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Journal of Advanced Chemical Engineering

Engineering design of solar concentrator for transporting sunlight through optical fiber

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Abstract

The method for the determination of the fraction of visible light in solar radiation was proposed. The solar spectrum was divided into three regions: ultraviolet, visible and infrared radiation. The spectral distribution of the intensity of solar radiation under various conditions was considered. With the help of the Mathcad software package, the spectral luminosity of a black body was calculated. Further, the proportion of natural light in solar radiation was estimated. This calculation showed that 1 W/ m2 of natural light is 213 lm/m2, which was confirmed by 100,000 lux (lm/m2) with solar radiation of 1000 W/m2. The comparison is made between the absorption spectra of polymethylmethacrylate, perfluoropolymer and quartz fibers. The scheme of thermophysical processes occurring during the interaction of radiation with matter is considered. The formulas for calculating the threshold (critical) power density necessary for heating the surface to a given temperature for pulsed and continuous heating are derived. Further, the calculations of the critical power density and the allowable size of the area are made, with which the concentration of natural light in the POF could be determined. We presened the development of an optical system for the concentration of natural radiation. The optical system for the developed system of natural illumination based on fiber - Cassegrain system with a two-mirror lens - is considered. A system with a square section of mirrors is justified and calculated. Next, the reflection from the surface of the protective glass made of acrylic is evaluated and the required size of the end face of the polymer fiber used to transmit light to the room is justified. In conclusion, the radiation intensity at the output end of the polymer fiber is calculated. The system parameters were determined: a large mirror diameter of 198 mm, a small mirror diameter of 34.9 mm, a large mirror focal length of 49.5 mm, a small mirror focal length of 7.189 mm, the distance between the surfaces of the mirrors is 40 mm. The evaluation of the reflection from the surface of the protective glass made of acrylic showed that for the protective window of flat geometry the reflection coefficient is 7.74% and the convex geometry is 8.83%. The calculation of the radiation intensity at the output end of the polymer fiber showed that the total output power of the system will be determined by the number of fibers in the system.

Biography

Loshkarev I Yu has completed his PhD at the age of 25 years from Saratov State Agricultural University , Saratov, Russia. He is candidate Dr. of tech. Sciences, assistant professor of the department of "Engineering physics , electrical machinery and electrotechnology". He has 8 publications. Since 2018, he has been collaborating with LLC SOLARGY Group Izhevsk Russia. In collaboration with Sterkhov A and Petrov K research is being conducted at Polymer Science and Technology.

Citation: Loshkarev Igor Yuryevich, *Engineering design of solar concentrator for transporting sunlight through optical fiber*, Polymer Science 2020, International Conference on Polymer Science and Technology, Barcelona, Spain, August 31, 2020