NAFEMS UK Regional Conference 2018 - Abstract Submission

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Name	Dr. Tamas Deak
Job Title	Development Engineer Thermal
Company	Philips Lighting Hungary Kft.
Please identify the event for which your submitting?	NAFEMS UK Conference 2018
Will you be the presenting author?	Yes
Presentation Title	Design and simulation of thermal management solutions for professional LED luminaires
Relevant Themes / Keywords	LED, thermal management, electronics cooling, validation

Abstract (plain text)	The thermal management of LED luminaires intended for use in professional applications (stores, supermarkets, hospitality, healthcare, street lighting etc.) must meet several requirements. The temperature of LEDs and power supply electronics must be kept within certain limits for providing sufficient lifetime, the temperature of individual (primarily polymer) components has to be controlled in order to prevent aging processes, like discoloration. Further restrictions may apply, e.g. the maximization of the temperature of manually reachable outer surfaces. This must be provided in changing environmental conditions, like ambient temperature, sunlight, air current etc. As active cooling of LED lamps is obsolete and applied today only in very rare and special cases, the only way of heat extraction is convection and thermal radiation. Simulation can decrease the development costs significantly, because the thermal management solutions can be optimized to a certain extent before building prototypes. As thermal radiation is of primary importance in both heat emission and heat transfer between individual components within the luminaire, emissivity and reflectance values of the surfaces must be set realistically in the simulation, together with thermal contact resistances. Another problem is the warming of components due to the irradiation of visible light emitted by the LED. This can be significant in some cases, mostly in the optical components. The simulation of this phenomenon can be difficult, it can be most practically approached by calculating the light absorption on the affected surfaces and setting a surface heat source in the simulation on the corresponding locations. It must be carefully pondered which optical losses are calculated and simulated in this way, i.e. which have a measurable effect on the global thermal management. Irradiation must be taken into consideration also in thermal measurements, as thermocouples exposed to light can show false temperature values, because they are warmed by the light more than their immediate environment. Another important factor is the fluid-structure interaction, i.e. the convective heat transfer. The thermal behavior of the luminaires must be investigated for various ambient conditions and spatial positions. In this presentation the structure and setup of a LED luminaire is presented, along with the validation by thermal measurements and the associated challenges, e.g. the temperature measurement of irradiated areas and consequences of the application of materials with different thermal conductivities.
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