Saving energy in internal logistics: Lightweight tugger trains for indoor and outdoor use

About this project

GASSI

Saving energy in internal logistics: Lightweight tugger trains for indoor and outdoor use

Markets:

Material: Others (Recycled plastics from waste), Aluminium, Steel

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About this project

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

Many manufacturing plants need to move parts and components between different production halls that are separated by outdoor areas. They often use forklift trucks for these journeys. The energy required to power these trucks accounts for a significant proportion of the production process's carbon footprint.

Tugger trains – consisting of a tractor unit and trailers – are often more economical, better suited to production processes and easily automatable within production halls. However, they have so far lacked key characteristics for outdoor use. Rougher surfaces, joints, changes in level, gradients and weather conditions generate vibrations and shocks.

To cope with these stresses, tugger trains would need to be built significantly more robustly, which would increase the weight of a tugger by around 100 kg. However, this would reduce the payload or significantly increase energy consumption. Consequently, the outdoor use of tugger trains is often uneconomical. Lighter trailers mean more natural vibrations, which can lead to increased problems for electronics and cargo.

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Purpose

In the GASSI research project, the project partners are further developing tugger trains so that they can reliably handle transport tasks in factory halls and across outdoor areas. To this end, the researchers are using the HUSKi tugger train system as a starting point, which is currently designed primarily for indoor use. The team aims to further develop the tugger train system for universal use both indoors and outdoors, enabling seamless transport operations without the need to switch systems. It is essential that the system's own weight is not increased, despite the higher mechanical demands of outdoor use. Only in this way can payload and energy requirements remain economically viable.

The upgraded system is intended to enable companies to reduce energy-intensive forklift journeys between separate halls. This will significantly reduce energy consumption and CO# emissions in internal logistics. The optimised tugger trains are designed to handle gradients of up to 6%, ground level differences of up to 20 mm and adverse weather conditions, offer a load-independent transfer height for automated handover, and safely transport liquids in special large containers – known as Intermediate Bulk Containers (IBCs). In addition, the team is investigating the negative impact of reduced mass using particle damping.

Procedure

The project team is setting up an outdoor test track equipped with measuring instruments. There, the existing indoor version of the articulated vehicle will navigate typical obstacles such as joints, edges, bumps and small changes in height. Accelerometers will record the vibrations and impacts on the vehicle. At the same time, the team is analysing suitable materials for the planned damping system. The focus is on recycled materials such as stone dust, shredded plastics and similar substances.

A key development step is then the simulation-based optimisation of the system. To this end, the team creates a simplified simulation model based on the design data (Computer-Aided Design, CAD). It calculates the loads and optimises components for low weight. Furthermore, the project partners use an analysis of natural frequencies to determine where the structure vibrates most strongly and where damping can be optimally applied.

Based on these results, the team builds an outdoor demonstrator. This involves translating the simulation results into the final design, planning the manufacture and assembly of the demonstrator, and equipping it with measurement technology. In final tests, the team will test and optimise the outdoor demonstrator on the test track and assess its suitability for potential series production.

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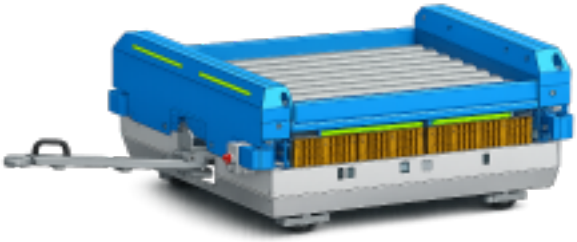

Funding duration:

Funding sign:	03LB4017	**Funding amount:**	EUR 829 thousand

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB4017A - GASSI in the federal government's funding catalogue

www.intrahuski.de/ - HUSKi Route Train Solutions homepage

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Project coordination

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English (EN){{ Projektpartner }}

Fraunhofer IFAM

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants	✓
Services & consulting Engineering, Prototyping	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight construction concepts	✓
Functional integration Actuator technology, Sensor technology	✓
Measuring and testing technology Visual analysis (e.g. microscopy, metallography)	✓
Modelling and simulation Loads & stress, Materials	✓
Plant construction & automation Plant construction, Automation technology, Handling technology	✓
Recycling technologies Material separation	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing 3D printing, Selective laser melting (SLM, LPBF, ...)	✓
Coating (surface engineering) Painting, Powder coating	✓
Fibre composite technology	
Forming Bending	✓
Joining Screwing, Welding	✓
Material property alteration Heat treatment	✓
Primary forming	
Processing and separating Drilling, Milling, Grinding, Others (Plasma electrolytic polishing)	✓
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Aluminium, Steel	✓
Plastics Others (Recycled plastics from waste)	✓
Structural ceramics	
(Technical) textiles	