The phenomenon of thermal conductivtt vn respect of human lvfe and economt vn polar areas

Circumpolar zone climates are infuenced by the variability of solar lightng and the length of a day during polar summer and winter night. In the warmest month of the year here, the temperature does not exceed 10 ° C. However, this applies only subpolar climate zones, in the polar one the temperature is signifcantly lower.

The distributon of annual temperature in the Arctc is diferent in the area of contnental climate variatons (eg. Northern Asia, central Greenlandn and in the area of maritme climate (eg. on Spitsbergenn. In the areas of closed isotherms (eg. Yakutan the lowest temperature reaches -70 ° C to create "cold poles", where, even in summer, the temperature is below 0° C.

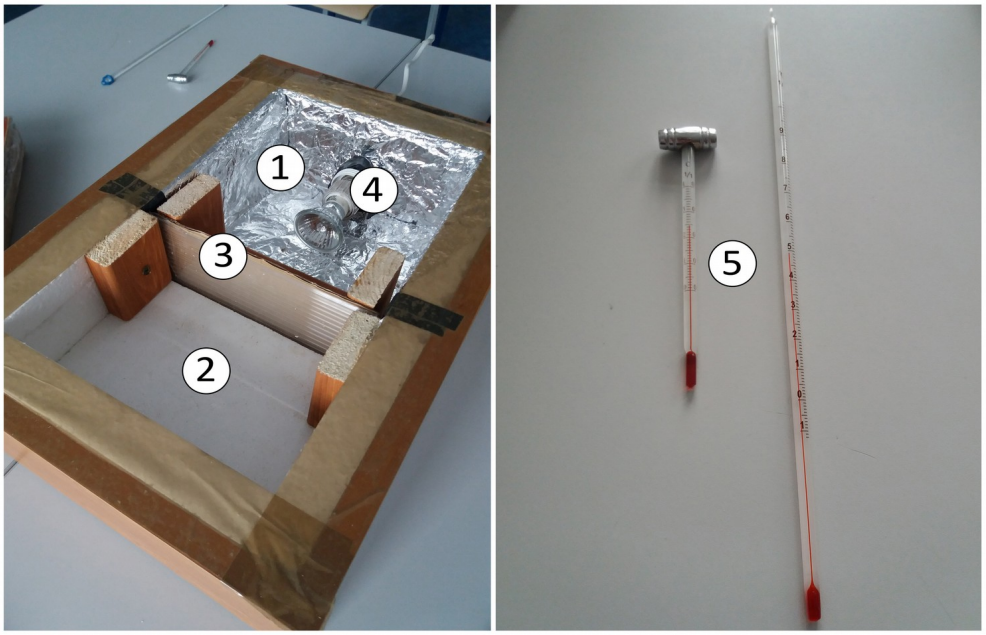
The disadvantageous temperature conditons in the areas of the Arctc signifcantly reduce the possibility of setlement there and undertaking any business or research actvity. The essental conditon of human actvity in the areas of low air temperature is the use of materials which are resistant to low temperatures and of low thermal conductvity, which are to be used for clothing and equipment producton, creaton of infrastructure and household appliances.

The authors of the project have been inspired by the problem to examine, using simple technical methods, principles of thermal conductvity in a specifc range of constructon materials which could be used in the Arctc. We believe that the scale of thermal conductvity of a material depends on its type, structure and thickness. The research equipment, which was made individually by the researchers, allowed them to measure the heat transfer process through a specifc type of partton between two separate environments. Therefore we wanted to check which of commonly available materials slow down the loss of accumulated heat.

To perform the necessary measurements we used the equipment, which main part consists of a wooden drawer, lined with styrofoam and divided into two chambers. In the chamber No.1. a heat source was installed – a lightbulb, and the walls are also lined with an

aluminum foil. Between chamber No.1. and chamber No.2. a removable frame was put, in which, during the experiment, a tested material was placed. The heat conductvity of a variety of materials was tested. The whole test apparatus is covered with a lid, in which two holes were made for two laboratory thermometers measuring the temperature in each chamber separately.

Photo.1. Measuring equipment.



1. Chamber No.1.

2. Chamber No.2.

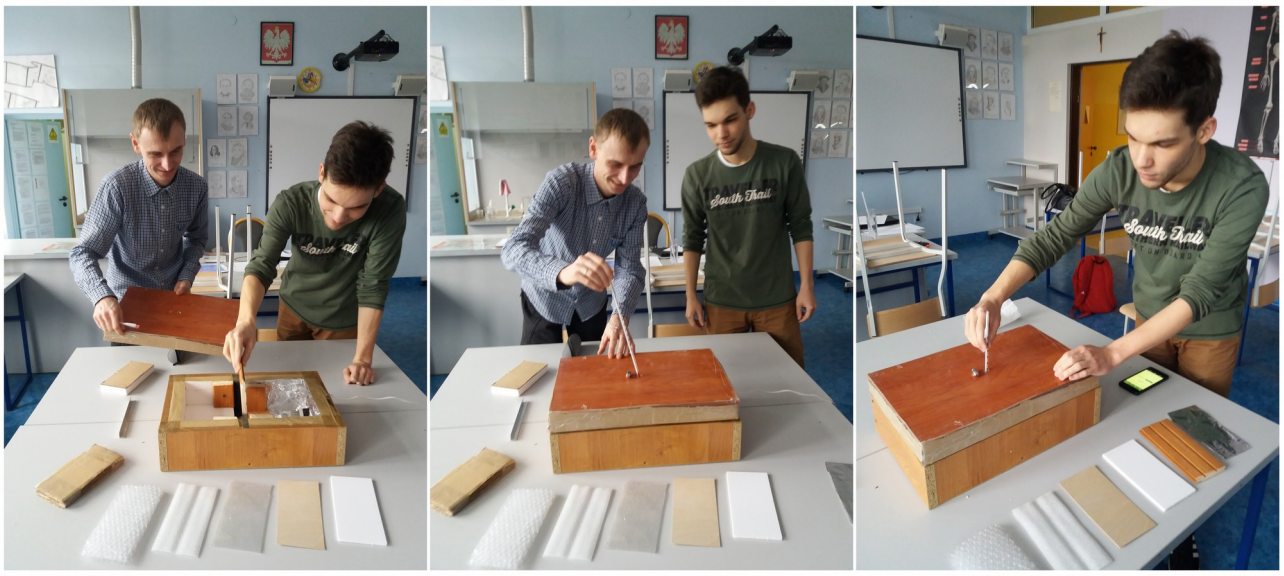
3. The insulaton frame.

4. The heat source.

5. Thermometers

To obtain representatve results of the experiment, we have examined a wide range of materials possible to be used in the constructon of lightweight objects. These were the plates of the same size, made of: styrofoam, corrugated board, cellular polycarbonate, polyethylene bubble foil, wood, plywood, polyurethane foam, aluminum foil, Kappa type foam (polyurethane foam lined both sides with cardboardn.

Fot.2 The measurements of thermal conductvity.



As the startng temperature of tested environments, 21C was established. In chamber No. 1 a lightbulb was installed as a heat source, which task was to rise the temperature of the environment up to 54 ° C (approx. in 4 minutesn. Afer reaching the required temperature in chamber No.1, the temperature in chamber No.2 was measured. All measurement actvites were carried out in the same way for each test sample.

The fndings:

No. of the sample	The ttpe of materval	The materval thvckness	The temperature vn chamber No.1	The temperature vn chamber No.2
1	Styrofoam	2,5 cm	54ºC	26ºC
2	Corrugated board	2,5 cm	54ºC	22ºC
3	Cellular polycarbonate	0,4 cm	54ºC	44ºC
4	Polyethylene bubble foil	2,0 cm	54ºC	36ºC
5	Wood	1,2 cm	54ºC	37ºC
6	Plywood	0,1 cm	54ºC	47ºC
7	Polyurethane foam	0,3 cm	54ºC	47ºC
8	Aluminum foil	0,1 cm	54ºC	54ºC
9	Kappa type foam	0,5 cm	54ºC	46ºC

Firstly, the obtained results allowed us to say that the intensity of the heat conducton of tested samples depends on their thickness. The larger it was (eg. polystyrene, cardboard, polyethylene foiln, the lower the conductvity was. The analysis of results showed also that the materials with a complex structure, where among the fbers of the material the air accumulates (eg. corrugated board, polyethylene bubble foil, polycarbonaten, are beter insulators.

The greater porosity of the material was, the lower was the temperature in chamber No.2.

The study also confrmed the assumpton that thermal insulaton of a material is also afected by the number of its layers. The more layers the sample was made of, the higher the level of insulaton was. The tested sample which showed the highest thermal conductvity was the aluminum foil. It proves that metals are very poor insulators. Our fndings allow to predict which kind of material, with its insulatng propertes, is predisposed to be used in the constructon of facilites built in the Arctc areas. Certainly, the best insulaton materials are: polystyrene, corrugated cardboard , polyethylene bubble foil and polyurethane foam. They can be a flling between outer walls of buildings made of wood and inside walls of plywood, or sheets of cellular polycarbonate. The advantage of these materials, besides low thermal conductvity, is their lightness and small volume. They are very important when the materials are transported over long distances. Most of these products are characterized by their high fexibility and sofness what makes the process of using them very easy. The use of materials of low thermal conductvity in constructon of buildings and facilites will ultmately lower the cost of heatng and reduce the consumpton of energy in extremely cold climates.