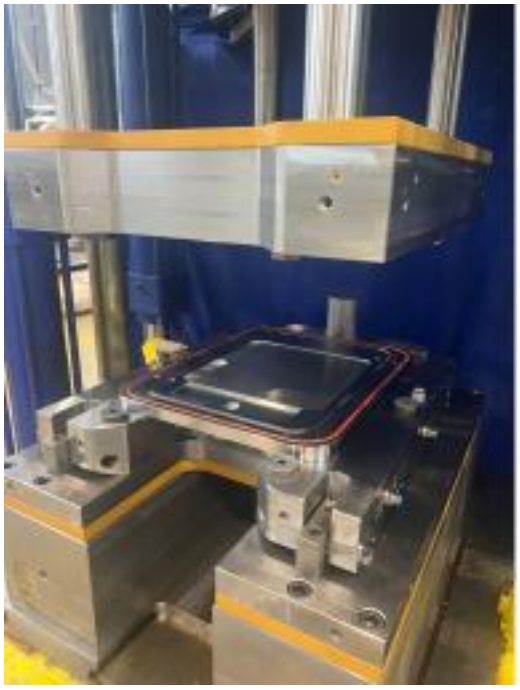
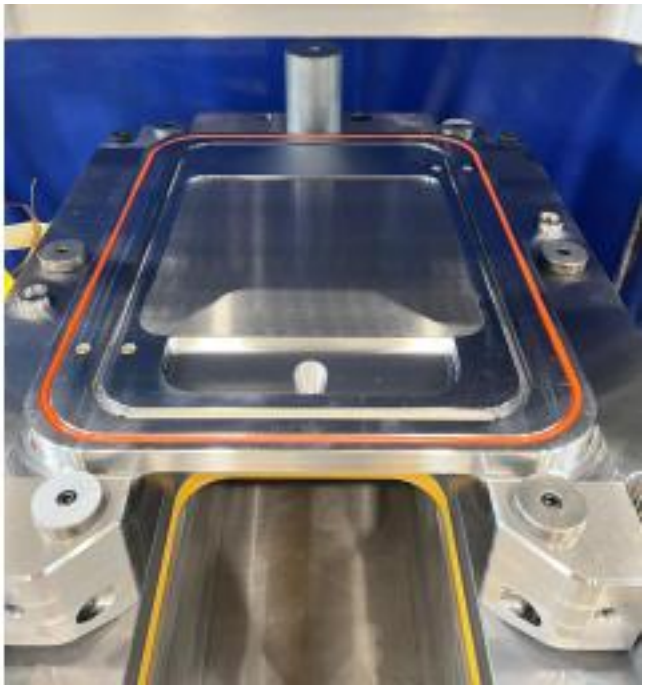
Removing components from the mould whilst dry: permanent coating instead of release agents

About this project





RDD

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Markets:

Material: Glass fibres, Carbon fibres, Thermoset plastics, Elastomers, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)

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

Companies frequently manufacture lightweight components from reactive polymer systems such as polyurethanes (PUR) and epoxy resins (EP). Depending on the material system and process, these are used in moulding tools to produce foamed, compact or fibre-reinforced components. Once the plastics have cured, the components must be able to be reliably removed from the mould. To prevent them from sticking to metallic surfaces, companies have traditionally used release agents.

These release agents facilitate demoulding but alter the manufacturing process. They can leave residues on both the mould and the components. Over several production cycles, resin and release agent residues build up on the mould surface. This so-called mould build-up must be removed regularly. To do this, companies must clean the moulds, which leads to downtime and increased energy consumption.

In the case of moulds with fine surface structures, this mould build-up also affects component quality. Micro- and mesostructures can only be reliably transferred if the structures are not clogged by the mould build-up. Otherwise, companies have to clean the moulds particularly frequently. This makes functional surfaces in many series production processes labour-intensive and expensive. Release agent-free, dry demoulding can therefore help to reduce cleaning effort and produce structured, lighter components more cost-effectively. This is where the project comes in.

Purpose

The project partners are developing a process that will enable companies to demould components made from polyurethanes and epoxy resins in series production without the need for additional release agents. To achieve this, they are replacing the additives previously used with permanent mould coatings. These very thin, plasma-polymerised layers are applied to the mould surface, where they facilitate separation from the component.

In doing so, the researchers are integrating a previously separate process step into the mould itself. This is intended to make demoulding more consistent, cleaner and easier to automate. If fewer residues are produced and moulds need to be cleaned less frequently, downtime, energy consumption and the use of solvents and cleaning agents are reduced. This improves cost-effectiveness and can reduce toxic emissions and CO# emissions.

At the same time, the stable release action is a prerequisite for making better use of structured mould surfaces. The project team aims to ensure that fine structures can be reliably transferred to components even in series production. This allows functions to be integrated directly into the surface, for example to reduce flow resistance, facilitate cleaning or minimise reflections. This eliminates the need for additional layers of material, making components lighter and more resource-efficient.

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About this project

Procedure

The project team is testing the permanent mould coatings under conditions close to those found in industry. In doing so, it is investigating how different polyurethanes, epoxy resins, component geometries and process parameters interact. The focus is on determining the conditions under which components can be reliably demoulded and the coating remains stable over many production cycles.

For these investigations, the researchers are developing a measuring cell for demoulding forces. It measures the force required to remove a component from the mould. This enables the team to systematically compare materials and coatings. At the same time, it evaluates key process variables such as temperature, curing time and material composition. If a material leaves residues during demoulding, the researchers analyse the interface between the component and the coating in greater detail.

The project partners are compiling the results in a digital knowledge base. There, they link measurement values, material and component data, process information and energy assessments. Guidelines, teaching modules and demonstrators are intended to show how companies can apply dry demoulding to their own series production processes.

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About this project

Funding duration:

Funding sign:	03LB3126	**Funding amount:**	EUR 2.7 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3126A - RDD in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

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Lightweighting classification

	Realisation
Offer	
Products Machines and plants, Software & databases, Materials, Tools and moulds	✓
Services & consulting Training, Validation	✓
Field of technology	
Design & layout Lightweight design	✓
Functional integration Sensor technology, Material functionalisation	✓
Measuring and testing technology Component and part analysis, Non-destructive analysis	✓
Modelling and simulation Life-cycle analysis	✓
Plant construction & automation Plant construction	✓
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering) Plasma process	✓
Fibre composite technology Resin infusion process, Resin transfer moulding	✓
Forming	
Joining	
Material property alteration	
Primary forming Others (RIM, RTM, extrusion, prepreg, infusion)	✓
Processing and separating	
Textile technology	
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Glass fibres, Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics, Elastomers	✓
Structural ceramics	
(Technical) textiles	