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Reduction of electricity consumption in television pavilions by 40-50% due to the correct choice of lighting devices and the application of lighting Laws in cinematography

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Annotation

The scientific article reveals such a problem as reducing electricity consumption in television pavilions through the use of more economical lighting devices, as well as through the application of lighting laws in cinematography in television pavilions. For example, only in the city of Tashkent there are more than 50 television pavilions, which use various lighting devices with different technical parameters. This paper will show a concrete example for one television pavilion located in the Media Center of the Uzbek National Television and Radio Company, accurate calculations of reducing electricity costs by 40-50 percent.

Keywords: lighting device, efficiency, electricity, duration of work in hours, main lighting on the set,luminous flux

Introduction

In recent years, the world has been promoting the reduction of emissions into the atmosphere, reducing the consumption of various natural resources to generate electricity, and reducing electricity costs in various ways. The scientific potential of the world community is created by various energy-saving devices, including electric lighting lamps. However, many enterprises and organizations are still using old non-economical technical means and electric lamps.

Since 2012, an analysis of electricity consumption in the television pavilions of the National Television and Radio Company of Uzbekistan has been carried out. It is known that on any television from 40 to 75 percent of electricity is consumed by lighting devices, depending on the use of various types of electric lamps, lighting methods and the number of lighting devices. This scientific work was carried out in order to find out why there are such different indicators of electricity consumption, what it depends on and how to achieve maximum energy savings. If all TV pavilions apply all the recommendations given in this article, then TV studios will reduce electricity consumption by 40-50 percent, reduce the cost of various materials by 70-80 percent, respectively and the material costs of studios will be reduced.

Chapter I. Reduction of electricity costs through the use of energy-efficient lamps.

After analyzing the lighting devices used in the pavilion, it turned out that 20 devices had halogen lamps, and 20 devices with gas-dischargelamps. Why was this option of "warm" and "cold" light chosen? The designers explained that they want to simulate both daytime and home light. While analyzing the electricity costs for the operation of this group of electric lamps, one

calculates the electricity consumption in this pavilion in accordance with the technical parameters. Halogen incandescent lamps are installed in the pavilion, in accordance with the technical characteristics of this type of lamps. We calculated the profitability of use, the cost of electricity and the purchase of this type of lamps. The only indicator for all technical indicators in comparison with other electric lamps is the best indicator of the color transfer coefficient. This indicator is at the top in cinematography and the use of these lamps justifies the costs, since this indicator is one of the most important for big screen cinema. However,thisindicatorisnotsoimportantfortelevision.

Table 1. Technical characteristics of incandescent lamps of the KG series

TIPE LAMP	Power Watt	Luminousflux, lm	Colortemperature, K	Average duration of work, h	Colortransfercoefficient
KG220-500-1	500	14000	3200	1500	100
KG220-500-6	500	9500	—	1500	100
KG220-1000-3	1000	26000	3200	400	100
KG220-1000-4	1000	26000	3200	420	100
KG220-1000-5	1000	22000	—	2000	100
KG220-1000-8	1000	22000	—	1500	100
KG220-1500	1500	33000	—	2000	100
KG220-2000-2	2000	54900	3200	450	100
KG220-2000-3	2000	54900	3200	450	100

Halogen lamps corresponding to the parameters of the lamp KG 220-1000-3 were installed in the pavilion in 20 spotlights. The studio buys these types of lamps for an average of $5. The average lifespan of work according to the table is 400 hours. In fact, the engineers say that on average, they work a maximum of 200 hours with such lamps. All incandescent lamps, including halogen, have an average efficiency of 5 to 7%. This means that 93-95 percent of the total electricity consumed is spent on heat. The release of a large amount of heat in the pavilion creates additional costs for air conditioning. Hence, according to the requirements, the pavilion must have a constant temperature in the range of 23-25 degrees Celsius. Engineers calculated that the average cost of electricity for air cooling depending on the time of year. In winter, 2 kW is spent on air conditioning per hour of operation of the pavilion, in summer more than 10 kW. On average, 6 kW of electricity is required. Now, let's calculate the material costs for 1 hour of operation of the pavilion with halogen lamps for one spotlight:

$$(1.0 + 6/20) \times 0.3 = 0.6\$$$

For 1000 hours, taking into account the duration of the lamp's operation for electricity per spotlight 0.6x1000 = 600$

The cost of buying this type of lamps for 1000 hours

1000/200 x 5 = $ 25 piece

The total cost of 26,000 lumens of luminous flux is $ 625 for incandescent lamps (Halogen lamps)

Now consider the costs of the other 20 spotlights working with metal halide lamps. Such kind of lamps are often used in movies and on television, however, not all of them, but only the kinds that have a good color rendering characteristics. These lamps differ from others in a small number of hours of operation.

Table 2. Technical characteristics of metal halide lamps of the DRI-1M brand

TIPE		Power watt	Luminousflux, lm	Average duration of work, h
DRI	400-1M	360	25200	1100
DRI	1000-1M	1000	80000	1100
DRI	2000-1M	2000	170000	900
DRI	3000-1M	3500	300000	650

(1.0 + 6/20) x 0.3 = 0.6$

For 1000 hours, taking into account the duration of the lamp for electricity per spotlight 0.6x1000x0.9 = 540$

The cost of buying this type of lamps for 1000 hours

1000/1100 x 95 = 86 $ piece

The total cost of 26,000 lumens of luminous flux is $200 for metal halide lamps

Now consider the costs if LED spotlights were used:

Table 3. Technical Specifications ARRI L7-C Hybrid DMX LED 1600w Multicolor

Power watt	LED 160 W rated. 220W maximum (Similar to the 1600-2200w halogen device)
Colortransfercoefficient	CRI 95 (3200° - 6500°K)
Luminousflux, lm	42000
Beamopeningangle:	15° - 50° (smoothadjustment)
Cost $ USA	5200 $
LED servicelife:	50000 h

(0.16 + 3/20) x 0.3 = 0.093$

For 1000 hours, taking into account the duration of the lamp for electricity per spotlight 0.093x1000 =93$

The cost of buying this type of lamps for 1000 hours

1200/50 = 24$

The total cost of 26,000 lumens of luminous flux is $ 121 for LED spotlights.

Comparing the costs only for electricity and for the purchase of lamps for spotlights, we get for spotlights

- with halogen lamps $ 625

- with metal halide lamps $ 200

- with LED lamps 121$

1. **Conclusion: the use of LED spotlights in television pavilions to generate a certain amount of light will cost 500% less on average than spotlights with halogen lamps compared those using spotlights with metal halide lamps by an average of 80%.**

Chapter II. Reduction of electricity consumption and reduction of operating hours of electric lamps due to the application of lighting laws in cinematography on television

Everyone knows that the image quality in cinema is much more professional than on television. This is the result of many years of research and work by the world's leading operators. The main work in this direction, the recommendations of which are used by many cinema operators, was carried out by the Soviet cameraman A.D. Golovnya, who described in his book all the nuances in cinema lighting which are now used by all experienced operators and illuminators not only in cinematography, but on theater stages and in television studios where competent operators and illuminators work, and on concert stages, as well. These laws, which are applied in cinematography, make the image more realistic, more voluminous and create the depth of the frame. According to the main methods of lighting in cinematography, it is necessary to properly illuminate the stage. It is known that there is only one natural lighting device in nature - the sun. And the main task of any operator is to create natural lighting. For example, all experienced cinema operators never shoot their films when the sun is vertically overhead, that is, at the zenith.

This means that the subject cannot be illuminated from all sides in the same way, as is done in most television pavilions, when all the floodlights illuminate with the same intensity. Even on theater stages, where experienced lighting operators work, they create a light composition for each scene of the performance so that the audience has a perception of natural lighting. What types of lighting are used in movies and theaters, that can be used in television pavilions, as well. These are: 1 - the main light that illuminates the subject by a maximum of 45 degrees to the left of the optical axis - 100%, 2-the filling light that illuminates the object 45 degrees to the right of the optical axis is 50% less intensity than the main light, the lighting of the scenery according to this law should be less than the main, but more filling light, this is approximately 75%. And the contour light, since it does not take up a large number of lighting devices, it can not be taken into account. D. Kilpatrickin his book accurately showed all types of lighting, and gave examples of proper lighting of objects, in particular the faces of people who are always the main subjects of shooting on any set. And so if we take for example our previously considered television pavilion with 40 lighting devices, which can only work with 20 devices at the same time.

Considering that, on average, 33% of the devices are the main lighting, 34% of the devices work as fill lighting and 33% of the contour lighting for the lighting of the scenery.

7 lighting fixture - remain unchanged, that is, 100%

7 lighting fixture - work with a load of 50 %

6 lighting fixture - work with a load of 75 %

This means that the electricity costs alone can be reduced by 25%.

CONCLUSION

Using the laws of cinematography lighting, it is possible to save on electricity on an average of 25% for any light sources.

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