

The textile stacks are situated under the negative mould of an AREVA rotor blade – recognisable in the foreground – where they are given the correct geometric structure and fixed in the mould via vacuum.
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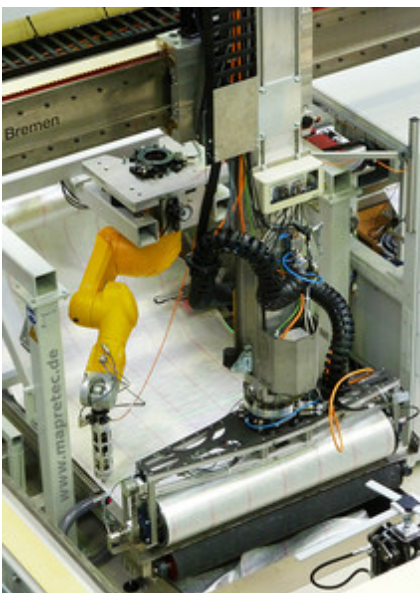
Automated production of rotor blades

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Producing rotor blades more quickly

Scientists at the University of Bremen have developed a new automated process for the production of rotor blades together with partners from industry. A textile product is first cut to size mechanically, stacked, shaped in accordance with the subsequent blade design and then placed in the negative mould. This is followed by the injection of the resin. The process is intended to shorten production time and improve quality.

An employee of the structure manufacturer Saertex is setting up a machine for production. The parallel threads, arranged in several layers above one another, can be seen.
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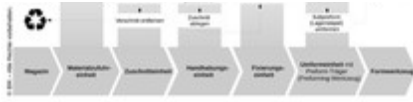


Here, the textile product is cut to size by an ultrasonic knife on the robot arm during the wrapping process.
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Rotor blades on wind turbines should be able to withstand temperature fluctuations, gusts of wind as well as lightning and hail for more than 20 years. The length of the blade on a modern large-scale system can be up to 80 metres, equivalent to the wingspan of an Airbus A380. Increasing length also means an increase in the forces on a rotor blade; this is accompanied by higher requirements in terms of quality. Necessary repairs or even replacement have a significant impact on the economic efficiency of the systems. A team from the University of Bremen has developed a manufacturing process for rotor blades, in order to improve the quality and simultaneously speed up production through automated process technology. Here, an ultrasonic knife cuts a textile material to size on a robot arm and this is then stacked free of folds. This type of textile structure consists of several levels of parallel threads, arranged one over the other, that are fixed together with binders or thermal processes. These stacks are subsequently fixed dry and pre-shaped three-dimensionally by a machine such that they correspond to the geometric structure of the final rotor blade. The pre-shaped stack is then placed in the negative mould and soaked in artificial resin through an injection process.

From manual work to the automated manufacture of rotor blades
In the initial years of the wind energy sector, the production of rotor blades involved a great deal of manual work. Each layer of the special textiles was cut to size by hand, placed in the rotor mould and soaked in resin. For some years now, employees have had recourse to mechanical support in





The chart shows the setting-up and re-shaping processes.
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partial processes. “We want to make significant progress on the way to automated blade manufacturing with our Mapretec project,” explains Jan-Hendrik Ohlendorf, Head of Department at the Institute for Integrated Product Development of the University of Bremen. He adds: “This offers an opportunity of being able to reproduce the quality standard achieved on one blade as often as possible. This is an important prerequisite for lowering costs during manufacturing and subsequent operation.”

To this end, the researchers have developed a series of machines for partial production processes. Cutting to size is carried out mechanically and in space-saving manner through wrapping technology. A precondition is efficient warehousing logistics. The cut strips are stacked dry up to ten centimetres high using mechanical means. The challenge here is to develop a system that recognises the cutting edges precisely and works free of folds. Only in this way exact stack formation is possible. A quality measuring head checks and documents on a layer by layer basis whether the textile has been damaged during processing or if folds occur. After fixing using a special adhesive, the stacks are pre-shaped by machine. As a result of this process, known as pre-forming, the stacks have the correct geometric structure for the blade prior to insertion into the mould and the resin injection. The process was tested on the so-called transition area of a rotor blade. This segment is situated directly on the flanges via which a blade is secured to the hub. As this section is particularly demanding from a geometric perspective, the research team chose it for the development of the process.

New textile product enables automated processing

The textile structure used was developed especially for the project. It stands out through special thread tensions and material compositions; according to the project participants, this excludes warping in the manufacturing process as well as the formation of folds. Even the intermediate storage of pre-shaped textile stacks is possible, thus enabling more rational use of the negative moulds. Until now, the layer-wise stacking of the textiles was also carried out directly in the mould. The new process therefore enables higher quantities per mould.

The recently completed Mapretec research project was funded by the German Federal Ministry for Economic Affairs and Energy. In 2014, the project received the Innovation Award of the global composite community JEC in Paris in the wind energy category. The project also achieved second place in the 2014 Industry Prize in the research and development category.

In the future, the Bremen University Institute BIK wishes to support interested industrial companies on the path to automated blade production and scale up the new process at the same time. The Institute for Integrated Product Development (BIK) at the University of Bremen carried out this research project under the name Mapretec, together with the companies Saertex, a manufacturer of structures, and Areva Blades.

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