



Using our insulation  
mattresses



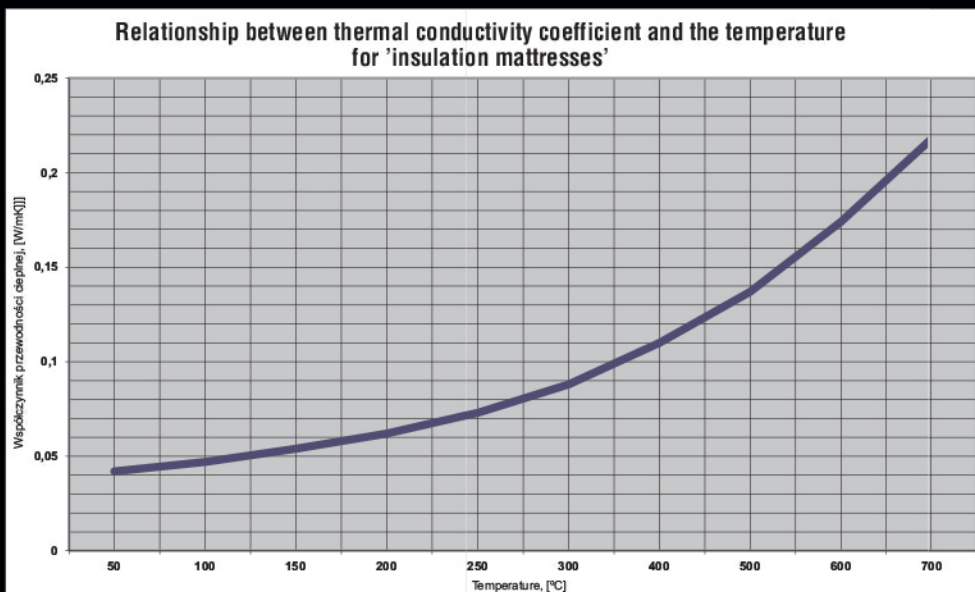
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'Insulation mattresses' are sewn for any size, easily removable insulation covers.

They may be repeatedly installed and removed and their performance remains unchanged. They increase the durability of insulation lining, contributing to lower costs and accelerated repair works. Insulation lining requires no drying, no protective coating nor securing with cover plates. Application of 'insulation mattresses' critically improves the conditions of insulation works to be performed. It eliminates the actual ecological hazards connected with high levels of dust generation in places where the repair works are carried out, hazardous fibrous dust and storage of dangerous fibrous waste generated during such works. In the case of 'insulation mattresses', it is not required to perform costly neutralisation of post-operating waste before having it safely stored. Moreover, the improved durability of the mattresses significantly limits the amount of waste.

Thermal conductivity coefficient for 'insulation mattresses':

|       |              |
|-------|--------------|
| 50°C  | - 0.042kW/mK |
| 100°C | - 0.047kW/mK |
| 150°C | - 0.054kW/mK |
| 200°C | - 0.062kW/mK |
| 250°C | - 0.073kW/mK |
| 300°C | - 0.088kW/mK |
| 400°C | - 0.110kW/mK |
| 500°C | - 0.137kW/mK |
| 600°C | - 0.174kW/mK |
| 700°C | - 0.218kW/mK |



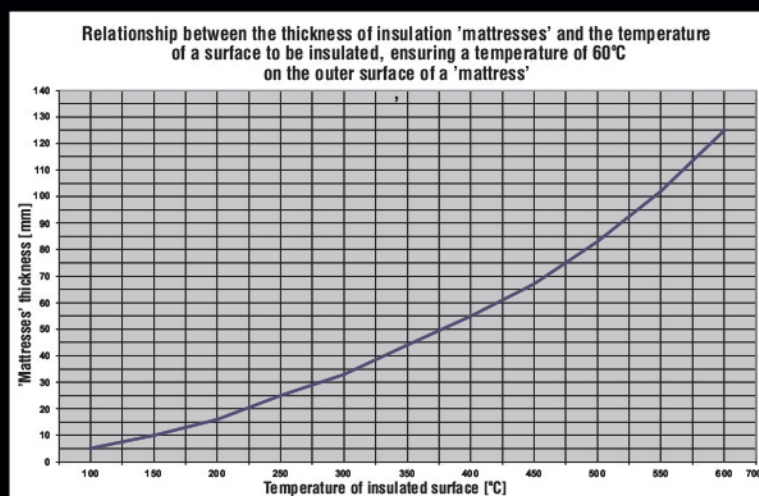


## Stream of heat losses without insulation

If a medium at a temperature of 100°C is separated from the environment with only a 3mm thick steel plate, then the temperature on the external side of the plate shall reach 99.8°C and the stream of losses in heat penetrating to the environment shall amount to 0.85kW/m<sup>2</sup>.

And, correspondingly:

|         |                        |
|---------|------------------------|
| 100°C - | 0.85kW/m <sup>2</sup>  |
| 150°C - | 1.65kW/m <sup>2</sup>  |
| 200°C - | 2.66kW/m <sup>2</sup>  |
| 250°C - | 4.00kW/m <sup>2</sup>  |
| 300°C - | 5.32kW/m <sup>2</sup>  |
| 350°C - | 7.07kW/m <sup>2</sup>  |
| 400°C - | 8.82kW/m <sup>2</sup>  |
| 450°C - | 10.89kW/m <sup>2</sup> |
| 500°C - | 13.17kW/m <sup>2</sup> |
| 550°C - | 15.66kW/m <sup>2</sup> |
| 600°C - | 18.35kW/m <sup>2</sup> |



## Stream of heat losses with insulation:

In order to obtain a temperature of 60°C, on the outer surface of the insulation, at the medium temperature of 100°C and heat conductivity coefficient of insulation of 0.05W/mK, the thickness of insulation should equal 5mm. The stream of heat losses shall then equal 0.44kW/m<sup>2</sup>.

And, correspondingly:

|         |          |   |       |   |                       |
|---------|----------|---|-------|---|-----------------------|
| 100°C / | 0.05W/mK | - | 5mm   | - | 0.44kW/m <sup>2</sup> |
| 150°C / | 0.05W/mK | - | 10mm  | - | 0.44kW/m <sup>2</sup> |
| 200°C / | 0.05W/mK | - | 16mm  | - | 0.44kW/m <sup>2</sup> |
| 250°C / | 0.05W/mK | - | 25mm  | - | 0.44kW/m <sup>2</sup> |
| 300°C / | 0.06W/mK | - | 33mm  | - | 0.44kW/m <sup>2</sup> |
| 350°C / | 0.05W/mK | - | 44mm  | - | 0.44kW/m <sup>2</sup> |
| 400°C / | 0.07W/mK | - | 55mm  | - | 0.44kW/m <sup>2</sup> |
| 450°C / | 0.07W/mK | - | 67mm  | - | 0.44kW/m <sup>2</sup> |
| 500°C / | 0.08W/mK | - | 83mm  | - | 0.44kW/m <sup>2</sup> |
| 550°C / | 0.09W/mK | - | 102mm | - | 0.44kW/m <sup>2</sup> |
| 600°C / | 0.10W/mK | - | 125mm | - | 0.44kW/m <sup>2</sup> |

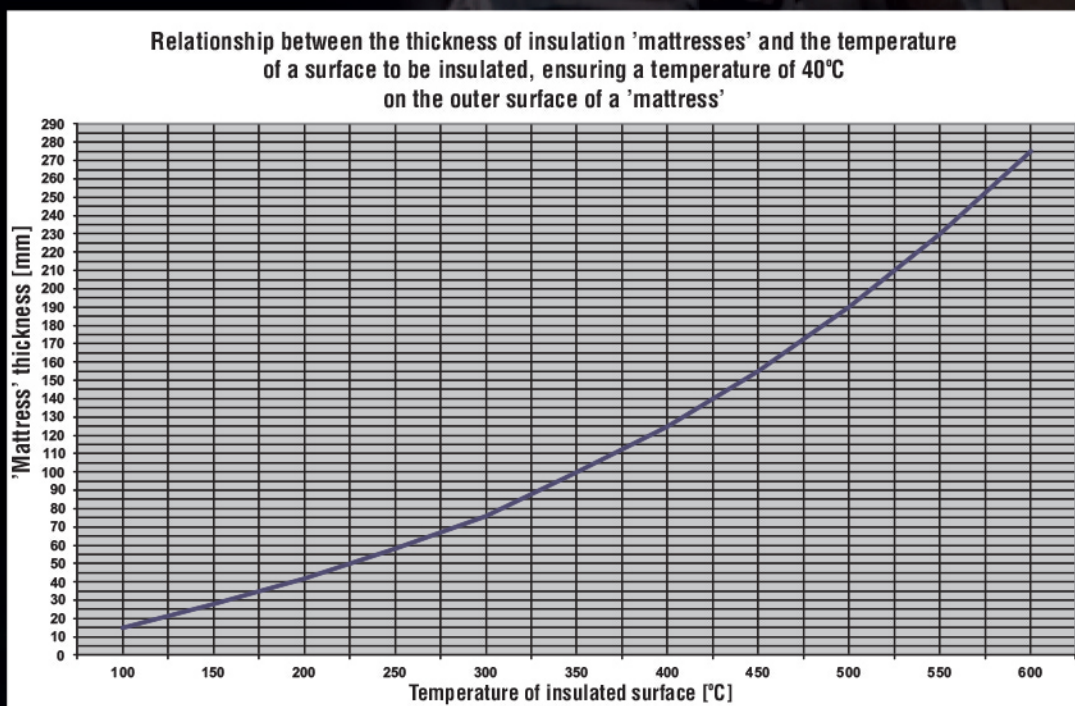




In order to obtain a temperature of 40°C on the outer surface of the insulation, at the medium temperature of 100°C and heat conductivity coefficient of insulation of 0.05W/mK, the thickness of insulation should equal 15mm. The stream of heat losses shall then equal 0.20kW/m<sup>2</sup>

And, correspondingly:

|   |  |
|---|--|
| 100°C / 0.05W/mK - 15mm - 0.20kW/m <sup>2</sup> | 350°C / 0.05W/mK - 100mm - 0.20kW/m <sup>2</sup> |
| 150°C / 0.05W/mK - 28mm - 0.20kW/m <sup>2</sup> | 400°C / 0.07W/mK - 125mm - 0.20kW/m <sup>2</sup> |
| 200°C / 0.05W/mK - 42mm - 0.20kW/m <sup>2</sup> | 450°C / 0.07W/mK - 155mm - 0.20kW/m <sup>2</sup> |
| 250°C / 0.05W/mK - 58mm - 0.20kW/m <sup>2</sup> | 500°C / 0.08W/mK - 190mm - 0.20kW/m <sup>2</sup> |
| 300°C / 0.05W/mK - 76mm - 0.20kW/m <sup>2</sup> | 550°C / 0.09W/mK - 230mm - 0.20kW/m <sup>2</sup> |
|   | 600°C / 0.10W/mK - 275mm - 0.20kW/m <sup>2</sup> |





## ENERGY SAVINGS RESULTING FROM THE USE OF 'INSULATION MATTRESSES'

If a medium at a temperature of 100°C is separated from the environment with only a 3mm thick steel plate, then the temperature on the external side of the plate shall reach 99.8°C and the stream of losses in heat penetrating to the environment shall amount to 0.85kW/m<sup>2</sup>. If we apply on this plate a 15mm thick insulation and we assume a heat conductivity coefficient of 0.05W/mK, the temperature on the outer surface of insulation shall then drop to 40°C, and the stream of heat lost into the environment shall decrease to 0.20kW/m<sup>2</sup>. The abovementioned results from thermal calculations for the state of equilibrium, assuming that ambient temperature is 20°C and the air surrounding the insulated object is still.

The stream of heat losses shall be decreased by:

◎  $0.85\text{kW/m}^2 - 0.20\text{kW/m}^2 = 0.65\text{kW/m}^2$

Annual savings:

◎  $0.65\text{kW/m}^2 \times 365 \text{ days/year} \times 24 \text{ hours/day} = 5694\text{kWh/m}^2$

Assuming that the price of 1kWh is PLN 0.25 (average price of kWh), we get a result of:

◎  $5694\text{kWh/m}^2 \times 0.25\text{zł/kWh} = 1423,50\text{zł/m}^2 \text{ per year}$





And, correspondingly:

## ENERGY SAVINGS RESULTING FROM THE USE OF 'INSULATION MATTRESSES'

| Temperature of the medium<br>[°C] | Thickness of insulation<br>[mm] | Temperature on the outer surface of insulation<br>[°C] | Stream of heat losses on insulated object.<br>[kW/m <sup>2</sup> ] | Stream of heat losses on uninsulated object<br>[kW/m <sup>2</sup> ] | Decrease of a stream of heat losses<br>[kW/m <sup>2</sup> ] | Energy savings per year<br>(8760 hrs/year)<br>[kWh/m <sup>2</sup> ] | Financial savings per year<br>(0.25 zł/kWh)<br>(0.25 zł/kWh)<br>[zł/m <sup>2</sup> ] |
|-----------------------------------|---------------------------------|--|--|---|---|---|--|
| 100                               | 5                               | 60   | 0.44   | 0.85  | 0.41  | 3592  | 898  |
|                                   | 15                              | 40   | 0.20   |   | 0.65  | 5694  | 1424   |
| 150                               | 10                              | 60   | 0.44   | 1.65  | 1.21  | 10600   | 2650   |
|                                   | 28                              | 40   | 0.20   |   | 1.45  | 12702   | 3176   |
| 200                               | 16                              | 60   | 0.44   | 2.66  | 2.22  | 19447   | 4862   |
|                                   | 40                              | 40   | 0.20   |   | 2.46  | 21550   | 5387   |
| 250                               | 25                              | 60   | 0.44   | 4.00  | 3.56  | 31186   | 7796   |
|                                   | 58                              | 40   | 0.20   |   | 3.80  | 33288   | 8322   |
| 300                               | 33                              | 60   | 0.44   | 5.32  | 4.88  | 42749   | 10687  |
|                                   | 76                              | 40   | 0.20   |   | 5.12  | 44851   | 11213  |
| 350                               | 44                              | 60   | 0.44   | 7.07  | 6.63  | 58079   | 14520  |
|                                   | 100                             | 40   | 0.20   |   | 6.87  | 60181   | 15045  |
| 400                               | 55                              | 60   | 0.44   | 8.82  | 8.38  | 73409   | 18352  |
|                                   | 125                             | 40   | 0.20   |   | 8.62  | 75511   | 18878  |
| 450                               | 67                              | 60   | 0.44   | 10.89   | 10.45   | 91542   | 22886  |
|                                   | 155                             | 40   | 0.20   |   | 10.69   | 93644   | 23411  |
| 500                               | 83                              | 60   | 0.44   | 13.17   | 12.73   | 111515  | 27879  |
|                                   | 185                             | 40   | 0.20   |   | 12.97   | 113617  | 28404  |
| 550                               | 102                             | 60   | 0.44   | 15.66   | 15.22   | 133327  | 33332  |
|                                   | 230                             | 40   | 0.20   |   | 15.46   | 135430  | 33857  |
| 600                               | 125                             | 60   | 0.44   | 18.35   | 17.91   | 156892  | 39223  |
|                                   | 275                             | 40   | 0.20   |   | 18.15   | 158994  | 39749  |

## Ecological effects of the use of 'insulating mattresses'

The ecological effects are related to savings in fuels (coal, natural gas etc.) and decreased emissions of CO<sub>2</sub>.

Heat of combustion:

- ⊙ Hard coal - 23MJ/kg = 6.44 kWh/kg
- ⊙ Natural gas - 35 MJ/kg = 9.80 kWh/kg

CO<sub>2</sub> emissions during combustion of:

- ⊙ Hard coal - 5.8 kg CO<sub>2</sub>/kg of coal
- ⊙ Natural gas - 4.4kg CO<sub>2</sub>/kg of gas

If an uninsulated object with medium having a temperature of 100°C is insulated with a 5mm thick mattress, the consumption of energy per annum (8760 hours) shall decrease by 3592 kWh from each 1m<sup>2</sup> of surface area.



Then:

- the savings in the form of unburned coal (gas) shall amount to:  
 $3592 \text{ kWh/m}^2 : 6.44 \text{ kWh/kg} = 558 \text{ kg/m}^2$  - for coal, annually  
 $3592 \text{ kWh/m}^2 : 9.80 \text{ kWh/kg} = 366 \text{ kg/m}^2$  - for gas, annually
- the above means a decrease of CO<sub>2</sub> emissions of:  
 $558 \text{ kg coal/m}^2 \times 5.8 \text{ kg CO}_2/\text{kg coal} = 3236 \text{ kg CO}_2/\text{m}^2$  - for coal, annually  
 $366 \text{ kg coal/m}^2 \times 4.4 \text{ kg CO}_2/\text{kg gas} = 1610 \text{ kg CO}_2/\text{m}^2$  - for gas, annually

And, correspondingly:

## ECOLOGICAL EFFECTS OF THE USE OF 'INSULATING MATTRESSES'

| Temperature of the medium<br>[°C] | Thickness of insulation<br>[mm] | Temperature on the outer surface of insulation<br>[°C] | Energy savings per year<br>[kWh/m <sup>2</sup> of insulated surface] | Savings in the form of unburned fuel, annually<br>[kg/m <sup>2</sup> of insulated surface] |             | Decrease of CO <sub>2</sub> emissions, per annum<br>[kg/m <sup>2</sup> of insulated surface] |             |
|-----------------------------------|---------------------------------|--|--|--|-------------|--|-------------|
|                                   |                                 |  |  | Hard coal  | Natural gas | Hard coal  | Natural gas |
| 100                               | 5                               | 60   | 3592   | 558  | 366         | 3235   | 1613        |
|                                   | 15                              | 40   | 5694   | 884  | 581         | 5128   | 2556        |
| 150                               | 10                              | 60   | 10600  | 1646   | 1082        | 9546   | 4759        |
|                                   | 28                              | 40   | 12702  | 1972   | 1296        | 11440  | 5703        |
| 200                               | 16                              | 60   | 19447  | 3020   | 1984        | 17515  | 8731        |
|                                   | 40                              | 40   | 21550  | 3346   | 2199        | 19408  | 9675        |
| 250                               | 25                              | 60   | 31186  | 4842   | 3182        | 28086  | 14002       |
|                                   | 58                              | 40   | 33288  | 5169   | 3397        | 29980  | 14946       |
| 300                               | 33                              | 60   | 42749  | 6638   | 4362        | 38500  | 19193       |
|                                   | 76                              | 40   | 44851  | 6964   | 4577        | 40394  | 20137       |
| 350                               | 44                              | 60   | 58079  | 9018   | 5926        | 52307  | 26076       |
|                                   | 100                             | 40   | 60181  | 9345   | 6141        | 54200  | 27020       |
| 400                               | 55                              | 60   | 73409  | 11399  | 7491        | 66114  | 32959       |
|                                   | 125                             | 40   | 75511  | 11725  | 7705        | 68007  | 33903       |
| 450                               | 67                              | 60   | 91542  | 14215  | 9341        | 82445  | 41100       |
|                                   | 155                             | 40   | 93644  | 14541  | 9556        | 84338  | 42044       |
| 500                               | 83                              | 60   | 111515   | 17316  | 11379       | 10043  | 50068       |
|                                   | 185                             | 40   | 113617   | 17642  | 11594       | 10232  | 51012       |
| 550                               | 102                             | 60   | 133327   | 20703  | 13605       | 12007  | 59861       |
|                                   | 230                             | 40   | 135430   | 21029  | 13819       | 12197  | 60805       |
| 600                               | 125                             | 60   | 156892   | 24362  | 16009       | 14130  | 70441       |
|                                   | 275                             | 40   | 158994   | 24689  | 16224       | 14319  | 71385       |





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