recycling

A new generation of wind turbine blades

The goal of the four-to-five-year Effiwind project launched in March 2014 is to develop a new generation of wind turbine blades that are made of recyclable thermoplastic acrylic polymer materials.

The project, worth a total €10.6 million, is sponsored by the French Environment and Energy Management Agency (ADEME) and the Nouvelle-Aquitaine Regional Council. It mobilizes a twelve-partner industrial consortium that includes Arkema, Canoe, Plastinov, Epsilon Composite, AEC Polymers, Valorem, Tensyl, Chomarat, and Bernard & Bonnefond.

The context

Thermoset polymer composites are the materials currently used to make wind turbine blades. These materials have proved to be technologically mature and easy to work with during the manufacturing steps, with highly fluid resin that adheres well to the composite's reinforcement fibres. Their mechanical performance, however, is not the best (especially for fatigue), and recycling these materials is expensive.

Clear-cut objectives

The Effiwind project should enable the use of thermoplastic acrylic polymer composites in the manufacture of very large parts like blades and nacelle covers for offshore wind turbines. This will be a major technological innovation for the wind energy sector, one that could reduce both weight and manufacturing costs (no need for a cure cycle) and enable recycling. During the project, a set of reinforced acrylic thermoplastic blades will be manufactured and tested on a wind turbine that is already in operation.

In concrete terms, Effiwind has three objectives:

- manufacture 25-metre-long blades that are longer than standard ones (23 metres), but which weigh the same, thanks to the use of a recyclable acrylic resin along with pultruded carbon fibre,
- incorporate pultruded carbon fibre to serve as the blade's "backbone" and help support mechanical stresses,
- assemble the blade's two half-shells using a methacrylic adhesive.

The first new-generation wind turbine blade has just been finished in Plastinov's facilities at Samazan in southwestern France, with the help of Canoe to prepare for certification by Germanischer Lloyd (GL). Three blades are scheduled to be finished by the end of 2016, for installation on a wind turbine in Brittany's Plougras test site in the Côtes d'Armor region.

Sequence of events

The main steps of the project are as follows:

- develop new material solutions, in this case acrylic thermoplastic resins, that will lead to the design of recyclable, repairable blades, higher mechanical strength, and lower weight than blades made of standard materials. Weight reduction is especially important, since it impacts both performance and cost;
- develop the processes to manufacture the blades from these materials;
- demonstrate the technical feasibility of this solution on an operating wind turbine;
- apply the material solutions to the wind turbine's other plastic components, in particular the nacelles for offshore machines.

Fig. 1: Three blades are scheduled to be finished by the end of 2016

Fig. 2:
The first new-generation wind turbine blade

Focus

Your partner at the heart of an innovation network

Canoe is a technology transfer platform created in France in 2009 at the initiative of the Aquitaine Regional Authorities. This centre for research and technological innovation focuses on the development of innovative organic nanostructured composite and coating technologies.

Canoe promotes technology transfer and the development of industrial supply chains (from raw material to finished product) that integrate SMEs and large groups in the field of aeronautics, transport (automotive, yachting) and renewable energy (photovoltaics, wind power, green chemistry).

Expected results

- Innovation: Effiwind will constitute a major technological innovation for the wind turbine sector. Lowering the weight of the blades will make it possible to increase rotor efficiency with more lightweight blades or, for equal weight, longer ones.
- Economic and social: thermoplastic composites can be more easily repaired and facilitate maintenance operations. These benefits can then lead to lower operational costs and a potentially important impact on the value chain.
- Environment: the environmental benefits will affect the entire life cycle of the blades and nacelles: lower material consumption, a manufacturing process that avoids exposure to toxic or otherwise harmful products; easier repair and recyclability.

Application and upgrade

Effiwind technology will be applicable to all large composite parts. The first upgrade products will be the blades for the retrofit market (replacing parts on a wind turbine but maintaining its initial configuration) and the nacelle covers of offshore wind turbines.

Over the medium and long term, markets like extra-large land-based and offshore wind turbines will be targeted.

A coordinator involved in composites

Canoe contributes its know-how in the acrylic resin infusion process to this project, thereby ensuring the feasibility of the process. Using its experience with this manufacturing technique, the platform is enabling the creation of a new generation of wind turbine blades by validating the different infusion strategies for recyclable acrylic resin.

In an extension of the project, Canoe is partnering with Arkema and Plastinov for two projects: Reverplast, a state-approved project under the first four dossiers of state commitments for ecologically sustainable growth that aims to create the first recycling stream for acrylic thermoplastic materials for the automotive, wind energy, photovoltaic, and boating markets; and the Porcinette demonstration platform project on energy transition.

More information:
www.plateforme-canoe.com
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