Shedding Light on **Auto Lamp Manufacturing**

Simulation saves time and resources in the development of an injection mold.

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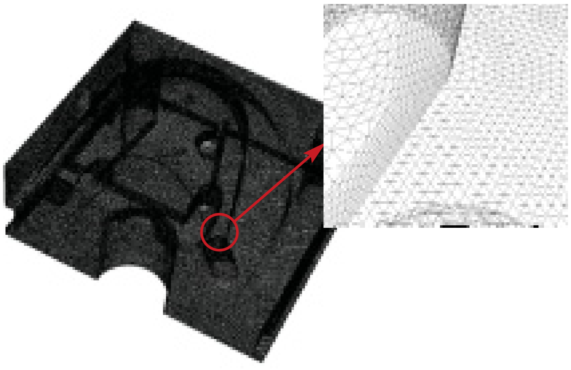
In the standard automotive lamp, reflector optics are responsible for distributing the light beam out of the lamp and toward the road. One common method for manufacturing the reflector section of the lamp is to use an injection molding process. When it comes to developing and optimizing the effectiveness of the molding process, one way to ensure consistent heating and shaping of the injected plastic is to incorporate thermal resistances into the mold itself.

The traditional method of placing these resistances relies on a trial-and-error procedure, based mainly on previous experience. Temperatures on the surface of the mold are then measured and compared to the allowable values. In order to break the paradigm of predicting the position of these resistances based on an almost empirical procedure, ARTEB Industries S.A., a Brazilian automotive lighting company, chose to use FLUENT software to pursue a simulation-based, thermal conduction study. Simulation offered the ability to expedite the development process, replacing the time-consuming traditional alternative with a more efficient option and providing engineers with a better understanding of the physical aspects involved in headlamp design.

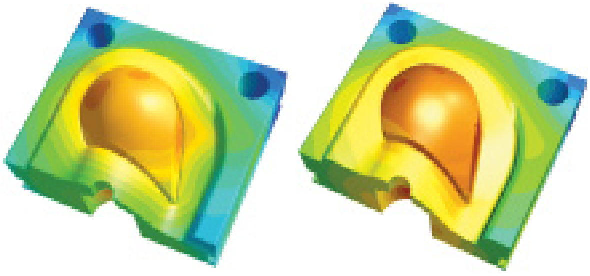
Using existing CAD geometry, a three-dimensional computational fluid dynamics (CFD) model was created. All the relevant aspects of the heat transfer phenomena were taken into account, and a conduction model was created based on the fact that the injection mold exchanges heat with the environment mainly through a natural convection mechanism. Mesh refinement was used near the mold surface in order to ensure a reliable discretization of the conjugate heat transfer mechanisms between the fluid and the solid structure representing the injection mold.



Meshed geometry for an automotive headlamp mold

An initial simulation of the mold was pursued in order to examine a preliminary configuration of the thermal resistances. The analysis of the results showed an unacceptable temperature gradient at the surface of the injection mold in two locations. Such variation cannot be permitted, as it could cause thermal stress problems if this particular resistance configuration were to be used.

The surface temperature distribution that resulted from the initial configuration provided ARTEB engineers with the information needed to modify the position of these thermal resistances and create a new CFD model. The second analysis presented a temperature distribution with a much more uniform pattern along the entire reflector surface, decreasing the temperature gradient and creating a maximum observed temperature difference that was within an acceptable range over the entire mold surface. By using simulation, ARTEB designers found that they could reduce the time and resources needed to identify a reliable and accurate mold design. ■



Surface temperature distribution on a headlamp mold shows initial resistance disposition (left) and a redesigned final disposition (right). The redesigned case showed a reduction in gradient across the headlamp region of the mold.