (mm)	surface temperature (°C)	thermal conductivity (W/(m·K)) α = 1,38 W/(m²·K)
Anticor1	0,7	64,9	0,0013
Anticor2	0,6	63,3	0,0010
Anticor3	0,5	63,1	0,0009
Anticor4	0,6	60,6	0,0009
Anticor5	1	56,2	0,0012
average			**0,0011**
Facade1	1,5	53,4	0,0015
Facade2	1,1	54,3	0,0012
Facade3	2	45,2	0,0013
Facade4	1,9	43,6	0,0011
Facade5	1,2	47	0,0009
average			**0,0012**
Classic1	1	63	0,0017
Classic2	1,2	61,5	0,0019
Classic3	0,6	64	0,0011
Classic4	1	58,3	0,0013
Classic5	0,9	60,5	0,0013
average			**0,0015**

One has to take into account that these measurements do not experimentally determine the absolute value of λ. In these calculations the order of magnitude of λ is determined by one of the factor α provided by manufacturer, other inaccuracy comes from the measurement of temperatures. Now calculated average values for thermal conductivity coefficient λ are in all measured temperatures in line with the value provided by the manufacturer, 0,0012 W/(m·K).

As a conclusion, now performed temperature measurements show out the thermal insulation properties of the thermal insulation coatings Bronya Anticor, Bronya Facade and Bronya Classic.

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