

Volodymyr SHEPITCHAK, Vasyl ZHELYKH, Nadiia SPODYNIUK
National University "Lviv Polytechnic", Ukraine

STUDY OF PECULIARITIES OF SURFACE IRRADIATION WITH PARALLEL ARRANGEMENT OF INFRARED HEATER

The article presents the experimental study for determining the intensity of radiant energy in the zone irradiated by infrared heaters with their parallel arrangement in relation to the distance between them. The purpose of the study is to analyze the intensity of radiant energy on the surface of infrared heater and its influence on the temperature parameters in the working area.

Keywords: heating supply, energy-efficient systems, heating, infrared heaters, radiant energy, radiation area, irradiation intensity

INTRODUCTION

Energy conservation and its efficient use belong to the components of energy security of any country. Due to the introduction of energy saving and implementation of more restricted standards of energy efficiency there appeared an urgent need for radical revision of the principles of engineering and constructing civil and industrial facilities, particularly, systems for their heating supply.

At present, the bulk of the heat energy is obtained by natural gas usage. Heating systems for large industrial buildings belong to the biggest consumers of heat energy. As a result of the work of convective heating systems, which are used most frequently, typical temperature gradient can be observed which is characterized by cold floor and warm air at the ceiling. This phenomenon has negative impact for industrial facilities, as long as the working area is not higher than 2 m above the floor and heating supply of the upper zone is unreasonable. The need for economy and heat loss reduction leads to an intensive search for new methods of heating supply in industrial premises. One of these methods is the heating system based on the use of emitters of infrared radiation.

EXPERIMENTAL RESEARCH AND ITS ANALYSIS

Radiation heating systems is one of the kinds of heating supply, where the infrared emitters are used as the heat source. They can be used both as an independent kind of thermal comfort maintenance and as an additional one.

Their main advantage is that they heat only the areas where heating is necessary. As a result of the use of such heating systems, only certain surfaces and objects are heated. Thus, we can achieve the desired thermal condition in different zones and individual workplaces [1-7]. However, when using the radiant heating systems, radiant energy distribution on the surface is non-uniform.

Figure 1 shows the surface of radiation intensity distribution. As we can see, the overwhelming amount of radiant energy is emitted by infrared source within a quite small solid angle, radically decreasing in the direction from projection of the centre of emitter. Hence, the task is to provide uniform heat distribution over the whole working area [8].

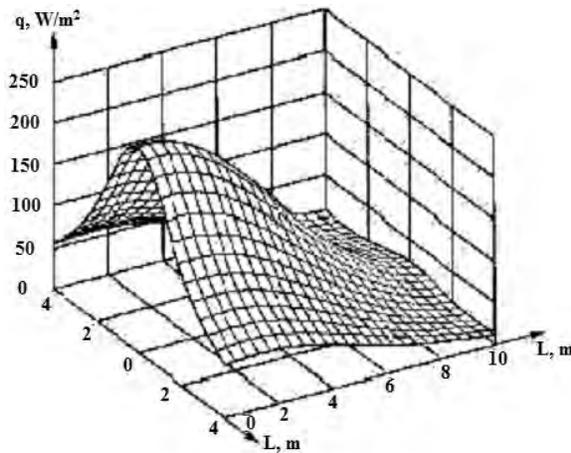


Fig. 1. The surface of radiation intensity distribution under the conditions of radiant heating

For the effective use of radiant heating, experimental studies for determining the density of radiant energy in common areas of exposure have been conducted. To carry out the experiment two infrared heaters with the capacity of 2000 W have been used, which were located at the height of 4 m; the distance between the heaters varied from 0 m to 8 m. Determining of the surface irradiation intensity was made from the vertical axis of the infrared source location along the horizontal surface.

Figure 2 shows the graphic chart of radiation intensity distribution emitted by radiant heaters with the capacity of 2000 W.

Graphic curve shows that the intensity of radiant energy on the surface changes along with the distance between the emitters. The intensity of the radiation increases with the use of two infrared heaters and increasing the distance between them up to 4 m (Fig. 2).

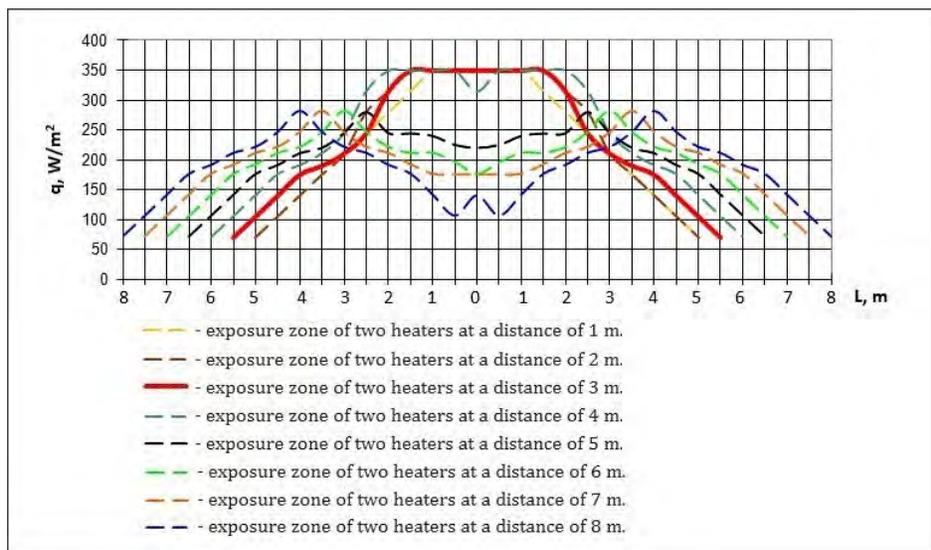


Fig. 2. Chart of changes in the radiation intensity of infrared heaters with the capacity of 2 kW at the distance $L = 1$ m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m

Uniform distribution of radiant energy on the surface is achieved at the distance of 3 m between the sources. Analyzing the graphic curve on Figure 2, we can see that the non-uniform radiation intensity of the surface grows proportionally to the distance between the radiation sources.

CONCLUSIONS

Thus, the change in the distance between infrared heaters is one of the possible ways to achieve a uniform distribution of radiant energy density. Based on the experimental results mentioned above, we can conclude that the distance $L = 4$ m is reasonable for radiation sources with the capacity of 2 kW located at a height of 4 m, in cases when the uniformity of the heat flow is achieved.

REFERENCES

- [1] Ango M.A., Infrared Irradiation, Gosenergoizdat, L.: 1957, 82 p.
- [2] Burakovskiy T., Hizinskiy E., Salia A., Infrared Emitters, Translated from Polish, Energia, L.: 1978, 408 p.
- [3] Machkashi A., Banhidi L., Radiant Heating, Translated from Hungarian, Strojizdat, M.: 1985, 462 p.
- [4] Khudenko A.A., Radiant Heating and Cooling, Workbook, KNUCA, Kyiv 2004, 152 p.
- [5] Bogoslovskyy V.N., Skanavi A.N., Heating: Textbook for Universities, Strojizdat, M.: 1991, 736 p.

- [6] Heating, Textbook for University Students in Specialty "Construction", A.N. Skanavi, L.M. Makhov, ASV, M.: 2002, 576 p.
- [7] Bakowski K., Networks and gas installations, Scientific and Technical Publishing, Warsaw 2002.
- [8] Shepitchak V.B., Energy-saving heating systems for industrial premises, [in:] V.M. Zhelykh, V.B. Shepitchak, Modern technologies, materials and designs in construction: scientific and technical collection, Vinnytsia: Universum - Vinnytsia, 2012. - N2 (13), 157-161.

BADANIE WŁAŚCIWOŚCI POWIERZCHNI PROMIENIOWANIA PRZY RÓWNOLEGŁYM UMIESZCZENIU PROMIENNIKÓW PODCZERWIENI

W artykule przedstawiono wyniki badań prowadzonych w celu określenia natężenia energii promieniowania w strefie promieniowania, usytuowanych równolegle promienników podczerwieni w stosunku do odległości między nimi. Celem badania jest analiza natężenia promieniowania na powierzchni promiennika podczerwieni i jego wpływu na parametry temperatury w obszarze roboczym.

Słowa kluczowe: ciepłownictwo, energoefektywne systemy, ogrzewanie, promienniki podczerwieni, energia promieniowania, obszar promieniowania, natężenie promieniowania