Researchers at Chemnitz University of Technology, together with companies in Thuringia and Poland, have developed a 26 percent lighter headrest for a child seat and established the technical foundations for its resource-efficient production.

A suitable child car seat must meet three main criteria: a high degree of safety, low weight and easy handling. Researchers from the Department of Lightweight Structures and Polymer Technology (SLK) at Chemnitz University of Technology are making an important contribution to ensuring that these points are met in the best possible way and that components are produced more economically. As part of an international research cooperation with the Polish child seat manufacturer Avionaut and the Thuringian plastics company Polycomb, they have designed an exceptionally lightweight headrest, which also offers improved crash performance and paves the way for a more advantageous component production.

Part of the fundamental research carried out at Chemnitz University of Technology was the development of a so-called “formed organic sheet” for the local reinforcement of the headrest. “Organic sheets are fibres which are embedded in a thermoplastic matrix. They are characterised by their particular rigidity, strength and low weight, making them ideal for use in lightweight construction applications, for example in aircraft or automotive engineering,” explains Norbert Schramm, research associate at the department SLK.

The Polycomb employees in Auengrund (Thuringia) were responsible for the injection moulding in the further course of development. They manufactured the so-called preform, an intermediate stage of the component in production. This included the headrest carrier plate, which serves to integrate the headrest into the back of the seat. Child seat manufacturer and project initiator Avionaut in Wreczyca Wielka (Poland) specified suitable materials and realised the overmoulding of the headrest with thermoplastic foam beads using an energy-saving process called particle foam composite injection moulding, as well as the completion of a demonstrator. The newly developed headrest of a child car seat for children in the weight group from 9 to 36 kilograms is 26 percent lighter than a comparable standard component.

The technology development was funded by the German Federation of Industrial Research Associations (AiF) and the Federal Ministry for Economic Affairs and Energy (BMWi) as part of the Central Innovation Programme for SMEs (Zentrales Innovationsprogramm Mittelstand, ZIM).

Keyword: Particle Foam Composite Injection Moulding (PCIM)

Particle foam composite injection moulding is a coupled process: In the first stage, an organic sheet is formed into an insert in an injection mould with a turnover plate and back-injected with a short glass reinforced plastic matrix. The preform produced in this way is then transferred to a second mould on the machine and overmoulded with particle foam. As this production process requires no intermediate storage and thus no cooling and reheating, it is particularly...
resource-efficient, because the thermal energy that has to be introduced in the first step can be utilised further in the second step. Here the basic idea of the so-called bivalent resource efficiency has been applied. This strategy is part of the mission statement of the Cluster of Excellence MERGE at Chemnitz University of Technology and describes the aim to conserve energy during use as well as production. Additional savings in the production process are achieved as the component comes out of the mould ready-to-install.

The possible transfer of the production process of the headrest into one step, together with the developed component design, result in numerous advantages for manufacturers and users. PCIM not only saves assembly steps and energy during production, the components of the final product also hold together better and the significantly reduced weight leads to further energy savings during transport and easier handling for parents or other carers when installing and removing the child seat. In addition, financial savings gained from the component's cost-effectiveness can possibly be passed on to customers. The responsibility for the practical implementation of the project results now lies with the child seat manufacturer.

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