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AN IMPROVEMENT OF WORKING CONDITIONS IN METALLURGY AT THE EXPENSE OF RATIONAL ILLUMINATION

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There are considered questions of luminosity influence of work places at metallurgical shops on the working conditions and probability of accidents. There are executed experimental researches of operating capacity of industrial light-emitting-diode lamps at the conditions for like to conditions of its work at metallurgical production. There are offered measures on the increase of reliability and stability of work of these lamps which are promoted to improvement of working conditions metallurgical shops.

Keywords: metallurgy, working conditions, luminosity, taking of warmth, screening of radiation, energy-savings

Introduction. Working conditions in metallurgy, taking into account illuminance of working zone of plants are very difficult. On evenness and stability of illumination of workplaces negatively influence: presence of dust; selection of different on color and by the temperature of gases and continuous or periodic motion near the stationary lamps of technological machines and mechanisms, such as bridge cranes, platforms with ladles, which contain liquid metal or slag which is the sources of thermal and light radiation, conveyers with friable material; railway transport et al.

Light is one of major factors, which operate not only on the function of vision of worker but also on activity of its organism on the whole. It is known that at the insufficient state of illumination of working zone there is a rapid fatigue of worker, decline of the its working productivity, the potential danger of erroneous actions and accidents grows. It is set that to 5 % traumas insufficient or inefficient illumination of workplaces causes. Visuognosis of workers: accommodation (adaptation of eyes to clear vision of objects on different distances from a man); adaptation (adaptation of eyes to treason of conditions of illumination - level of illuminance); convergence (ability of eye to occupy such position at consideration of near objects, when its visual axes intersect on an object), - depends on density of processes, that they execute.

Bad illumination can result in the professional fallings of worker (short sight, spasms of accommodation). The unevenness of illumination and different brightness of surrounding objects results in frequent predictive of eyes and rapid fatigue of sight organs.

Taking into account the considered factors and sanitary requirements industrial illumination must provide both evenness of illuminance and approximation to natural

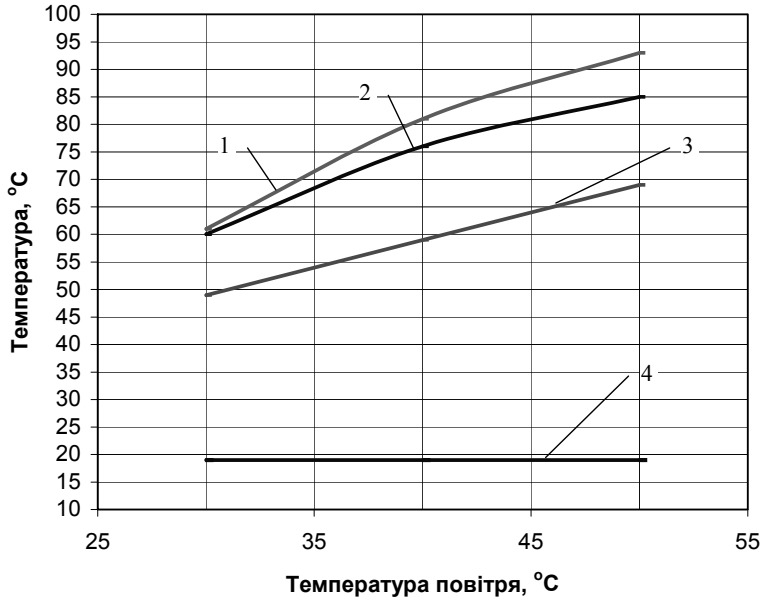
spectral composition of light and minimum fatigue of vision; and also to eliminate possibility of blindness and presence of reflections of working surface [1,2].

Analysis works of the multi-faceted lighted devices, which use in metallurgy testifies, to advantage of the use of light-emitting diodes. Comparatively with incandescent lamps and more modern gas-discharge lamps of high-pressure as DPL type and sodium DNT light-emitting-diode lamps allow evenly to light up considerable floor spaces, sending greater part of the world to the working zone. The modern construction of such lamps provides protecting of their surface from the accumulation of dust and moisture, and transparency of glass in a most measure coincides with natural light.

Problem formulation. At LTD. «Tesla-Z» the original construction of industrial light-emitting-diode lamp in an impermeable aluminum corps is worked out. At the test of pilot sample of device a serious defect was educed - overheat of transformer and, as a result, periodic functioning of thermal protection which results in disconnecting of illumination. In obedience to technical documentation on completing, transformer and light-emitting diodes exploitations have certain ranges of working temperature which guarantee them positive-acting work. In the case of increase of temperature of transformer over 90 °C takes place wear its thermal defense and disconnecting to the transformer. At the increase of temperature of light-emitting diodes more than 110 °C such devices can to fait [3]. In this connection the complex of researches, sent to determination of the thermal mode of device and development of measures on perfection of its construction is executed.

Basic part. There is investigated the lamp experimental sample of power 126 W. Temperature of separate elements of device was by means of thermo-electric transformers of Kh-A type with registration of values of thermo-electromotive force by digital multimeter. Hot joints of the noted transformers are calked in the corps of lamp or densely pinned in places, comfortable for mounting. Transformer temperature was measured, using the technological opening which is closed by pung.

The collected researched sample was disposed in a chamber, where maintained the set temperature of air (surrounding environment). Tests executed for three values surrounding temperatures: 30, 40 and 50 °C. According to the results of industrial researches of working conditions of cram machinists in the zone of location of lamps in hot metallurgical workshops on height of more than a 10.0 m the temperature of air usually did not exceed 50 °C except for the hottest days in summer. In winter and in autumn a level of the noted temperature was considerably less. For the workshops of preparation of charge, cold rolling of metal, repaid mechanical workshops the noted level of temperature is not fixed by a summer. After translation of lamp in a thermal steady-state the value of temperature of its separate elements is fixed. The temperature diagram of research for base construction of device is given on fig. 1.



1 is a transformer; 2 are light-emitting diodes; 3 is a corps;
4 is an overfall of temperature «corp- surrounding environment»

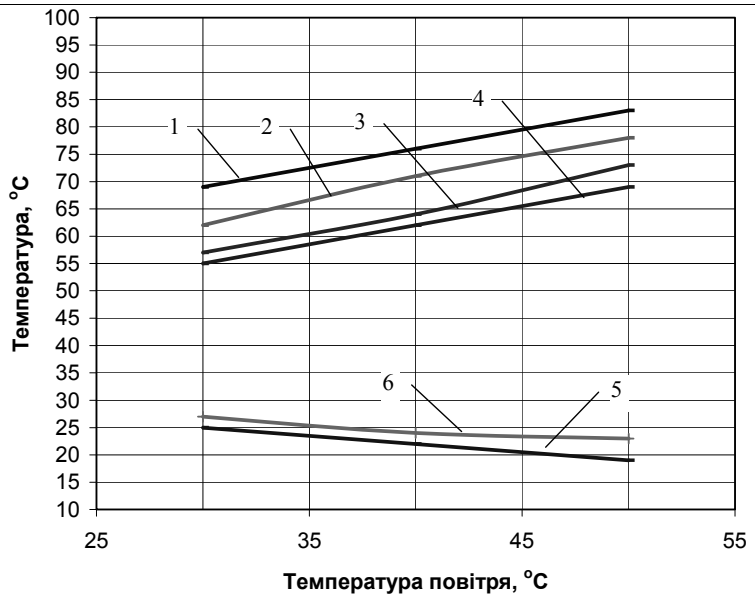
Figure 1 - Temperature diagram of research of base lamp**:**

At realization of researches it is set; that light-emitting-diode elements have a possible level of temperature in all investigated range of (30-50 °C) temperature of surrounding environment, however taking of warmth from a transformer is insufficient. For surrounding temperatures higher after 40 °C look after heating of transformer to the temperature 81-93 °C and functioning its thermal protection.

Heat emission from the external surface of lamp corps to the surrounding environment is not by limiting element at taking of warmth from a transformer, as an overfall of temperature between a corps and surrounding environment folds 18-19 °C, id est. for a diminution in the temperature of transformer necessary placing on its surface of radiator which takes a thermopaste is used.

On the structural considering as a thermal radiator was used by overhead dismountable aluminum panel of lamp, for what changed the place of location of transformer in the corps of device: there is carried out its attaching to the noted panel, thus for the improvement of thermal contact used thermopaste.

After bringing in the construction of light-emitting-diode lamp of treasons the new cycle of researches on the analogical program was executed. The temperature diagram of research of the improved construction of device is presented to fig. 2.



1 are light-emitting diodes; 2 is a transformer; 3 is a radiator; 4 is a corps;
5 is a drop of temperature «corp-surrounding environment»;
6 is an drop of temperature «radiator-surrounding environment»

Figure 2 - Temperature diagram of research of the modernized lamp:

For the estimation of efficiency of thermal radiator application the engineering calculation of heat emission from the corps of lamp to the surrounding environment was carried out. Size of thermal stream from an area the surfaces of corps, which is a radiator for the transformer Q_{gen}, expected after a formula:

$$Q_{gen} = \sigma_0 \cdot \varepsilon \cdot \left[\left(\frac{T_c}{100} \right)^4 - \left(\frac{T_{env}}{100} \right)^4 \right] \cdot F + \alpha_{conv} \cdot \left(T_c - T_{env} \right) \cdot F \ , \qquad (1)$$

where σ_0 is a coefficient of radiation, W/(m^2·K^4); ε is a degree of blackness of corps, for the unpolished aluminum $\varepsilon = 0.07$ [2]; T_c, T_{env} - accordingly temperature of corps of lamp and surrounding environment, K; F is a pottage of heat emission, in our case $F = 0.0135$ m^2; α_{conv} is a coefficient of heat emission by a convection, W/(m^2·K^4), for a horizontal surface used a formula [3]

$$\alpha_{conv} = 3{,}3 \left(T_c - T_{env} \right)^{0{,}25} \ . \qquad (2)$$

The results of calculations are presented in a table. 1.

The test of the modernized device and executed calculations testify that the conditions of its work get better at the use as radiator of transformer of removable cover of lamp. Yes, for surrounding temperature 30 °C temperature of corps of transformer not exceeds 62 °C, for surrounding temperature 40 °C - does not exceed 71 °C, but for surrounding temperature 50 °C - does not exceed 78 °C. Temperature of area of cover, which serves as a thermal radiator, rises, that provides the greater dope of temperatures between a radiator and surrounding environment, and, thus, and improvement of conditions for taking of warmth from a transformer. The size of thermal stream from the surface of thermal radiator of transformer increased in the working interval of temperature to 2.43-2.93 W (on 0.42-0.040 W), that provides a diminution in the temperature of

transformer on 10-15 ºС. Here size of radiant constituent of thermal stream of cooling from the surface of lamp in surrounding environment considerably smaller its convective constituent, that it is related with the subzero measure of blackness of material of corps and level of temperature of bodies which participate in a heat exchange.

Table 1 - Efficiency of the use of cover-radiator

Surrounding environment temperature °С	Thermal stream from the surface of area of lid, W:						Treason thermal to the stream, W
	with a transformer			without a transformer			
	rad.	conv.	resul.	rad.	conv.	resul.	
30	0,124	1,767	1,891	0,184	2,742	2,926	1,035
40	0,223	1,767	1,990	0,170	2,366	2,536	0,546
50	0,243	1,767	2,010	0,185	2,244	2,429	0,419

In the case of dust deposit and it's of direct sun radiation on the corps of lamp, and also on the area of radiator of transformer there is possible a decline of efficiency of taking of warmth, as a result, increase of temperature of transformer to the critical size (90 °С).

Conclusions.

1. Up back of light-emitting-diode lamps substantially promotes evenness and stability of illumination of working area, it is restrains spectral composition and colored spectrum of light which assists the improvement of working conditions in metallurgy and decline of risk of accidents.

2. Laboratory researches testify to reliability of work of lamps for temperature of surrounding environment to 50 °С.

3. It is set that the use of light-emitting-diode lamps is possible in hot metallurgical workshops in the zone of temperate climate or for the cold or transitional period of year, and in the workshops of the cold rolling, peppier and mechanical workshops, workshops for preparations of charge and additional workshops - for the expensive period of year.

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