Some new aspects of low-E glasses application

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Abstract

Everybody knows that the low-E glasses application for energy saving also has some drawbacks. We concentrated on the decrease of light transmittance and UV-transmittance especially in comparing with initial glasses. As UV intake may be very important for some regions, the information about UV transmittance value by different products is very important. Results of our measuring show that UV transmittance level of sheet glasses lies in range of approximately 60-70% but low-E glasses are characterized by lower and more variable values: 15- 56%. Such values for the single glass mean that for double and triple glazing UV transmittance could be very low. When one faces problem of glass selection or glazing size changing, he needs the information about these parameters. Therefore, producers have to provide such information. In addition, we discuss possible consequences of obligatory requirements for UV characteristics on law level. This measure could permit to decide the energy saving problem without disturbance of sanitary norms for natural illumination and for UV access that is very significant for northern regions.

Introduction

At present, entire world community have an important question about the savings of energy resources, including about reduction in the energy expenditures for the heating of accommodations, what everybody considers usually first of all. One of the efficient methods to the solution of this problem is application of energy-saving IGUs with the glass with the low-emissive coating. Practice already showed that this method actually makes it possible to decrease energy consumption very substantially for the heating of accommodations. In connection with this even point of view appeared as the need to legislatively fasten the use of glass with the low-emissive coating in the external glazing of buildings and constructions in the required order. However, one ought not to forget that the savings of energy can be achieved not only due to reduction in the expenditures for heating, but also due to the savings of expenditures for the illumination of accommodations and their cooling in the summer period. Therefore the glazing has to reduce to the minimum the sum of expenditures for heating, the illumination, the cooling in the annual cycle. In this article we give our primary attention to the influence of the low-emissive glass application to the transmission of visible light, i.e., to the natural illumination of placements and ultraviolet radiation (UV). By UV radiation in this case we implied the ultraviolet radiation of neighbor range 300-380 nm - the range A, whose specific portion is necessary for the normal vital activity of living organisms. (Harmful rigid ultraviolet of ranges [B] and [C] can’t pass through the glass at all.)
The application of glass with the low-emissive coating has some minuses. It facilitates reduction in the heat losses, with the entire undoubted effectiveness of this measure. But we can list some weaknesses and the main is that low-emissive glass are characterized by lower level of the radiation transmission in the short-wave band of solar spectrum in comparison with the initial glass without the coating. And if this decrease in the region of visible light is comparatively small, it is much more substantial in the UV region.

The main text

In order to estimate the decrease degree and the spread of these values for the products, represented on the market, we have carried out the measurement of light transmission and transmission in the UV range for the sheet glass with 4 mm thickness without the coating and with the low-emissive coating from several producers. Obtained data are represented in tables 1, 2 [1, 2].

Table 1. The optical characteristics of some sheet glass from different producers [1].
The numbers are for glass with 4 mm nominal thickness.

Producer number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Glass mark	**M1**	**M1**	**M1**	**M5**	**M6**	**M6**	**M1**	**M6**	**M0**	**M0**
τ vl,%	90	91	91	91	90	90	91	90	90	90
τ el,%	84	85	83	81	79	78	84	82	81	82
τ UV,%	71	71	73	66	65	58	68	67	67	66

Table 2. Comparative data on transmission of ultraviolet and visible light by glass with different low-E coatings [2].

Producer number	**τ UV,%**	**τ vl,%**	**ε**	**Thickness, mm**	**Coating type**
1	31	86	0,04	3,9	S
2	38	80	0,1	3,81	S
3	40	86	0,08-0,09	3,85	S
4	54	84,5	0,15	3,85	H
5	32	67,5	0,16	3,9	S
6	15	84	0.59-0,61	3,9	S
7	25	85,5	0,09	3,8	S
8	53	84	0,21	3,1	H
9	49,5	82	0,13	3,9	S
10	22	83	0,09	3,85	S
11	56	84	0,2	3,1	H

It is evident from the tables that if reduction in the transmission of visible light in glass with the coating is comparatively small, then in the UV region it is much more substantial. So glass without the coating transmits 90- 91% of visible light and from 58% to 73% in UV - range. Glass with the low-emissive coating transmits 84- 86% of visible light, but the value of transmission varies from 15 to 56% in the ultraviolet range, comprising on the average only 30- 40%. I.e., the coefficient of light transmission in low-emissive glass is reduced on 5- 6%, but the transmission of ultraviolet decreases almost doubly. We found that the more significant decrease of this value is characteristic for the glass with the soft coating. In other words, if the heatproof properties of glass with the hard coating are inferior to the soft coated glass (emissivity coefficient for the first ranges 0.13 - 0.21, comparing 0.04 - 0.1 for the lasts), then with respect to UV transmission situation is reverse.

Let us note that the transmission in UV range is not the standardized value, so there is a completely significant spread of this value between the initial (without the coating) products of different producers. It is caused by glass composition and technology of production. For the coated glass all these factors means more spread in UV transmissions. Therefore, it is obvious that an improvement in the heatproof properties of glass is accompanied by a decrease in the level of the access to natural insolation into the living spaces in particular in the ultraviolet range. I.e., positive situation with respect to one parameter (heat economy) proves to be negative with respect to another (illumination).

Solution of this problem is to attain the necessary decrease of heat losses and not to break sanitary requirements with respect to illumination [3] in this case. It seems not so simple matter and requiring the weighed approach.

In the existing accommodations the solution can be achieved only by the most thorough selection of the components of glazing, that is the components of IGU (it relates both to the glass with the low-emissive coating and to the glass without the coating). The complete set of glass should be selected with the desired (or necessary) level of heat shielding and simultaneously with the acceptable illumination level. So analysis is necessary for the appropriate characteristics of glass in the complex. It is possible to use the procedures of calculation of the transmission coefficients of visible light and UV and heat resistance transfer, given in the standards [4, 5] for that. Taking into account the existing spread of these characteristics in glass of different producers, this problem can be solved. Let us note that if the task cannot be solved by using standard M0 and M1 glass, the solution can be achieved by including as the IGU component more transparent glass (advanced transparency glass). For the clarity typical curves of the visible light and UV radiation transmission by glass without coating and by low-emissive glass with max and min transmission level are represented in figure 1.

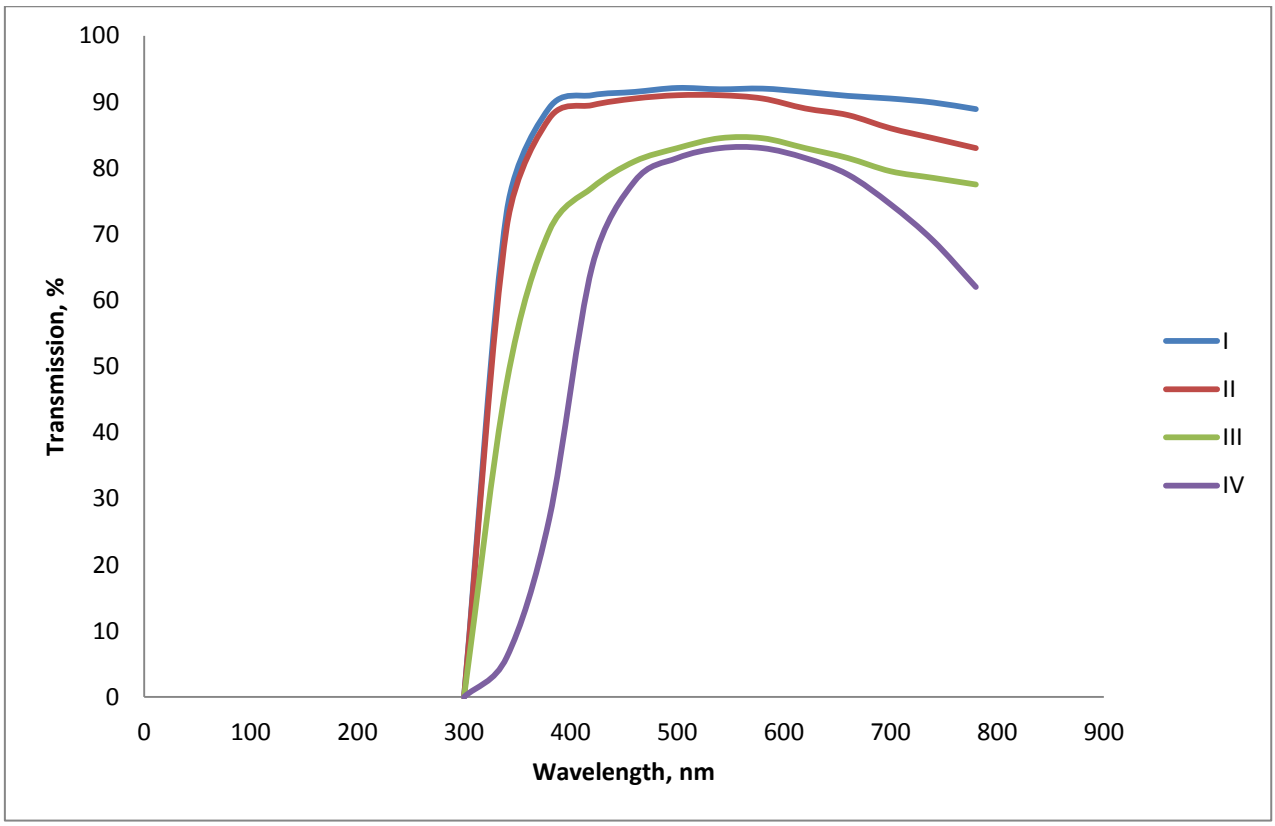

Figure 1. Transmission characteristics for some glass types.
I - Optiwhite (6mm), II - M1(4mm), III - low-E H (4 mm), IV - low-E S (4mm)

In the case of the new accommodations designing one of the ways of the necessary level of insolation retention with the use of low-emissive glass can be an increase in the sizes of light apertures, although it also entails the concealed threat of reduction in the effectiveness of energy-economy. In other words it is present the situation, when the achievement of desired values of two indices is required directly opposite actions. All this means that the practical use of low-emissive glass needs not only collecting of available complete information about the optical and thermal characteristics of glass, but it is also necessary to conduct the calculations of these characteristics for the versions of glazing for the specific application conditions (both in the case of already existing habitation and in the projected building case). Such analysis will make it possible to observe the necessary balance. We do assume that only serious mathematical approach with the use of procedures, given in [4, 5] will make it possible to solve problem of energy-economy without the offence against sanitary standards [3] with respect to of natural illumination and access of ultraviolet. Discussed problem is especially urgent for the northern regions because the specific dose of ultraviolet is necessary for a correct flow of metabolic processes in human and animals and it does contribute to the processes of photosynthesis of the plants, sealed in the hot-houses [6].

Conclusions

As indicated above, it is necessary to have available initial data concerning all appropriate parameters in order to carry out the calculations pointed out before, i.e. it is necessary to obtain complete information from the producer including the ultraviolet transmission. At present this value is not normalized and is not always indicated in the characteristics of glass products both with the coating and without it. Therefore it seems reasonable that the information about this parameter would be indicated in the required order. Moreover, the introduction of definite requirements for the transmission in the ultraviolet region can be expedient also at the legislative level.
And let us note also that the accessibility of entire set of the necessary parameters is very important, but also the responsibility of producer for the announced characteristics of production is very important too taking into account the multi-aspect character and the complexity of the standing task.

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