APPLICATION **NOTE**

Direction-Dependent Determination of the Thermal Conductivity of Fiber-Reinforced Plastics Using the LFA 467 *HyperFlash*®

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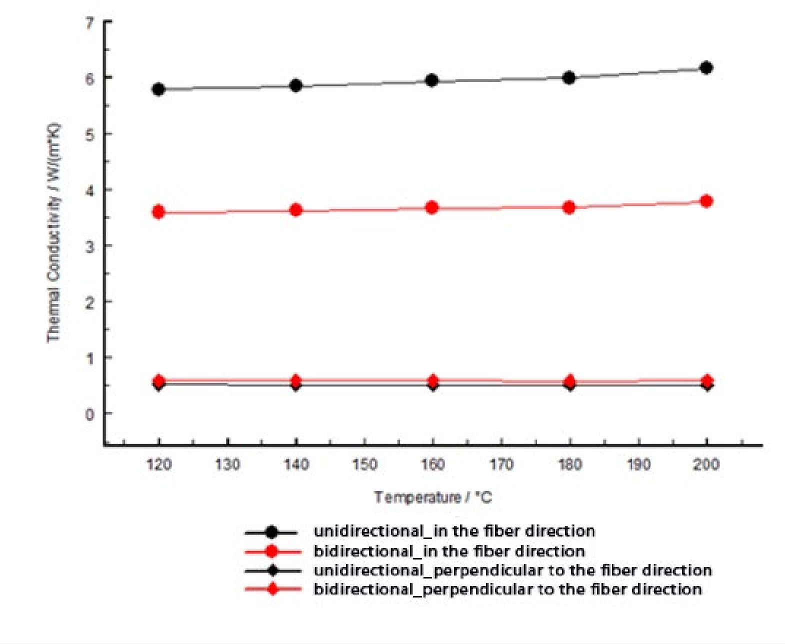
Introduction

Fiber-reinforced plastics are light, yet they exhibit high stiffness. These properties make them useful as construction materials in the automotive industry. For optimizing process times during production, the thermal conductivity of these materials is an important property to monitor. It depends not only on temperature but on the orientation of the reinforcement material as well.

Using the LFA 467 *HyperFlash*®, the thermal conductivity of anistropic materials can easily and quickly be determined as a function of temperature in different spatial directions.

Samples and Experimental

A carbon fiber-reinforced epoxy resin was investigated which was unidirectionally* and bidirectionally** reinforced. The thermal conductivity was analyzed both parallel and perpendicular to the fiber direction. The measurements were carried out in a standard sample holder (12.7 mm square) between 120°C and 200°C in steps of 20 K. The specific heat was determined by means of the DSC 204 ***F1*** *Phoenix*®.



1 Thermal conductivity of an unidirectionally and bidirectionally carbon fiber-reinforced epoxy resin

Results and Discussion

Depicted in figure 1 is the thermal conductivity of the unidirectionally (black) and bidirectionally (red) reinforced plastic samples. The unidirectionally reinforced sample, measured in the fiber direction (black dots) exhibited the highest thermal conductivity. The thermal conductivity of the bidirectionally reinforced sample, also measured in the fiber direction, was a bit lower. Due to the high thermal conductivity of the carbon fibers in the fiber direction (dots), thermal conductivities parallel to the fiber direction were 7 to 12 times higher than thermal conductivities

* unidirectional: all fibers of the reinforcement material are parallel to each other
**bidirectional: the fibers of the reinforcement material are crossed at 0° and 90° angles

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perpendicular to the fiber direction (diamonds) for both samples. Measurements in the perpendicular direction yielded nearly the same thermal conductivity values for both samples, since the overall orientation of the fibers perpendicular to the direction of measurement have almost no influence.

Conclusion

A variety of sample holders has been developed for special measuring tasks by the LFA 467 *Hyperflash*®, e.g., measurements on liquids, powders, thin metal foils, etc. Among these is a special lamiante sample holder employed for the investigations described here. Using this specially designed sample holder, the anistropy in the thermal diffusivity of the carbon fiber-reinroced materials due to the orientation of the embedded fibers could be determined quickly and easily.

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