Production of 3D composite sandwich components: foaming and impregnation in one process

About this project

SingleStepSandwich

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Markets:

Material: Biocomposites, Aramid fibres, Basalt fibres, Glass fibres, Carbon fibres, Natural fibres, Thermoset plastics, Thermoplastics, Aluminium, Laid webs, Woven fabrics, Knitted fabrics, Nonwovens, mats, Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Natural fibre reinforced plastics (NFRP), Closed-pore

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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

Sandwich components are used in cars, trains, aeroplanes and wind turbines. They consist of two solid cover layers and a lightweight foam core, usually made of fibre-reinforced plastic (FRP). This construction method enables complex 3D shapes to be produced with low weight.

However, today's production is complex: 3D cores are often milled from large sheets and glued together, while the textiles for the cover layers are prepared in separate steps. This generates waste, lengthens processes and increases costs. Vapour-based manufacturing processes are very resource-intensive and therefore costly due to the high energy input in the form of gas, oil, electricity and water. What is therefore needed is a technology that produces foam cores directly in the mould almost in their final form, integrates the preforming of textiles, does not require water and uses recyclable foams. This is precisely where SingleStepSandwich comes in.

Purpose

With SingleStepSandwich, the project partners aim to reduce emissions in the production of 3D sandwich components by around 35 per cent. At the same time, they are paving the way for mass production. To achieve this, the researchers are developing a single-step process that combines two previously separate methods: the radio frequency (RF) foam moulding process, in which foam cores are created directly in the mould without steam, and resin transfer moulding (RTM), in which fibre layers are impregnated with resin in a closed mould. The foam core is created almost in its final form. At the same time, the textiles are moulded and impregnated.

In this way, the partners avoid waste, shorten process chains and ensure consistently high quality. They rely on recyclable PET foam that can be returned to the material cycle. This allows them to combine ecological benefits - fewer emissions, less material, less energy - with economic advantages such as lower costs and shorter cycle times.

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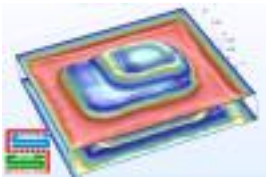
Procedure

The project partners are initially developing moulding systems for 2D sandwich components. In these tests, they determine how foam expansion, draping of the textiles and resin injection can be optimally controlled. These results serve as the basis for work on complex 3D geometries.

In the next step, the researchers adapt the moulding technology so that the expanding PET foam drapes the textiles directly in the mould. A special test rig provides precise measurements and supports the design. At the same time, the partners work out the parameters for the resin injection and ensure a reliable bond between the foam core and the cover layers.

In the end, the researchers combine both sub-processes into a single-stage procedure. Tests and simulations accompany the development to ensure that the components achieve the required strength and quality. As a demonstrator, the team is producing a battery casing for electric vehicles. The process can also be transferred to other applications, such as rotor blades for drones and small aircraft, lightweight components in rail transport or structural components in aviation.




Funding duration:

Funding sign:	03LB3071	**Funding amount:**	EUR 1.4 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3071A - SingleStepSandwich in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Machines and plants, Materials, Tools and moulds	✓
Services & consulting Consulting, Testing and trials, Engineering, Simulation, Technology transfer	✓
Field of technology	
Design & layout Lightweight manufacturing, Hybrid structures, Lightweight material construction	✓
Functional integration	
Measuring and testing technology Component and part analysis, Materials analysis, Destructive analysis	✓
Modelling and simulation Crash behaviour, Loads & stress, Processes, Structural mechanics, Materials	✓
Plant construction & automation Plant construction, Automation technology	✓
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Resin transfer moulding, Pre-preg processing, Vacuum infusion	✓
Forming Compression moulding, Thermal converting	✓
Joining	
Material property alteration	
Primary forming Others (Particle foam process)	✓
Processing and separating	
Textile technology Preforming	✓

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Lightweighting classification

	Realisation
Material	
Biogenic materials Biocomposites	✓
Cellular materials (foam materials) Closed-pore	✓
Composites Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Natural fibre reinforced plastics (NFRP)	✓
Fibres Aramid fibres, Basalt fibres, Glass fibres, Carbon fibres, Natural fibres	✓
Functional materials	
Metals Aluminium	✓
Plastics Thermoset plastics, Thermoplastics	✓
Structural ceramics	
(Technical) textiles Laid webs, Woven fabrics, Knitted fabrics, Nonwovens, mats	✓