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Navigating the vehicle lightweighting landscape: Interview with Covestro

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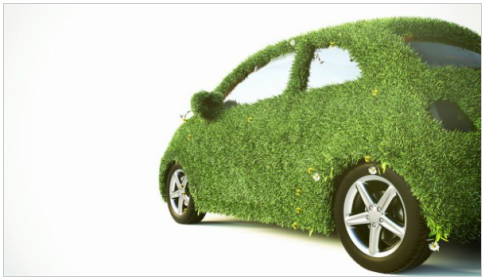
Lightweighting enhances vehicle performance and sustainability using advanced materials like polymers



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Lightweighting in the automotive industry is a pivotal strategy aimed at enhancing vehicle performance, efficiency and sustainability. As the demand for alternative and future mobility concepts grows, polymers emerge as key enablers, offering design flexibility and integration capabilities for advanced applications such as autonomous driving technologies. However, the transition to alternative materials raises critical considerations, including reliability, safety and the challenges of recycling materials like carbon fiber, which, while promising for mass production due to their lightweight and high-strength properties, face end-of-life recycling hurdles.

Current trends highlight the increasing use of composites, which not only improve vehicle performance but also align with sustainability goals. Smart materials, including endless fiber reinforced thermoplastic composites, present cost-effective alternatives to traditional metals, offering superior lightweight benefits while maintaining structural integrity. The integration of hybrid solutions, such as plastic parts with metal inserts, further exemplifies innovative approaches to lightweighting.

Material properties play a key role in supporting alternative powertrains, influencing both performance and environmental impact. Collaboration between material suppliers and automotive manufacturers, supported by computer-aided engineering simulations, is essential for developing advanced materials that meet the evolving demands of the industry. As lightweighting trends continue to evolve, the automotive sector stands at the forefront of a transformative shift toward more sustainable and efficient mobility solutions, driven by innovative materials and technologies.

To learn more we spoke to executives from Covestro, a global leader in high-performance polymer materials, specializing in innovative solutions that support original equipment manufacturers in reducing vehicle weight.

Key takeaways:

- Polymers enhance automotive design through flexibility, lightweight solutions and functional integration. They support innovations like autonomous driving and will increasingly incorporate recycled materials, driving sustainability in future mobility concepts. This evolution emphasizes the importance of polymers in merging IT and automotive applications.
- Key considerations for using sustainable materials in vehicle manufacturing include reliability and supply safety, necessitating the development of sustainable ecosystems. While carbon fiber offers lightweight and stiffness advantages, high production costs and limited recycling options pose significant challenges, impacting its promotion in mass-produced vehicles.
- Smart materials hold significant promise in the automotive industry by enabling advanced applications like high-performance sensors and batteries. They facilitate the design for recycling, allowing for mono-material components that enhance sustainability and recyclability without compromising performance or safety.
- Recycling waste polycarbonate components into post-consumer recycled (PCR) polycarbonates significantly conserves resources and reduces carbon emissions in the automotive industry. High-quality mechanical and chemical recycling processes enhance performance for advanced applications.

The following is an edited transcript of the conversation.

S&P Global Mobility: What are the new and potential automotive applications for polymers, and how do they contribute to alternative and future mobility concepts?

Covestro: Polymers in general are strong enablers when it comes down to form flexibility, design freedom, ease of functional integration and lightweight. This has been shown many times in the past and more recently with the integration of new [human machine interface] concepts in the car interiors as well as advanced front displays and sensor integrations on the car exterior and bodies to enable autonomous driving, to only side a few.

Moving forward, an increasing number of new applications, transcending the historical barrier between IT devices and mobility concepts, will continue to emerge by relying on seamless integration through polymeric materials. Furthermore, polymers will play a very big role in the realization of more sustainable concepts and functionalities within the design of a car. Therefore, we can expect an increased usage of recycled polymeric materials of all kinds in the construction of cars and other mobility concepts.

When considering alternative materials in vehicle manufacture, what are the key considerations and challenges that need to be addressed?

We understand alternative materials in the sense of this question as "sustainable materials."

For sustainable materials to be successfully used in the highly complex frame of automotive design and construction principles, the materials need fulfill a couple of key criteria.

To cite two of the main ones: reliability (predictability) and supply safety.

- Reliable supply is key, therefore we are working to develop ecosystems that work under sustainable conditions, while we try to expand the streams that are suitable from both waste and renewable sources.
- Safety and performance of the materials and derived parts cannot be jeopardized.

Where do you see the greatest opportunities and applications for carbon fiber in mass-produced cars, and what are the challenges associated with its end-of-life recycling?

Carbon fibers are well-known to combine lightweight and high stiffness. Unfortunately, the complexity of production and the associated costs of raw materials are very high. We also see that the recycling options for such types of products are limited. This was also noticed during the draft of the latest EU regulations.

We do not currently promote such types of products for the automotive industry and therefore would like to refrain from commenting too much on such types of applications.

Which applications show the most promise for the use of smart materials in the automotive industry, and what benefits do they offer?

Smart materials are by definition enabling the design, construction as well as integration of new applications within the frame of mobility concepts. For example, the integration of high performance lidar sensors, touch sensors, drivers monitoring systems or simply high-performance batteries could be cited. Every time, such new applications are enabled by the right high performance polymeric material. Many more of such technologic leaps, leading us to autonomous, intelligent and more sustainable cars will come through the right choice of polymer material.

As a second example, smart materials are an enabler when it comes to design for recycling. Design for recycling is describing new ways to design and manufacture parts that previously have been comprised of multiple materials that needed to be mounted together by screws or glue. Rethinking the design of parts from scratch by considering smart polymer materials early in the design phase can result in mono material designs with no compromises in terms of performance and safety, but being either or even both more sustainable during manufacture as well as much easier to recycle because it is a single material waste stream. Covestro has demonstrated the potential of mono-material design in an automotive headlamp concept by introducing a smart polymer material that is thermally conductive called Makrolon© TC.

How does the recycling and processing of waste polycarbonate components into post-consumer recycled (PCR) polycarbonates contribute to resource savings and carbon emissions reduction in the automotive industry? Can you share any specific examples of interior and exterior vehicle applications where these recycled materials can be used?

By recycling polycarbonate (PC) waste either through mechanical or chemical recycling processes the material receives a second life. This is a clear benefit from a resource conservation as well as emission reduction perspective. The usage of mechanically or chemically recycled polymer materials in this case, specifically PC, is depending on the type of usage and part performance required. Low complexity parts not bound to any safety requirements can be done with lower quality recycled materials. Nevertheless, we see that the level of performance needed from recycled plastics is rapidly increasing, to cover even the most advanced applications. This is why high quality mechanical or chemical recycling processes are needed. Covestro is focused on using such high-quality materials and feedstock sources to ensure high material consistency and purity.

How does Covestro plan to address the increasing demand for PCR plastics, particularly in compliance with regulations like the European Commission's proposal for enhanced circularity in the automotive sector?

Among other aspects, Covestro believes that partnerships are one of the essential building blocks to meet the objectives of a circular economy. Therefore, Covestro has teamed up in multiple projects with partners across the value chain. Three examples showcase how we target to build new recycling feedstock streams with partners to meet the increasing demand of PCR materials:

i. By targeting car-to-car plastics recycling with automotive partners such as NIO and VW in a project that has been initiated by the German federal enterprise GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit).
ii. By building reverse supply chains to generate polycarbonate recycling feedstock for mechanical recycling.
iii. By chemically recycling discarded tires into optically pure polycarbonates in a partnership with Neste and Borealis.

Additionally, it is important to develop new recycling technologies. Here, Covestro has announced to invest into a pilot plant for the chemical recycling of polycarbonate into monomers. These monomers can then be converted back into polycarbonate by established processes.

Can you provide more details about the AI-driven sustainability platform, Alibaba Cloud's Energy Expert, and how it enables carbon accounting and tracing for sustainable materials along the value chain? What specific digital technologies, such as blockchain, are utilized in this platform?

Circularity and scope 3 upstream emission are the two most relevant sustainability aspects of engineering plastics, and hence data transparency and material traceability become more and more important. With this background Covestro is actively working with partners to improve the overall availability of sustainability data for the value chain. One example is the collaboration with Alibaba Cloud, as [a] major player in cloud services globally. Recently Alibaba Cloud developed a new service called "Energy Expert," to help their clients better quantify their institutional carbon emissions and products' carbon footprint, with the use of AI technologies. Covestro works with Alibaba Cloud in the following way:

- Identify opportunities together where a common customer uses Covestro's engineering plastics as one of their raw materials of the products.
- Customer needs to quantify their products' sustainability aspects (e.g. the use of Covestro's CQ products where the cradle-to-gate carbon footprints are lower than the conventional fossil based (virgin) version.
- When Alibaba Cloud was asked by this customer to perform the quantification (calculation) of, say their products' carbon footprint via [the] Energy Expert service, Covestro would provide the necessary sustainability data about the material in question as part of the quantification process, per customer's request.
- Covestro, Alibaba and potentially with the customer together, would consider to disclose the customer product's quantification results based on agreements by all parties involved

Regarding technologies like AI and blockchain etc., Alibaba Cloud is the major party to adopt such technologies in their process of quantification.

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