Секція: ЕЛЕКТРОТЕХНІКА ТА ЕНЕРГО-ЗБЕРЕЖЕННЯ

УДК 621.327

Павло Авраменко
Національний університет України «КПІ», Україна

СУЧАСНІ МЕТОДИ ЗБЕРЕЖЕННЯ ЕЛЕКТРОЕНЕРГІЇ В ОСВІТЛЮВАЛЬНИХ УСТАНОВКАХ

Pavlo Avramenko

MODERN METHODS OF ENERGY SAVING IN LIGHTING INSTALLATIONS

In recent years the problem of energy saving in lighting installations has acquired a particular importance all over the world. A large number of associations and enterprises working in the field of lighting engineering are currently involved in finding the feasible solutions to this problem. What makes it an urgent issue is the energy shortage. For instance, the growth of industrial output in China leads to a continuous shortage of electricity. In summer 2012 as well as in the previous year there was the energy shortage of as much as 30-40 million kilowatts. According to the International Energy Agency (IEA) more than 20% of the total electricity consumed is intended for lighting purposes. On the whole, the cost of electricity consumed for lighting is approximately €265 billion a year [3]. Thus, if this issue is not addressed immediately, the global consumption of lighting resources is most likely to increase by 60% by 2030.

The main energy saving technologies applied in lighting engineering are:

- the use compact fluorescent lamps (CFLs)
- the use of T5 fluorescent light bulbs
- installation of electronic control gear (ECG)

Let us consider the mentioned above methods in more detail.

Compact fluorescent lamps. In the last decades the output of CFLs has grown tenfold. Compared with incandescent lamps, CFLs have8-12 times longer service life and five times greater light output (luminous efficacy). The practical applications of such CFLs can be most effective in lighting installations in which the most common sources of light are conventional incandescent lamps.

The field of CFL utilization is residential areas as well as commercial and office buildings. Small-sized CFLs with ECG can directly replace incandescent light bulbs. It has been calculated by *Philips Lighting* that by replacing three 60W incandescent light bulbs in any out of the 145 million households in the EU with three 11W CFLs with ECG of equivalent luminous flux output we may achieve the annual energy savings which could result from the elimination of ten 600MW thermal power plants in the territory of Europe [1: p.876].

T5 fluorescent light bulbs. In 1995-1996 the production of a new-generation linear fluorescent light bulbs was begun. At present two series of lamps are manufactured: T5 type with a thin 16 mm tube, which reach the highest light output of 104 lm/W, and ultrathin 7 mm lamps with the highest luminous flux per unit length, being designed for the operation only with ECG.

The main advantages of fluorescent light bulbs are the high luminous efficacy, a long service life (up to 20,000 hours), and a small decay in luminous flux during the operation period. The use of T5 fluorescent light bulbs with special-type ECG will reduce the power losses by 30-35%. The above advantages can allow decreasing the power capacity of lighting installations from 25 to 10 W/m^2 without any adverse effects upon the lighting performance quality.

Electronic control gear. ECGs are secondary power sources intended for the operation with fluorescent light bulbs. They have almost unlimited functionality required to provide optimum starting and operating modes of fluorescent light bulbs.

The main advantage of ECGs in terms of energy saving is not only the reduction of intrinsic loss and power consumption, but also the increase of light output to 50%. As a result, one may pre-

dict that future lighting technology will heavily rely upon using this type of control gears, reaching the energy saving rate of 75%. The set of T5 fluorescent light bulbs with A-class ECG also offer some prospects in terms of energy saving. Thus, the European Commission intends to take the challenge of increasing the market share of ECG to 55% [1: p.878]. The potential of energy savings by using the above lighting methods is illustrated in Table 1.

Table 1. The potential of energy savings

Lighting method	**Energy savings**
Use of CFLs (direct replacement of incandescent lamps)	75-80%
Use of energy-efficient T5 fluorescent light bulbs	30-35%
Use of ECG	75%

Today the most promising and exciting trend in energy saving in the field of lighting engineering is the use of light emitting diodes (LEDs). This is the most recent type of light sources that fundamentally differs from thermal radiators or gas-discharge tubes and is very attractive in terms of energy efficiency and environmental compatibility.

In contrast to other light sources LEDs give the advantages of high luminous efficacy (100-150 lm/W), low power consumption, high efficiency, high durability (more than ten years of continuous operation), etc. Due to a rapid progress in the field of LEDs design there are already a number of installations available in which LEDs are applied for general lighting. For example, the construction of Turning Torso building in Malmö (Sweden) is a real-life illustration of how LEDs are used for space lighting. Over 16,000 Golden DRAGON High-Flux LED illuminate the Turning Torso corridors with a pleasant uniform light. Motion sensors can reduce energy consumption, and the LEDs reach their full luminous flux at once. Even frequent on/off switching will not shorten the useful life of LEDs. However, the high cost is the major obstacle to the wide application of LEDs.

Modern lighting technology can save up to 40% of electricity worldwide, which amounts to €106 billion a year [2]. A simple substitution of more efficient technologies for incandescent lamps in all areas of lighting applications will save the energy proportional to that produced by 400 coal-fired power plants and reduce the global energy consumption by about 2.5%. At any rate the energy savings in lighting should not be achieved by lowering the lighting standards or abandoning artificial lighting, since the losses from deterioration of lighting conditions may greatly exceed the cost of electricity saved.

References

1. Справочная книга по светотехнике / Под ред. Ю.Б.Айзенберга. 3-е изд. перераб. и доп. – М.: Знак, 2006. – 972 с.

2. Энергосбережение. Световые решения для всех сфер применения. Режим доступа: http://www.lighting.philips.ru/pwc_li/ru_ru/connect/assets/product_brochures/Energysaving_brochure.pdf

3. Guidebook on energy efficient electric lighting for buildings. Aalto University School of Science and Technology. Department of Electronics. Lighting Unit. Espoo 2010. Retrieved from http://www.ecbcs.org/docs/ECBCS_Annex_45_Guidebook.pdf