Lightweight and economical: using eco-concrete with carbon reinforcement at scale

About this project

nd Congreen.Carbon.System (CCS)

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Markets:

Material: Textile-reinforced concrete

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

The cement industry is one of the largest emitters of greenhouse gases and is responsible for around eight per cent of global CO# emissions; this sector also accounts for a large proportion of emissions in Germany. As cement is a key component of concrete, high concrete consumption is also associated with the considerable use of other primary resources such as sand, gravel and water.

Infrastructure structures such as bridges are also often associated with long construction times. Traffic disruptions or closure periods, especially in rail transport, cause high economic damage and affect public acceptance. In addition, material-related damage such as chloride ingress from de-icing salts or carbonation of the concrete limit the service life of today's reinforced concrete structures, which is typically around 40 to 80 years.

Against this background, there is a great need for action to reduce the consumption of resources in concrete construction, shorten construction times and at the same time significantly increase the service life of infrastructure structures. This is where the CCS project comes in.

Purpose

The researchers are developing and testing precast concrete components made from eco-concretes in combination with non-metallic reinforcements. For infrastructure structures - particularly small bridges in the railway sector - they are further developing the approach technically and investigating it theoretically. A demonstrator in infrastructure construction shows the feasibility as a pilot solution.

Railway bridge construction is considered one of the most demanding disciplines in civil engineering due to the high loads from train traffic and the dimensional accuracy required. Following its introduction in this segment, the process optimisation will be transferred to less demanding areas of application such as road transport. The aim is to contribute to reducing the CO# footprint in the construction industry. In addition to reducing the cement content in the concrete, a more filigree construction method also reduces the total amount of concrete used. This conserves important primary resources such as sand and gravel.

Shorter construction times and less disruption to road and rail traffic minimise the economic impact and increase public acceptance of infrastructure measures. At the same time, the service life of the structures is increased to up to 150 years. The aim of the researchers is to create the conditions for the widespread use of eco-concretes with non-metallic reinforcements as a central mass construction material to reduce emissions.

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Procedure

The scientists first analyse whether the material is suitable for the particularly technically demanding application. They then transfer the findings on design and construction principles to other areas of application according to the top-down principle. In addition, they identify further potential applications.

The overarching aim is to help reduce emissions in the construction industry and conserve natural resources through the targeted development of a suitable mass building material. In doing so, the researchers ensure that they comply with the requirements profile of current construction practice in order to enable implementation on the construction site.

At the same time, the participants are systematically driving forward research in this field. The practical suitability of the prefabricated parts made of eco-concrete in combination with non-metallic reinforcements is ensured from the outset through long-term tests, which will continue beyond the end of the project.

Funding duration:

Funding sign:	03LB2085	**Funding amount:**	EUR 2.2 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2085A - CCS in the federal funding catalogue

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Project coordination

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CARBOCON

KLEI-HUES Betonbauteile GmbH & Co KG

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Materials	✓
Services & consulting Engineering	✓

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Lightweighting classification

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

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Textile-reinforced concrete	✓
Fibres	
Functional materials	
Metals	
Plastics	
Structural ceramics	
(Technical) textiles	