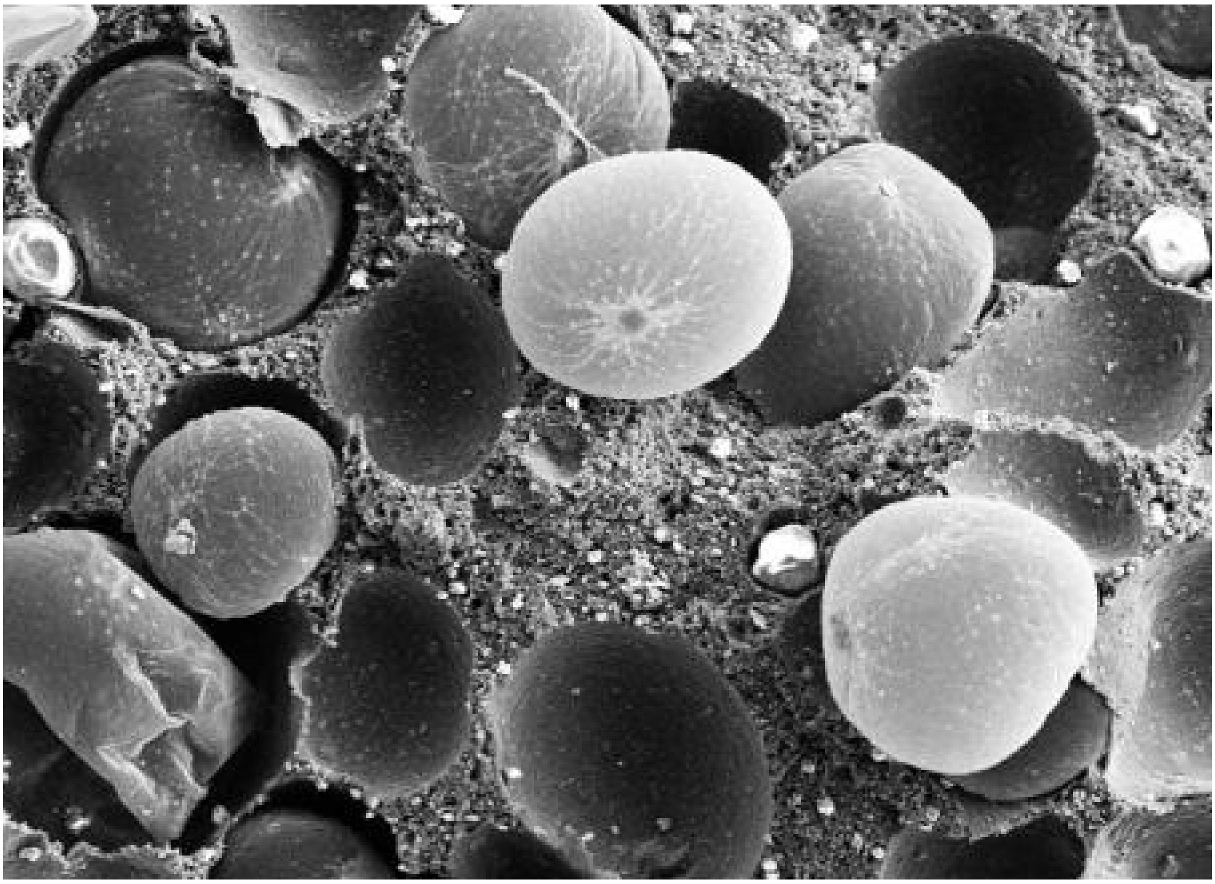
Efficient design of elastomer components: Optimised material mixtures and production

About this project



ReLEA

Efficient design of elastomer components: Optimised material mixtures and production

Markets:

Material: Bioplastics, Elastomers, Closed-pore, Open-pore, Syntactic foams

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This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

Context

The automotive industry uses lightweight construction technologies to reduce the CO2 footprint of vehicles. The use of new sustainable materials and increasing the resource efficiency of existing materials is becoming increasingly important. Elastomers are polymer materials with high elasticity that are used in components such as tyres, seals and vibration dampers.

Despite these properties, elastomer components are often over-dimensioned, as development has so far been heavily based on empirical approaches. This means that the potential for targeted optimisation remains untapped. For example, a lack of topology optimisation - a method for optimal material distribution based on mechanical loads - leads to unnecessarily high material usage. A comprehensive life cycle assessment (LCA), which assesses the carbon footprint of a product from manufacture to disposal, is also often lacking. This impairs the efficient use of resources.

Purpose

The ReLEA research project aimed to reduce the weight of elastomer components while maintaining their mechanical properties. The researchers used innovative polymer materials, including CO2-based rubbers and high-molecular polymers, as well as advanced fillers such as functionalised and highly structured carbon blacks.

In addition to material efficiency, the researchers systematically investigated all process steps - from mixing to extrusion, injection moulding and vulcanisation. This enabled them to precisely harmonise material properties and production processes, which significantly reduces the use of resources and energy consumption. With these optimised formulations and manufacturing processes, the project team significantly reduced the CO2 footprint of the components.

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Procedure

The project team analysed all stages of the production chain in detail. In the laboratory, the researchers specifically tested new polymer-filler combinations and developed customised formulations. Using simulation-based topology optimisation, they adapted the component geometry so that the material is used exactly where it is mechanically required.

The team also used modern methods such as AI-supported process modelling and evolutionary optimisation approaches to precisely control the processes from material mixing to vulcanisation. A systematic life cycle assessment evaluated the energy and resource consumption over the entire life cycle. The validation was carried out on real components in order to establish practical and resource-efficient production methods.

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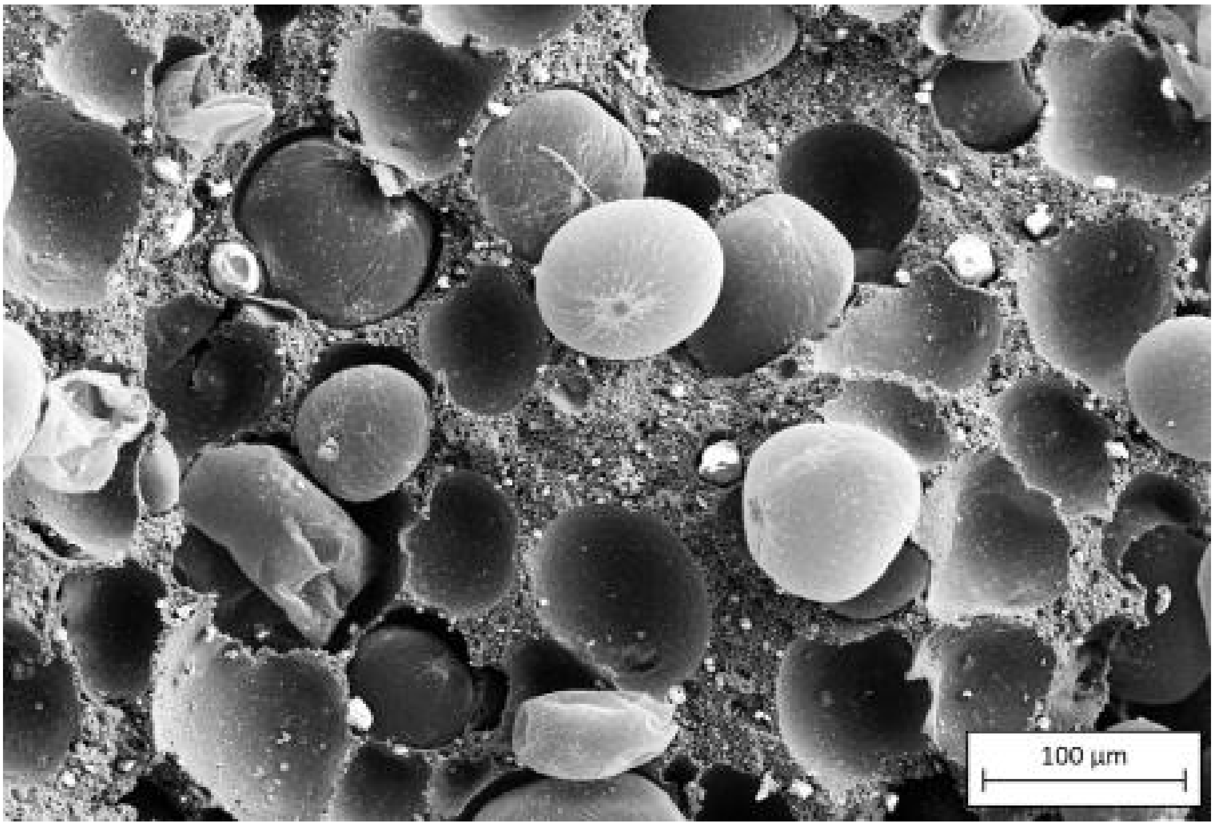

Funding duration:

Funding sign:	03LB3012	**Funding amount:**	EUR 1.7 million

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3012A - ReLEA in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Machines and plants, Software & databases, Systems and end products, Materials, Tools and moulds	✓
Services & consulting Training, Consulting, Testing and trials, Engineering, Prototyping, Validation, Simulation, Technology transfer, Others (Research and development)	✓
Field of technology	
Design & layout Lightweight manufacturing, Lightweight design, Hybrid structures, Lightweight construction concepts, Lightweight material construction	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), System analysis, Materials analysis, Destructive analysis, Non-destructive analysis	✓
Modelling and simulation Crash behaviour, Loads & stress, Life-cycle analysis, Multiphysics simulation, Optimisation, Processes, Structural mechanics, Materials	✓
Plant construction & automation Others (Elastomer processing)	✓
Recycling technologies Downcycling, Material separation, Recycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming Extrusion, Injection moulding	✓
Processing and separating	
Textile technology	
Material	
Biogenic materials Bioplastics	✓
Cellular materials (foam materials) Closed-pore, Open-pore, Syntactic foams	✓
Composites	
Fibres	
Functional materials	
Metals	
Plastics Elastomers	✓
Structural ceramics	
(Technical) textiles	