

Section 01. Innovations in Engineering

Kseniia Mudrak

V.E. Volkova, research supervisor

I.I. Zuyenok, language adviser

National Mining University, Dnipro, Ukraine

Modern glazing materials

According to numerous studies, buildings consume 40 to 50% of all the energy in the world. Approximately half of this volume comes from heating and air conditioning. In modern homes the heat loss from windows is 40% of the total, searching for improved window systems to reduce heat losses started many years ago. The aim of this paper is to share the results of the research has been done with the overall objective: to determine the rational variant of glazing for the climatic conditions of the 1-st temperature zone of Ukraine, where Dnipro city belongs to.

To evaluate the heat-shielding properties of building structures the coefficient of resistance to heat transfer is used. The higher the coefficient of resistance to heat transfer of the material, the more reliable it is to protect building from cold.

The territory of Ukraine could be divided into two climatic or temperature zones. The first one includes the majority of Oblasts except South of Ukraine: Zaporizhzhian Oblast, Odessa, Kherson and Mykolaiv Oblasts, Crimea and Uzhgorod Oblast, the only one from Western Ukraine.

So, Dnipropetrovsk region belongs to the first climatic zone. It is characterized by comparatively high solar radiation and low rainfalls. The average January temperature for this temperature zone ranges from -2 to -9 C degrees. Such temperatures last from 1 to 2 winter months. The average July temperature is within the range of 20 to 24 C degrees. The area is located at 48 latitude, which means that specific measures are needed to protect houses from the sunlight.

To optimize thermal insulation properties it is recommended to put a 2-chamber double-glazed window or a double-glazed window with an energy-saving coating. For the first temperature zone, the value of the resistance to the heat transfer R_0 (the main characteristic of the material efficiency evaluation) should be at least $0.75 \text{ m}^2 \cdot \text{K} / \text{W}$ ($0.6 \text{ mK} \cdot \text{K} / \text{W}$ for the 2nd) [5], i.e. the coefficient of heat transfer K is not higher than 2.0) (Kotenova: 2007). Naturally, the coefficient of heat transfer 2.0 can be achieved only when the double-glazed unit: $4 * 16 * 4$ (i), $4 * 10 * 4 * 10 * 4$ (i) are used in the window design.

The application of low-emission optical coatings on the surface of the glass ensures the passage of short-wave solar radiation and prevents the out-going of longwave warm radiation. The most effective solution to this problem is the use of multifunctional glasses. As the double-glazed window occupies more than 70% of the window structure, then the main part of heat loss occurs through it.

So-called selective (low-emission) glasses with a special coating have been developed to reduce the loss of thermal radiation. At present, there are two types of such glasses: "*K-glass*" - with a hard coating and "*i-glass*" - with a soft coating. "*I-*

glass", which appeared later has thermal insulation characteristics is 1.5 times higher than "K-glass", so the market share of "i-glass" is constantly growing.

The first two versions of double-glazed windows can be used in window constructions for installation in unheated rooms. 25-35% of orders set in Ukraine use the described above double-glazed units. Double-glazed windows with i-glass can be applied in the glazing for the second climatic zone, but for the first climatic zone their properties are not enough. One of the solutions to this problem is the use of inert gases or a second i-glass, i.e. double-glazed windows must be double chambered.

«*I-glass*». It is possible to use as argon, one of the three glasses with i-sputtering, as filling of air interlayers of interstitial space. The width of the double-glazed windows in these cases should be at least 36 mm. In the third variant, an inert krypton gas is used, one of the three glasses with i-sputtering. By its energy-saving performance krypton is superior to argon. In the fourth variant, we a 32-mm glass unit without the use of an inert gas can be used, but with two i-glasses.

To sum up, it is practically impossible to make a translucent structure energy-saving without using glasses with spraying. It is advisable to use glass with a soft coating, because it significantly exceeds all the existing ones by its energy-saving properties. Taking into consideration the climatic characteristics of Dnipropetrovsk region, it is recommended to install 2-chambered double-glazed windows.

References

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