Computer Simulation of Retrofit Led Lamps

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Abstract: COMPUTER SIMULATION OF RETROFIT LED LAMPS.The present paper considers the actual problems of development of modern LED products, the features of traditional light sources, as well as the possibility of their direct replacement by LED. It considers the possibilities of computer modeling of LED sources, including LED retrofit lamps. We modeled LED lamps with CREE LEDs in CAD COMPAS-3D and TracePro Softwares.

Keywords: Light Device, LED, Light Source, Optical System, Modeling, Design, Retrofit

I. INTRODUCTION

LEDs are used in almost all areas of lighting engineering. Modern LEDs (SD) are characterized by economical energy consumption, vibration resistance, rich color scheme, almost "eternal" service life (up to 100 thousand hours or more), mechanical reliability and strength, lack of inertia. SD has already taken its place in the lighting sector, firmly, finding its application in automotive headlights, traffic lights, road signs, and, of course, lamps of various designs and purposes. Therefore, an important issue, especially for Russian manufacturers of lighting products, is the development of such lamps and devices fully meet modern international requirements [1-3]. Development of LED lamps for installation in various lamps of industrial and special purpose as lighting lamps is our actual purpose. Among the main trends in the development of LED-products are: size reduction, cost reduction, the use of plastic materials in retrofit lamps, besides the expansion of the lamps functionality. Recently, the market of LED products is actively saturated with similar LED retrofit lamps designed to replace the incandescent lamps (light bulbs). These are upgraded lamps in which new light sources are enclosed in traditional housings. The advent of such products is largely due to the technical and economic benefits, determined by the simplicity of replacing the old-style lamps with new modern analogues.

II. FEATURES OF LED RETROFIT LAMPS

The transition from traditional to LED lighting can be carried out in one of the two following ways. The first involves the replacement of the light source (is) in the lighting device (OP). The second involves a complete replacement of the lamp or spotlight by the LED device [4,5]. Both approaches are associated with advantages and disadvantages.

When switching to LED lighting, you can replace the traditional with the –so- called LED retrofit lamp, compatible with it in size, connector type, light intensity curve (KSS) and power supply parameters. In General, the

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LED retrofit lamp consists of a traditional base (E27, E14, GU10,GU5, 3), which can be installed in a conventional cartridge, a glass (plastic) shock-resistant bulb (transparent/ matte) with a standard shape (pear-shaped, spherical, candle-shaped, etc.), a driver, thanks to which electricity is converted into light, a radiator, a cooling driver that extends the life of the lamp, a Board with LEDs (Fig. 1).

Fig. 1: construction of LED retrofit lamps

In recent years, the market has been almost saturated with LED-based lamps with form factors of linear and compact fluorescent lamps, as well as incandescent lamps and halogen incandescent lamps [6,10]. In terms of lighting characteristics, the closest option incandescent steel filament is LED lamp, in which the "filament" consists of a set of led chips (Fig. 2).

Fig. 2: Filament LED bulb of a form factor of incandescent bulbs for general purpose

III. COMPUTER SIMULATION OF RETROFIT LED LAMPS

Computer SIMULATION allows to reduce the time and material costs to obtain all the information required for the project research. Computer modeling in lighting engineering consists of the construction of producing models using computer-aided design systems and optical modeling programs as well as the study of their parameters [7-9]. Furthermore, given the obtained information, samples of these products can be made and subsequently brought to the production of batches. This modeling is necessary for calculation of illumination, modeling the function of the lighting systems, in addition to the calculations of new

lighting systems with the set characteristics. The specialized CAE systems (engineering analysis systems) are used in the field of making instruments, among which the following groups can be distinguished: computer-aided design of systems, optical element design programs, optical modeling systems such as LightTools, TracePro, ASAP, SPEOS, etc. They provide two main ways to visualize the results of optical modeling: first, it is the visualization of the distribution of the output light characteristics (illumination, brightness, light intensity) on the radiation receiver and, second, the visualization of light fields (for example, ray trajectories) in the optical system. TracePro is the universal software for the calculation of rays in the design of lighting and non-imaging optical systems, as well as for photometric analysis. The development of lighting products begins with the creation of a model as accurate as possible to meet the parameters of the future product. To this end, it is necessary to develop a 3D model, create a database of optical properties of the materials and the used coatings.

IV. MODELING OF LED LAMPS WITH LED ,CREE & RESULTS

Simulate lamp based on LEDs from CREE series XR–C7090. 3D LED models and lamps was developed in CAD COMPASS-3D (Fig. 3), after which they were exported with the Trace Pro system. Here, the parameters of the LED as a radiation source, the properties of the substrate surface, and the diffuser material were set. We traced the rays and simulated light distribution (Fig. 4).
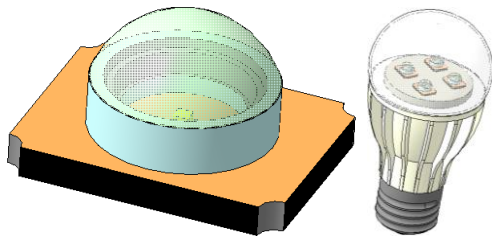

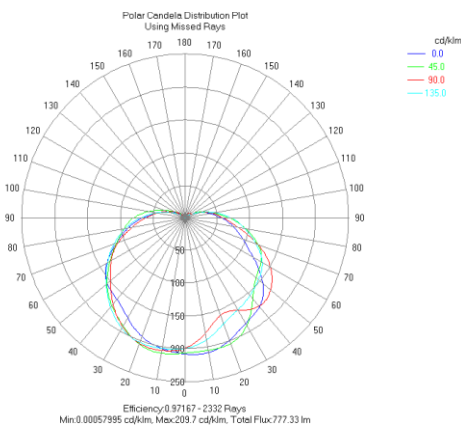**Fig. 3: 3D model of LED XR-C7090 and LED lamp**

Fig. 4. КCC LED lamp with LED XR-C

The designed LED lamp retrofit form factor incandescent lamps for general purpose. To this end, we used modern computer technologies of computer-aided design COMPASS-3D, and optical modeling by TracePro software. The obtained light distribution curves allowed us to come to a conclusion about the possibility of using such lamps for direct replacement of the traditional lamps.

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