Resource-efficient machine elements: Researching bionically inspired self-lubrication

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About this project

SinziA

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Markets: 

Material: Steel

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 lubrication of highly stressed machine elements is necessary to reduce friction and wear. Conventional lubrication methods, such as oil or grease lubrication, require suitable components for lubricant supply and conditioning and for sealing and lead to significant load-independent losses. An innovative approach is modelled on nature: similar to the human knee joint, where the pores in the meniscus serve as reservoirs and channels for synovial fluid, porous sintered metals can store lubricant and release it as required under load. This technology, inspired by nature, is already being used successfully in low-load components such as plain bearings. The advantages: Self-lubrication means that the required amount of lubricant is supplied directly to the functional point. This reduces the amount of lubricant used, reduces the size and weight of the gearbox, increases resource efficiency through lower load-independent power loss and thus improves the CO# balance. In the SinziA project, the researchers are investigating how this bionic approach can also be utilised for highly stressed machine elements using the example of gears in stationary and transient gearboxes.

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Purpose

The aim of the SinziA project is to develop oil-impregnated sintered gears that can be used as self-lubricating machine elements in applications subject to high mechanical loads. To this end, fundamental findings from material analyses and tribological investigations with material, lubricant and surface variants are being researched according to industrial application requirements in order to make the technology usable for broad industrial application.

The researchers are focussing in particular on the overall objective of significantly reducing the amount of lubricant required in the gearbox and reducing the installation space and complexity of the gearbox. By using suitable material-lubricant-surface configurations, they want to minimise power losses compared to conventionally lubricated gearboxes through the self-lubrication of the tooth contacts. They also want to significantly extend the service life compared to dry-running gearboxes.

In the long term, the team is aiming to establish the technology across all sectors - from the automotive and mechanical engineering industries to aviation and food technology. Thanks to the wide range of possible applications, the researchers hope that the technology will make an important contribution to conserving resources and reducing CO# emissions.

Procedure

The project team combines experimental modelling and component investigations with high-resolution analytics in order to transfer the findings to potentially applicable self-lubricating system configurations in application tests and to examine their technological maturity. Firstly, they define the requirements of stationary and intermittently operated target applications. Based on this, they determine suitable sintered material and surface specifications as well as a suitable lubricant and identify industrially realisable impregnation processes in order to evenly fill the pore structure of the materials with sufficient lubricant.

The research partners then test the self-lubricating material and surface combinations in model tests under laboratory conditions. They analyse friction and lubrication as well as damage behaviour under defined conditions and determine the load limits of the self-lubricating technology. These findings are incorporated into the development of practical demonstrators, which are tested in module tests under real operating conditions. Finally, the researchers develop practical design guidelines in order to be able to design self-lubricating machine elements for further investigation and transfer to a wide range of applications.

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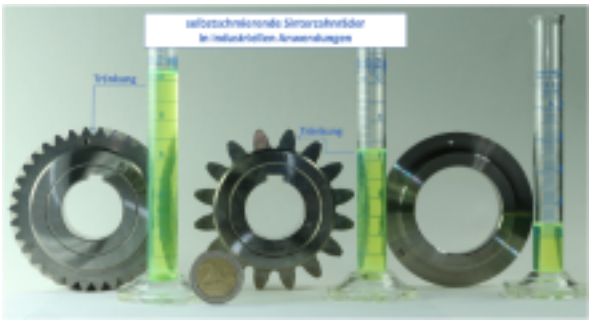

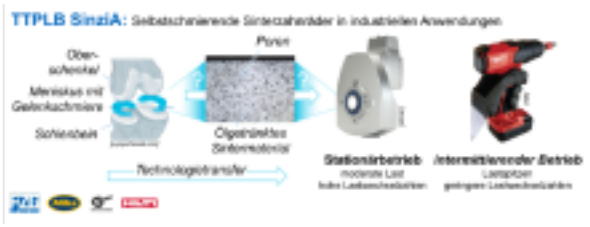

Funding duration:

Funding sign:	03LB3001	**Funding amount:**	EUR 434 thousand

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3001A - SinziA in the federal funding catalogue

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English (EN){{ Projektpartner }}

Getriebebau NORD GmbH & Co. KG

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants, Materials	✓
Services & consulting Training, Testing and trials, Engineering, Standardisation, Prototyping, Validation, Simulation, Technology transfer	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight construction concepts, Lightweight material construction	✓
Functional integration Material functionalisation	✓
Measuring and testing technology	
Modelling and simulation Multiphysics simulation, Optimisation, Materials	✓
Plant construction & automation Plant construction	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration Mechanical treatment, Heat treatment	✓
Primary forming Sintering	✓
Processing and separating	
Textile technology	

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Lightweighting classification

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