Lightweight construction with copper: developing a high-strength alloy for thin components

About this project

Leichtkupfer

Lightweight construction with copper: developing a high-strength alloy for thin components

Markets:

Material: Others (Copper)

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

Technology Transfer Program Leichtbau

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Context

It is impossible to imagine many industries without copper: companies in mechanical engineering, energy technology, medical technology and mobility, among others, rely on the material due to its high heat resistance and conductivity, its durability and recyclability. However, copper has its limits in lightweight construction in particular. There is a lack of reliable characteristic values and standards for use in components subject to cyclical stress, such as door systems in rail transport, fittings or energy technology components. In addition, the alloys available today are hardly suitable for the production of extremely thin-walled structures in die casting. This means that key potential remains unutilised.

At the same time, German foundries are under high competitive pressure, particularly from Asia, where stainless steel investment casting is often produced at low cost. Against this backdrop, the development of new, high-strength copper alloys opens up a double opportunity: it enables more resource-efficient components with significantly reduced mass and at the same time strengthens the competitiveness of domestic manufacturers with a noticeably lower environmental impact.

Purpose

The project team is developing a new copper casting alloy that enables lightweight construction in permanent moulding processes such as die casting - the rapid filling of a mould with liquid metal under high pressure - and gravity die casting - casting in reusable metal moulds. The material is said to achieve a tensile strength of over 1000 megapascals (MPa) at strains of up to 5 per cent - a measure of the mechanical strength of materials. This puts it on a par with high-strength steels and significantly outperforms conventional aluminium alloys. The researchers want to increase castability, systematically record fatigue strength and derive design concepts from this. In this way, components can be designed with thinner walls and still be reliable. A reduction in wall thickness of around 20 per cent is possible in gravity die casting and up to 50 per cent in die casting. This reduces material and energy requirements in production and brings measurable CO# benefits in use - for example in rail transport.

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Procedure

First, the project team adapts existing copper alloys such as aluminium bronzes and brasses to the requirements of die casting. Building on this, the researchers are developing a new type of alloy that is significantly more efficient in mechanical and technological terms. At the same time, they are recording the behaviour of the material under changing loads in systematic tests and deriving design routines for thin-walled structures from this.

In addition to alloy development, the project partners are also optimising the process control in die casting and gravity die casting in order to further reduce wall thicknesses and improve castability. Practical requirements are incorporated at an early stage: The project team tests demonstrator components under real continuous loads. The result is a material that can be processed in a resource-saving manner and opens up new lightweight construction applications in many industries.

Funding duration:

Funding sign: 03LB2064 **Funding amount:** EUR 1 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2064A - Light copper in the federal government's funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants, Systems and end products, Materials	✓
Services & consulting Testing and trials, Engineering, Validation	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing, Lightweight material construction	✓
Functional integration	
Measuring and testing technology Component and part analysis, Materials analysis, Destructive analysis	✓
Modelling and simulation Loads & stress, Life-cycle analysis, Reliability validation	✓
Plant construction & automation	
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming Casting	✓
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Others (Copper)	✓
Plastics	
Structural ceramics	
(Technical) textiles	