# Composites for energy

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Advanced composite materials are playing a vital role in improved design and reduced operating costs for renewable energy technologies. Research presented today will highlight how wind, marine and solar power could address these challenges within the renewable energy industry.

The 'Composites for Energy' seminar has been organised jointly between Bristol University's Advanced Composites Centre for Innovation and Science (ACCIS) and the University's BRITE Futures Institute, a new multidisciplinary research hub dedicated to environmental systems and technologies. The seminar is part of this year's annual ACCIS conference.

Recent studies have suggested that around 5 per cent of the UK's electricity needs could be supplied by tidal stream devices and unlike tidal barrages, they do not block tidal channels and have none of the associated environmental impacts such as loss of inter-tidal habitats for bird and marine life. Tidal stream devices capture energy from fast-flowing tidal currents, such as those found in constrained channels around headlands.

A collaborative project, 'New Materials and Methods for Energy Efficient Tidal Turbines (NEW-MMEETT),' involving the University, Aviation Enterprises Ltd (blade manufacturer), Advanced Composites Group Ltd (composites manufacturer) and Materials Engineering Research Laboratory Ltd is developing more fatigue resistant materials and improved design techniques for tidal turbine blades. This will enable a reduction in the mass of material required for blade manufacture, essential for making such devices more commercially viable, whilst also ensuring required in-service lifetimes can be met with minimum maintenance requirements.

Bristol's role within the project involves the development of a numerical modelling technique for predicting how damage grows in composite materials under cyclic loading.

Dr Stephen Hallett in ACCIS said: "The outcomes of the NEW-MMEETT project, with respect to both more fatigue resistant materials and improved design techniques, will also have strong potential for application to wind turbine blades."

Wind turbines are already a well-established technology but further design and manufacturing improvements are essential in helping the industry meet its expected growth targets over the coming years. The Global Wind Energy Council (GWEC) has predicted that wind energy could provide as much as 13 per cent of global electricity demand in 2020 and as much as 25 per cent in 2030.

Modern wind turbine blades are generally made from a combination of glass and carbon fibre reinforced plastics. During manufacture, the plastic resin is heated and cooled in a controlled manner so that it bonds with the fibres and sets to form a rigid structure.

The combination of very strong fibres surrounded by a lightweight plastic matrix enables a greater strength to weight ratio than is possible with conventional metallic materials. By carefully controlling the direction and tension of the fibres, it is also possible to create a bi-stable composite, which can snap between two distinct rigid shapes.

Dr Weaver in ACCIS said: 'We are currently focused on producing morphing blades, which can rapidly change their aerodynamic profile to best suit the current wind conditions. This has the potential to significantly relieve unwanted stresses in the blades, increasing their efficiency and helping to prolong their life. In addition to wind turbine and helicopter rotor blades, morphing composites are also being developed for aircraft wings, reducing the need for mechanically operated control surfaces.'

The Lithiated Nanoparticle Diamond Solar Energy Converter project, based at the University and funded by the energy company, E.ON, plans to exploit solar heat to produce electricity.

The project uses a novel application of commercially available, low cost diamond powder to form Lithium-doped nano-Diamond (LiD) electron emitters. The LiD emitters use solar infra-red radiation to produce thermionic emission in a vacuum valve. The current and voltage produced by the valve is converted to electrical power that may be fed into the national grid. Such a device is termed a thermionic converter and has the potential to realise theoretical conversion efficiencies of 66 per cent.

Dr Neil Fox, in the University's School of Chemistry, said: "We aim to demonstrate a working nanodiamond-based solar energy converter as an alternative technology to conventional photovoltaic solar cells. The target is to achieve operation below red heat. If this can be realised, the new thermionic converter technology will have applications in renewable energy generation particularly for Concentrated Solar Power."

Source: University of Bristol (news : web)