Let there be more LED light!

Over the last decade, as the efficiencies of Light Emitting Diodes (LEDs) has increased to the point where they are a viable replacement for incandescent bulbs and compact fluorescent lamps (CFLs) the world has reached a tipping point in the usage of LED Lighting within automotive lighting, street lighting, back lighting (for consumer electronics) and now general lighting applications.

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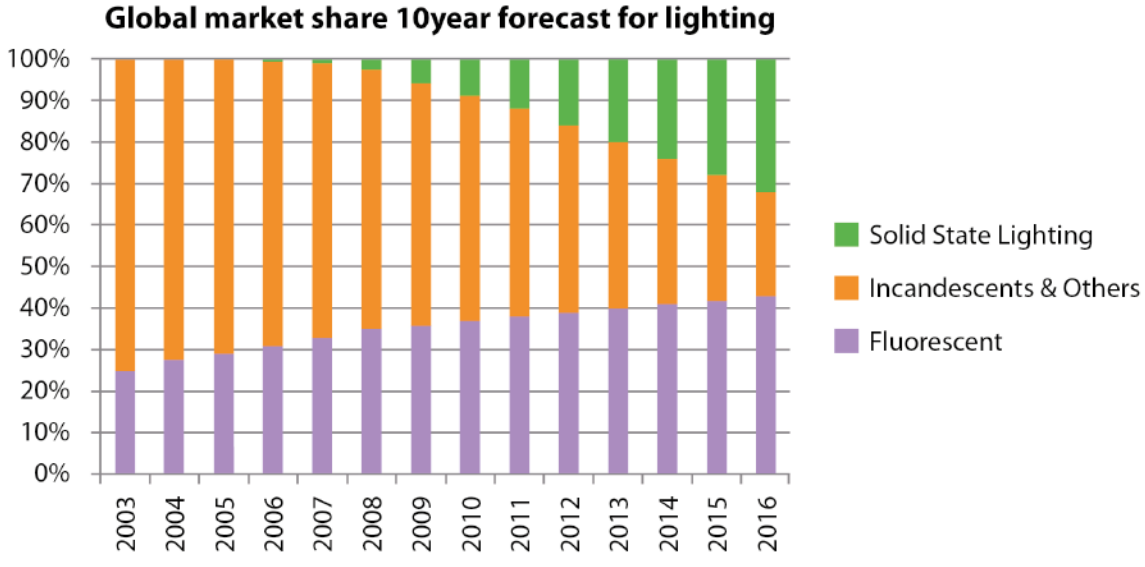
UP to 95% of the electric input in traditional incandescent light sources becomes heat and is largely dissipated via radiation. LEDs however are significantly more efficient with up to 60% becoming heat and not all of it dissipated via radiation. The challenge for this rapidly growing industry is therefore effective thermal management of these Solid-State Lighting (SSL) products. Heat must be removed by conduction and convection in order to keep the LED cool for quality lighting outputs, reliability and product lifetime. Hence, the key technology barrier to LED adoption for general lighting applications is thermal.

The LED lighting industry has also been hampered by a lack of standardization on data relating to the thermal performance of the LEDs themselves. As LEDs emit a substantial proportion of the power they consume as light, the power emitted as light has to be taken into account when calculating their real thermal resistance. It was for this purpose that the Mentor Graphics hardware product TeraLED™ was originally developed and released in 2005, and as LED light emission and lifetime strongly depends on temperature, proper thermal characterization of individual LED components is therefore very important. Accurate information on the real thermal resistance of LEDs is critical for lighting system designers to develop proper thermal management solutions of their SSL products. Knowledge about temperature dependence of the light output characteristics (such as luminous flux or color coordinates) of LEDs is necessary for designing luminaires which provide light intensity and light distribution patterns as required by lighting standards. Unfortunately, due to lack of industry standards, LED vendors' data sheets hardly provide any useful information in this regard.

With these factors and trends in mind, Mentor Graphics has released two new productlines. These offer new capabilities for the LED supply chain from manufacturers through sub-assembly to end user SSL products; a larger TeraLED and an LED Module for the CAD-embedded CFD product, FloEFD:

Extended TeraLED Product Family

The market demand for bigger, brighter LEDs that dissipate more power has necessitated the development and release of a larger TeraLED sphere with greater heat sinking capability. Mentor is now offering both 30cm and 50cm integrating spheres and a range of cooling options up to 50W of cooling. T3Ster® measurement results can be converted into so-called compact thermal models (CTMs) suitable for CFD simulation.



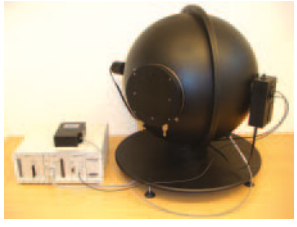
Source: Optoelectronics Industry Development Association (OIDA) Lighting Technology forecast 2007 – 2017

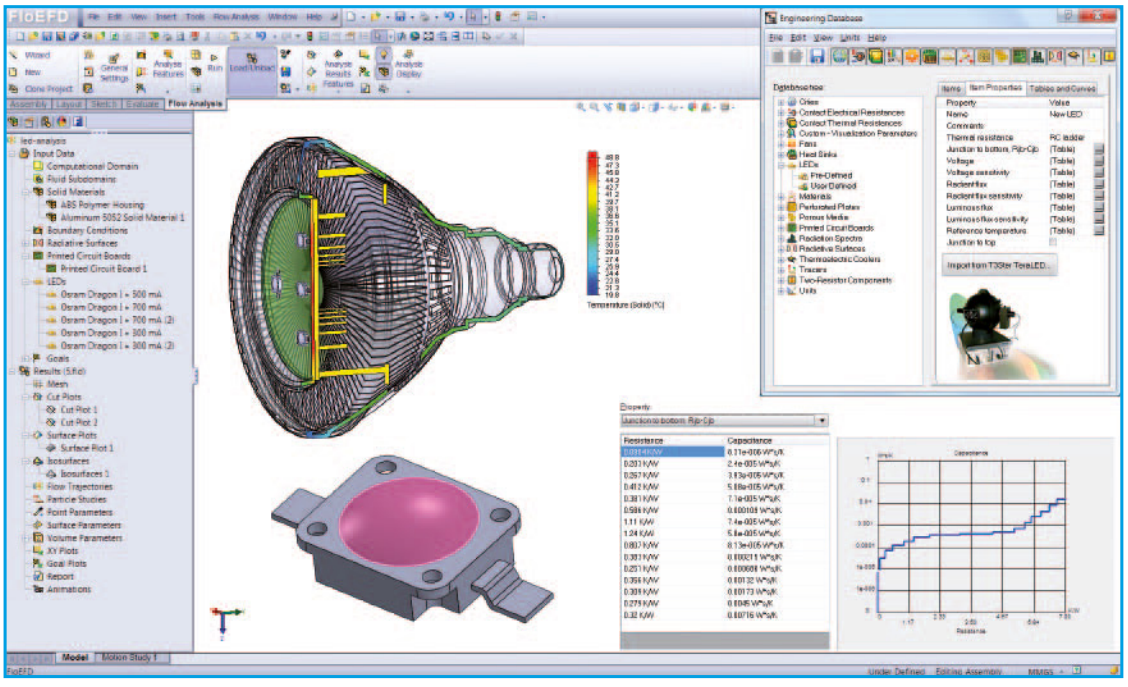
These models have now been extended via TeraLED measurements to include temperature-dependent light output data. These provide SSL designers, for the first time, with the precise models of individual LEDs needed to calculate the 'hot lumens' of their luminaire designs.

New CFD Module for LEDs

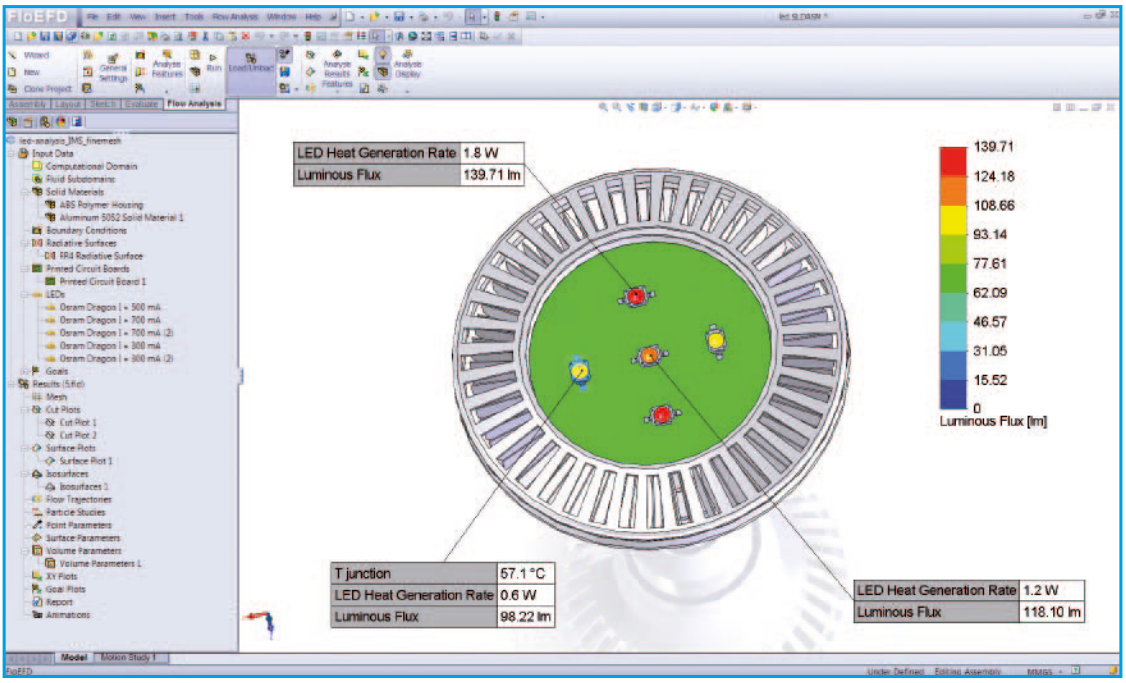
The FloEFD V12 release includes a unique CFD solution capability for designing Solid State Lighting. The innovative LED Module now allows designers to use accurate CTM and photometric models of LEDs obtained from T3Ster and TeraLED within a general purpose CFD simulation package. These models are uniquely driven at constant current as opposed to estimated power consumption inputs that yield less accurate predictions. This ensures correct accounting for power that is emitted as light when calculating the heat dissipation of the LED. Hence, the temperature, power consumption and light output (hot lumens) of the LED are all predicted accurately by FloEFD. To enable this, a "starter pack" of thermally and photometrically characterized LED models is provided as part of the module. These are: CREE XT-E; Osram Golden Dragon; Seoul P4; and Philips Luxeon REBEL. The module also includes the ability to account for adsorption of radiation in semi-transparent solids such as a lens in front of the LED, and is able to represent a PCB as a compact model with orthotropic thermal conductivity.

New 50cm, 50W TeraLED





Typical LED Module interface panels illustrating the T3Ster-TeraLED workflow in FloEFD 12.0



Typical LED Module "Hot Lumens" prediction of a retrofit SSL bulb in FloEFD 12.0