ENERGY EFFICIENCY OF LED LIGHTING USAGE

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One of the primary directions in municipal energy management involves the implementation of modern and more efficient lighting sources. In Ukraine, a significant portion of electricity, approximately 15% or 27 billion kilowatt-hours per year, is consumed for lighting purposes. This is in line with the situation in developed countries, but the efficiency of its utilization is quite low. Annual lighting expenses in Ukraine amount to approximately 42 million kilowatt-hours per person, compared to 100-110 million kilowatt-hours per person in the United States. This issue arises due to the substantial use of inefficient lighting sources such as incandescent lamps, constituting 35% of the total amount, as opposed to 20% in Western countries. Additionally, there is a low adoption of energy-efficient semiconductor lighting sources in the public and administrative building sectors. Semiconductor light sources and LED panels represent promising alternatives to traditional thermal and discharge lamps.

LEDs have a robust potential in the field of lighting. Recent research has demonstrated that LEDs have achieved record-breaking levels of luminous efficiency, up to 276 lm/W for laboratory samples and approximately 200 lm/W for commercial models. This signifies the high level of sophistication in their design. Additionally, it is essential to highlight the extended service life of LEDs, ranging from 25,000 to 50,000 hours, characterized by a decrease in light output to 70-50% of the nominal value. While semiconductor light sources may be more expensive, they offer numerous advantages, including high brightness, compactness, ease of light output adjustment, and the ability to create various stylistic solutions. Every year, the growth of energy production and consumption in the world creates the necessary conditions for accelerating scientific and technical progress and improving the well-being of the people of the planet. At the same time, the increase in energy consumption requires more and more hydrocarbon raw materials, the reserves of which are unlimited. The main factor contributing to the need for energy saving is the depletion of fossil fuel reserves. As a result, oil and gas prices can be expected to rise steadily in the future. The solution to this problem involves a strict energy-saving policy based on the use of energy-saving technologies, nuclear power, alternative energy sources, and, above all, renewable ones, which include solar, wind and geothermal energy, biomass, small and large hydropower, and ocean energy.

With the ongoing technological advancements in semiconductor lighting sources and their decreasing costs, the adoption of LED lighting is becoming increasingly relevant. Significant energy savings, amounting to approximately $7,000 per year, can be achieved through the use of LEDs. The extended service life of LEDs will spare consumers from additional expenses associated with lamp replacements. Companies such as Philips and General Electric manufacture LEDs designed to operate for at least 7 years, fully paying off their initial costs within about one and a half years. The economic benefits derived from replacing old lighting sources with LEDs demonstrate that the investments in lighting modernization are justified and lead to substantial energy resource savings. Energy-saving technologies include new or improved technological processes characterized by a higher coefficient of useful use of fuel and energy resources. With the aim of conserving electrical energy consumed for lighting, LED light sources and lighting systems based on them are being implemented. This includes the utilization of imported semiconductor plates with LED technology (Bukharin, 2011).

In conclusion, it can be emphasized that LEDs are promising lighting sources with numerous advantages, representing the potential for creating efficient and modern lighting systems. Specifically:

1. LEDs can operate effectively at low temperatures, making them particularly relevant in our climatic conditions, with an operating temperature range from -50 to +60 degrees Celsius.
2. High luminous efficiency of LEDs, with brightness reaching up to 130 lm/W in commercial production and up to 200 lm/W in laboratory conditions, significantly surpassing conventional incandescent lamps, which provide only 10 lm/W, marking a substantial improvement.
3. LEDs enable the generation of various colors and shades of light emission, including pure blue, white, warm white, blue-green, and many other colors that cannot be achieved using incandescent lamps.

4. High safety is ensured when using LEDs due to low heat generation and low operating voltage, allowing their use in various specialized conditions, including wet environments and facilities with high safety requirements.

5. LEDs have directional light emission, and various modifications with different light dispersion angles are available, allowing for the creation of efficient lighting systems without the need for additional reflectors or diffusers.

6. It is essential to note that LEDs do not contain mercury or other toxic substances, making them environmentally safe.

Overall, the implementation of LED lighting can significantly reduce electricity costs and contribute to the development of more energy-efficient lighting systems.

References

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