

Hexcel's Composite Materials  
for wind turbine blades





# Harnessing Nature's Power

Hexcel has been supplying composite materials to wind turbine blade manufacturers for over ten years. The introduction of composites technology has enabled blade size to grow to today's giant proportions, making wind power the world's fastest growing energy source.

Hexcel has supplied over 15,000 tonnes of composites to the industry to date. We work closely with our customer partners to develop products that are tailored to their specific requirements. This approach has enabled us to develop prepregs that cure faster at lower temperatures; to develop new fibre-reinforced matrix solutions for rapid cost-effective processing; to develop paste adhesives for bonding shells and gel coats that provide a hard wearing finish.

Hexcel is one of the few composite suppliers that manufactures carbon fibre in-house. This, combined with our dedicated weaving facilities, enables us to design composite reinforcements in glass and carbon, or hybrids of the two. We are the composite specialists, with dedicated R&T facilities in Europe and the USA. Our global technical support team will assist with material selection, processing and can provide training to those who are new to composites technology.



## Empowering technology

Prepreg is a glass or carbon fibre reinforcement that is impregnated with epoxy resin. It is supplied in roll form and is cured with the application of heat and pressure to produce high quality laminates with superior stiffness and strength – at low weights. Carbon fibre prepregs can be a cost effective option for very large diameter blades, as less material is required to achieve the strength of glass. Hybrid reinforcements of glass and carbon are also an option. Hexcel has six prepreg manufacturing facilities worldwide and recently invested in a new production line in Austria to manufacture cost-effective UD glass and carbon fibre prepregs in a kilo-ton scale.

Hexcel has extended its resin range for wind energy, to meet the requirements of customers seeking to reduce production times and smooth their production output. HexPly® M9F resin systems are another new development. These formulated epoxy systems are suitable for low pressure moulding processes. The resin systems are highly versatile, permitting a range of

processing temperatures from 85°C up to 150°C. HexPly® M9F systems are a further development of Hexcel's well-established M9 range, already widely used to manufacture wind turbine blades. The new epoxy formulations contain no environmentally harmful resins, or hardener components, which are classified as category 3 carcinogens or mutagens according to new EU product safety legislation. HexPly® M9F resins are fully compatible with Hexcel's standard M9 systems, in terms of properties and performance. With the new M9F resins, Hexcel continues the success of high performance composite materials specifically developed to meet the challenges facing wind turbine producers.

HexPly® M11 and M11.5 have been developed to adapt to low vacuum bagging processes, whether curing takes place at 70°C or 140°C. The main advantage of these systems is their rapid cure cycle at low temperatures: only 3.6 hours at 80°C or 8.7 hours at 75°C. HexPly® M11 and



M11.5 are diuron free, making Hexcel ahead of the game in anticipating future environmental legislation.



### Benefits

- optimised structural design
- consistent fibre volume ratios
- lower and consistent blade weight
- pure UD materials with optimised performance/cost ratio
- high strength and fatigue properties
- short total processing and cure cycle
- clean working environment
- low exotherm enable curing and co-curing of multi-ply laminates, eg. carbon with glass
- minimise stresses caused by differences in thermal expansion



3 HexPly® Prepregs



4 HexFIT™



4 Liquid Resin Infusion



5 Engineered Fabrics



5 HexCoat™ Gel Coats



6 Redux® Paste Adhesives



6 HexWeb® Honeycomb



## A quick and cost-effective solution

HexFIT is a film of prepreg resin combined with dry reinforcements of glass or carbon fibre. HexFIT is processed by applying heat and vacuum, which activates the resin, enabling it to flow and infuse the reinforcement. HexFIT provides a quick and cost-effective way of producing large, thick laminates. Hexcel's carbon UD HexFIT is a very effective way of manufacturing carbon blades, ensuring full infusion of the reinforcement.

### Benefits

- optimal material combinations
- good fibre alignment easy to handle and drape
- vacuum bag/oven or press cure
- controlled impregnation – no dry residual fibres
- good air release and full infusion of reinforcement
- void free laminates
- pure carbon UD with no impurities
- compatible with other processing methods (eg. LRI)
- higher compression strength due to use of non-stitched nonwoven reinforcements
- dry resin cleaner to use
- easier processing than prepreg

## Reinforcements and peel ply

Hexcel has extensive in-house weaving capabilities for the manufacture of unidirectional and woven reinforcement fabrics in glass, carbon and aramid fibres, and hybrids. The wide range of weave styles includes standard weaves, biaxials and multiaxials. Hexcel also supplies peel ply fabrics in the form of finely woven lightweight polyimide.

These are applied to the composite surface prior to curing the laminate and removed after cure.

### Benefits

- provides a clean surface ready for adhesive bonding.
- eliminates the need for mechanical abrasion of the composite surface



## Liquid Resin Infusion (LRI)

### An alternative process

LRI is an alternative composites processing method, using liquid resins to infuse a stack of dry reinforcement materials in a vacuum assisted or pressure moulding process. As the resin flows through the laminate, by the action of a vacuum pump or pressure, the air within the laminate is flushed out. This process produces composite

structures with low void content.

Hexcel is currently optimising resins for LRI processes, which have a low enough viscosity to flow easily through the fibre-reinforcements, while retaining the mechanical properties of resins used to manufacture prepregs.



## HexCoat™ Gel Coats



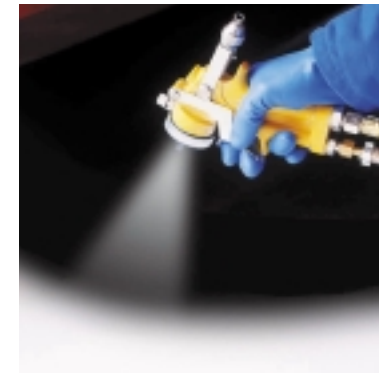
### A durable finish

Hexcel has developed a range of long lasting, weather resistant epoxy coating systems, which can be applied by roller or spray gun. HexCoat gel coats are compatible for co-curing with HexPly prepregs and provide an excellent surface finish

### Products and Benefits

- HexCoat™ 02 two-component epoxy gel coat is easy to mix, highly durable, abrasion resistant and UV stable

- HexCoat™ 03 is a two-component rapid drying finish coat for surface repair. This product has one less component than the current 3-part industry standard. It is very easy to mix, curable with heating blankets, and has a surface which can be sanded for an excellent finish





## Redux® Paste Adhesive

### An effective bonding solution

At Hexcel we have applied our decades of experience in formulating epoxy resin systems to the development of paste adhesives for the wind energy industry.

shell bonding requirements. The Redux pastes can be adapted to meet specific slump, open time, application and handling needs.



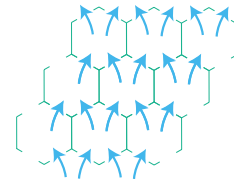
Various two-part epoxy systems have been developed which are suitable for root and



## HexWeb® Honeycomb

### Facilitating heat flow in mould tools

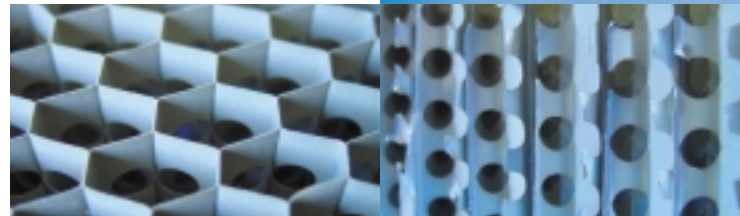
HexWeb metallic honeycomb can be very useful in the manufacture of tooling for wind turbine blades.



#### Benefits

The incorporation of drilled aluminum core allows a stiff and stable lighter-weight tooling to be constructed which facilitates the even distribution of heat

throughout the tooling. This ensures a consistent even cure throughout the laminate and avoids the risk of localised areas of semi-cured prepreg.





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