



STUDY OF LIGHT TECHNICAL CHARACTERISTICS OF MODERN LED LAMPS

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Abstract

Every year the issue of energy saving and energy efficiency is becoming more and more relevant. There are a number of reasons for this, among which one can distinguish:

- shortage of energy resources in Ukraine;
- reduction of natural resources;
- rising prices for energy imports;
- annual increase in electricity consumption.

Nuclear power plants, which today produce almost 60%, in 2017 reduced electricity production by 0.9% compared to the previous year to 87.6 billion kilowatt-hours.

So the problem of energy conservation has a global scale. Up to 20% of the total electricity consumption in the industry falls on electric lighting. One of the ways to increase energy efficiency is to modernize the lighting.

A few years ago, the introduction of LED-type lamps was too expensive, so it's not effective. Therefore, we decided to experiment experimentally with the introduction of different types of lamps, and to compare their economic expediency in time. But the situation in the market is changing, the cost of LEDs is reduced, as well as the electricity consumption.

Keywords: LED lamps, energy saving lamps, LED lamps composition.

THE FORMULATION OF THE PROBLEM

The problem of energy conservation has a global scale. Up to 20% of the total electricity consumption in the industry falls on electric lighting. One of the ways to increase energy efficiency is to modernize the lighting.

Our experiments indicate that many LEDs are poorly-matched, but not always consistent with the characteristics of manufacturers.

Also, at the moment, the issue of the influence of ambient temperature on the operation of LED lamps and their lighting characteristics has not been sufficiently studied.

ANALYSIS OF THE LAST RESEARCHES AND PUBLICATIONS

Having analyzed the available modern light sources, the main generalized characteristics of light sources.

After analyzing the above information and taking into account the problems of energy saving, it can be argued that one of the effective ways to reduce consumption (EC) for lighting is the replacement of incandescent lamps (IL) for compact fluorescent lamps (CFLs), whose light output is 4-5 times higher than in LR (Hoshko, 2014; Goshko *et al.* 2015a; Goshko *et al.* 2015b), and light-emitting diode (LED) lamps with light output of 5-8 times higher than LR, both in the illumination of the production complex, (Goshko, 2015; Goshko, 2016; Goshko *et al.* 2016) and in the housing and communal services. Street lighting is considered more economically - advantageous when using sodium lamps of high pressure with light output of 100 - 130 lm/W. (Hoshko, 2017)

FORMULATION OF THE PROBLEM

The purpose of the study is to investigate the effect of ambient temperature on the operation of LED lamps and their lighting characteristics.

MAIN MATERIAL

We examined LED lamps of the brands "IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwau", "Neo Max". The characteristics of the lamps are given in Table 1.

Table 1 – Characteristics of lamps provided by manufacturers

Виробник	Потужність: P, Вт	Напруга: U, В	Світловий потік: F, лм	Світлова температура: K	Світловідача: Ra	Срок служби: Год	Кут Освітлення: Град
IEK	11	230	990	4000	70	30000	200
Etron	10	165-265	900	4200	80	25000	200
Ledstar	10	160-230	850	3000	80	30000	270
Lightmaster	11	230	1100	4000	80	30000	200
Feron	10	230	850	4000	80	30000	200
Electro House	10	160-230	900	4100	90	50000	220
KODAK	10	220-240	890	4100	80	25000	270
Luxray	11	165-265	880	4200	80	30000	180
Jazzway	11	220-240	880	3000	75	25000	230
Neo Max	10	175-250	1000	4200	80	50000	360



Figure 1 – LED lamps under investigation



Figure 2 - LED lamp "IEK" 11 Watt.

Table 2 – Measurement results of "IEK" 11 Watt

U, В	E, Lx	F, Lx	t, c°
200	1215	71.5	19
210	1200	67.2	20
220	1198	68.1	21
230	1188	64.6	23
240	1183	61.6	26

The temperature of the environment during the study of the light source was 15°C, the illumination of the room was 15 Lux, and the distance to the luxometer was 30 cm.



Figure 3 - LED lamp "Etron" 10 Watt.

Table 3 – Measurement results of "Etron" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	1385	72.9	22
210	1346	71.2	25
220	1309	70.0	26
230	1285	65.7	27
240	1275	62.5	27



Figure 4 - LED lamp "Ledstar" 10 Watt.

Table 4 – Measurement results of "Ledstar" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	730	66.4	17.8
210	1016	64.5	19
220	1025	62.1	19.4
230	1012	58.7	20
240	988	54.9	22.2



Figure 5 - LED lamp "Lightmaster" 11 Watt.

Table 5 - Measurement results of "Lightmaster" 11 Watt

U, B	E, Lx	F, Lx	t, c°
200	1830	91.5	22.2
210	1772	87.0	23
220	1748	83.6	25
230	1708	78.2	26.5
240	1700	74.6	27



Figure 6 - LED lamp "Feron" 10 Watt.

Table 6 – Measurement results of "Feron" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	1080	67.5	21.5
210	1055	65.2	22.5
220	1030	60.8	23
230	1000	58.0	25
240	1000	55.6	25.6



Figure 7 - LED lamp "Electro House" 10 Watt.

Table 7 – Measurement results of "Electro House" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	1075	76.8	24.1
210	1051	71.5	26.3
220	1040	72.7	30
230	1028	68.8	32
240	1029	66.0	32.8



Figure 8 - LED lamp "KODAK" 10 Watt.

Table 8 – Measurement results of "KODAK" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	460	85.2	16.8
210	680	101.2	18
220	1020	74.8	20
230	1330	68.0	22.3
240	1460	64.0	24



Figure 9 - LED lamp "Luxray" 11 Watt.

Table 9 – Measurement results of "Luxray" 11 Watt

U, B	E, Lx	F, Lx	t, c°
200	1493	74.7	21
210	1463	69.7	22.5
220	1465	121.1	22.5
230	1421	112.3	23.7
240	1405	65.0	25



Figure 10 - LED lamp "Jazzwau" 11at.

Table 10 - Measurement results of "Jazzwau" 11 Watt

U, B	E, Lx	F, Lx	t, c°
200	720	62.1	18.8
210	865	57.2	20
220	880	53.3	21
230	870	50.4	23
240	850	47.2	25



Figure 11 - LED lamp "Neo Max" 10 Watt.

Table 11 - Measurement results of "Neo Max" 10 Watt

U, B	E, Lx	F, Lx	t, c°
200	720	62.1	18.8
210	865	57.2	20
220	880	53.3	21
230	870	50.4	23
240	850	47.2	25

Generalized research characteristics of modern lamps

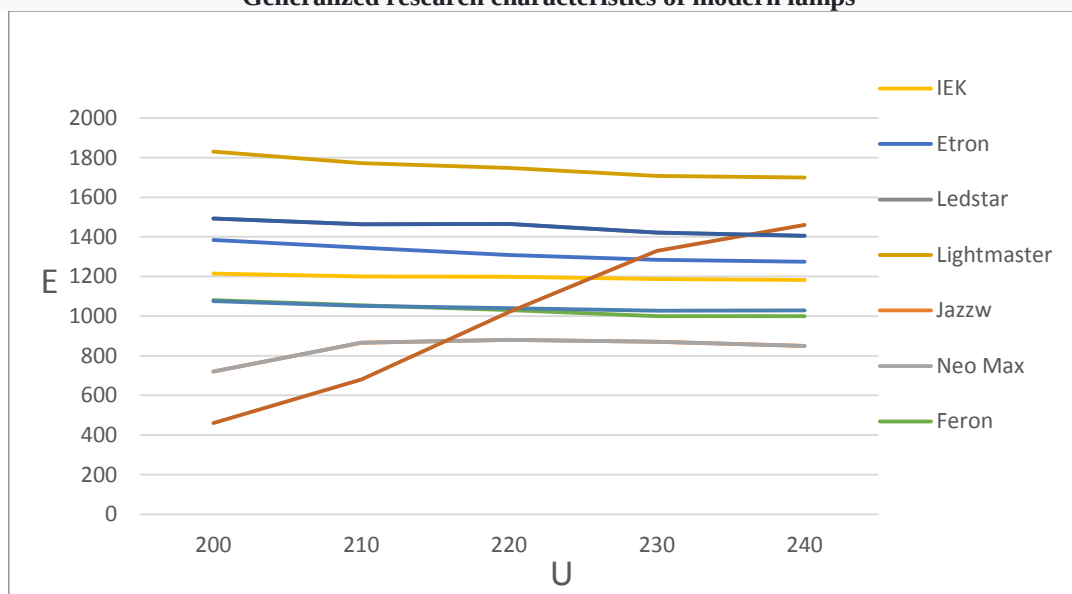


Figure 12 - Graphical dependence of light emission on the voltage of light sources of the brands "IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwau", "Neo Max".

Analyzing the graphical dependence of light emission on voltage, we see that for some lamps the control scheme provides a constant level of light emission when the voltage changes in this range and is from 870 Lux to 1708 Lux at the nominal voltage ("IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "Luxray", "Jazzwau"), and for others, the light emission depends on the voltage and is from 850 Lux to 1330 Lux at the nominal voltage ("KODAK", "Neo Max").

The highest value of light emission at the nominal voltage was obtained for the "Lightmaster" lamp and it is 1700 Lux.

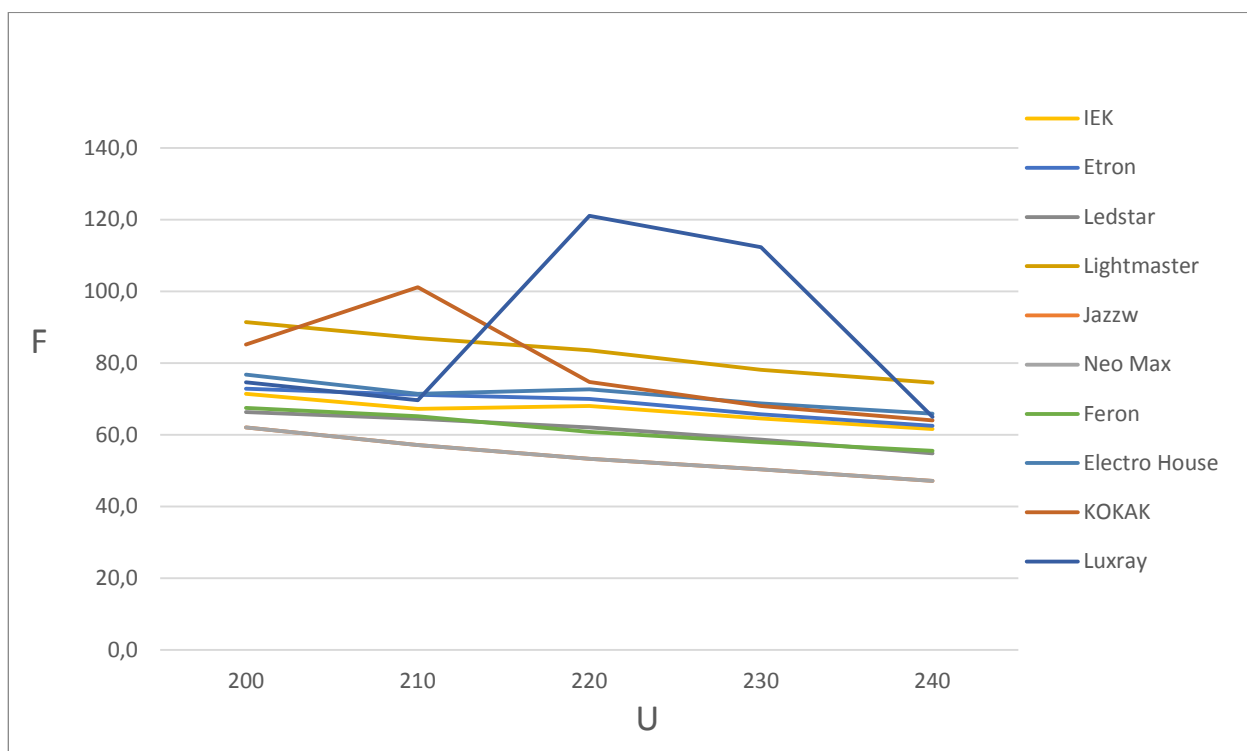


Figure 13 - Graphic dependences of light output on the voltage of light sources of the brands "IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwau", "Neo Max".

Analyzing the graphical dependence of light output on voltage, we see that for some lamps the control scheme provides a constant level of light output when the voltage changes in this range and is from 50 to 78 Lux/W at the nominal voltage ("Neo Max", "Feron", "IEK", "Etron", "Ledstar", "Lightmaster", "Electro House", "Jazzwau"), and for others, the light output depends on the voltage from 68 to 112 Lux/W at the nominal voltage ("Luxray", "KODAK").

The highest value of the dependence of light output on voltage at the nominal voltage was obtained for the Luxray lamp and it is 112 Lux/W.

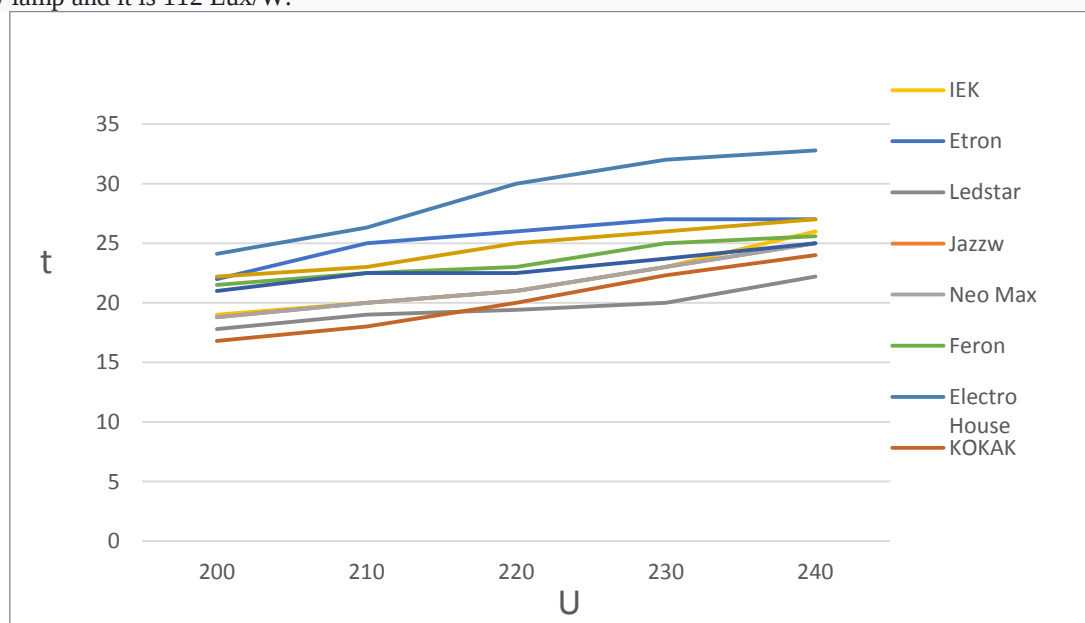


Figure 14 - Graphical dependences of the lamp heating temperature on the voltage of light sources of the brands "IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwau", "Neo Max".

Analyzing the graphical dependence of the heating temperature of the lamps on the voltage, we see that for all lamps the heating temperature of the lamps depends on the voltage and increases smoothly from 16.80C to 320C ("IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwa", "Neo Max").

We obtained the highest value of the heating temperature of the lamps at the nominal voltage for the "Electro House" lamp, and it is 32⁰C.

CONCLUSIONS

Having conducted an analysis of the available modern light sources, the main generalized characteristics of light sources.

Analyzing the graphical dependence of light emission on voltage, we see that for some lamps the control scheme provides a constant level of light emission when the voltage changes in this range and is from 870 Lux to 1708 Lux at the nominal voltage ("IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "Luxray", "Jazzwau"), and for others, the light emission depends on the voltage and is from 850 Lux to 1330 Lux at the nominal voltage ("KODAK", "Neo Max").

Analyzing the graphical dependence of the heating temperature of the lamps on the voltage, we see that for all lamps the heating temperature of the lamps depends on the voltage and increases smoothly from 16.80C to 320C ("IEK", "Etron", "Ledstar", "Lightmaster", "Feron", "Electro House", "KODAK", "Luxray", "Jazzwa", "Neo Max").

Analyzing the graphical dependence of light output on voltage, we see that for some lamps the control scheme provides a constant level of light output when the voltage changes in this range and is from 50 to 78 Lux/W at the nominal voltage ("Neo Max", "Feron", "IEK", "Etron", "Ledstar", "Lightmaster", "Electro House", "Jazzwau"), and for others, the light output depends on the voltage from 68 to 112 Lux/W at the nominal voltage ("Luxray", "KODAK").

We obtained the highest value of the heating temperature of the lamps at the nominal voltage for the "Electro House" lamp, and it is 320C.

The highest value of light emission at the nominal voltage was obtained for the "Lightmaster" lamp and it is 1700 Lux.

The highest value of light output dependence on voltage at nominal voltage was obtained for the Luxray lamp and it is 112 Lux/W.

Based on the results of the experiments, we recommend the use of Luxray lamps, which have the highest indicators in this class (light output at nominal voltage is 112 Lux/W, $\cos\phi$ is 0.79).

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