Core of the matter: how to cut blade weight and cost

DIAB is a leading manufacturer of core materials, one of the three primary building blocks used to construct composite wind blades and nacelles. In late 2013, Peter Norlin, technical services manager, and Ray Lewis, market segment manager, wrote the article: "The 'core' material in a blade". Here, *World Wind Technology* interviews the co-writers to establish developments since.

Could you remind us about the article, the response to it and market trends since?

Ray Lewis: We had just completed our five-year strategic plan and decided to take an open approach to the market, explaining our vision and mission, as described in the adjacent advert.

Peter Norlin: Experience has shown us that the most effective way to reduce total blade cost is to partner with our customers. Since the article, an increasing number of customers have implemented this methodology and we have had to recruit additional technical service support staff to support this.

RL: Flexibility is key today. In the high-growth years, manufacturers invested in new plants, but today's growth comes from emerging markets, with 'business case certainty' needed. Consequently, we see an increased use of subcontractors, many building to print.

The market has started to see raw material costs increase, for example resin and glass. Increases in core need to be planned also, prioritising total blade cost solutions, to meet the levilised cost of electricity (LCoE) driver.

Infusion has become the default processing technology. Linked to this (and blade weights below), several manufacturers are moving from PET and PET/balsa to PVC/balsa, as used historically.

> "If individual product specifications are opened, price competitiveness can be maintained by eliminating often hidden and built-in costs to producers."

With increasing blade size, weight seems a critical aspect, with many actively engineering weight out, but still remaining design allowable. How can core materials help?

PN: While, structurally, core is selected to meet similar design criteria in infused and prepreg blade, it performs an additional key processing function in the infusion process used to build most larger blades today. Core density has a major impact: the lower the core density, the lower the weight of the blade. For example, structurally, it would require a 100–110kg/m^3 PET to replace a 60kg/m^3 PVC foam.

Resin absorption – the amount of resin absorbed into the core material itself – is key. In a closed-cell foam, it is the resin amount needed to saturate the surface cells. For balsa, it is the resin amount absorbed into the wood's cell structure. So, for foam core, the resin absorption will be the same regardless of thickness, with the cell size determining the amount (typically, PVC foam cores have very low resin absorption compared with other foam core materials used in blade applications). Due to its orthotropic nature, the resin absorption of end-grain balsa is thickness dependent i.e. the absorption increases with sheet thickness. Overall, the resin absorption in end-grain balsa is considerably higher than foam cores.

Core finishing plays an important role in weight optimisation. It has a double impact: each time the core is cut, it increases the effective surface area susceptible to resin absorption, whilst generating a void that will be filled with resin during the infusion process. DIAB has developed many finishing options for the various components in a blade while maintaining the core's functionality as a 'resin distribution media' in the infusion process.

RL: If individual product specifications can be opened, price competitiveness can be maintained by eliminating often hidden and built-in costs to producers.

Finally, can you give us a case-study example?

PN: If we consider a typical hybrid infusion blade in the 45–50m range made from PET/balsa with non-optimised core finishing, the weight and cost saving potential is substantial. By replacing the heavier PET foam with a 60kg/m^3 PVC foam, blade weight can be reduced by approximately 400kg. If the core finishing of the foam components are optimised, an additional 280kg of reduced resin uptake can be expected. Focusing on the core type and finishing during the development process of a new blade will have huge impact on the weight and costs of the final product. ■

Further information
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