Wind Energy

Leading the Way for Wind Energy

OCV™ Reinforcements | OCV™ Technical Fabrics | OCV™ Non-Woven Technologies

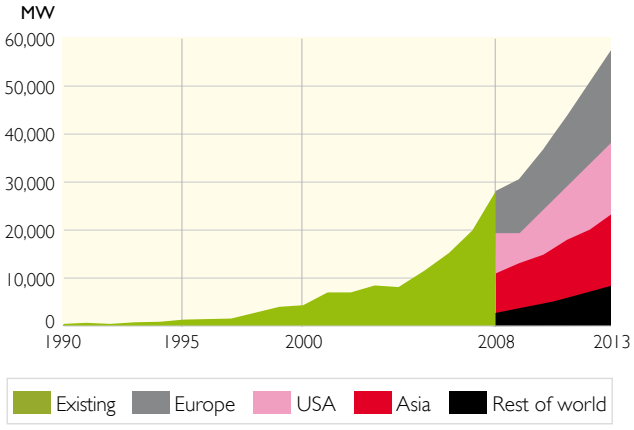
WIND ENERGY MARKET

Source for the four charts : BTM Consult ApS - March 2009

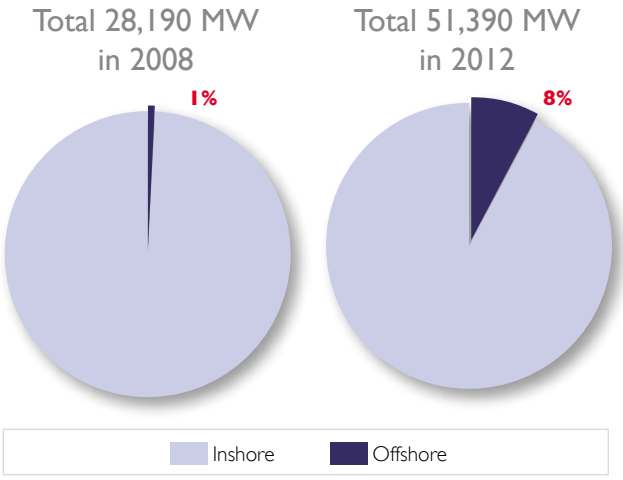
2020 estimation = 140,000 MW = 1 million ton reinforcements (7 tons / MW)

ANNUAL WIND POWER DEVELOPMENT

Actual 1990-2008 and forecast 2009-2013

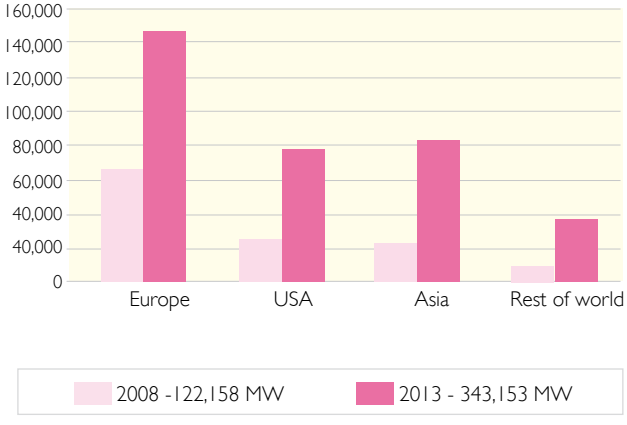


GLOBAL INSTALLED CAPACITY



GLOBAL WIND POWER FORECAST

Cumulative MW by end of 2007 and forecast 2013



DEVELOPMENT IN CO2 REDUCTION BY WIND POWER UP TO 2018

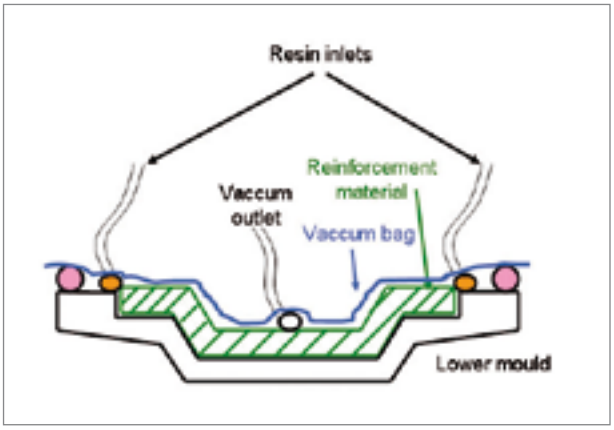
YEAR	ELECTRICITY PRODUCTION TWH	CARBON DIOXINE REDUCTION Mt per year
2008	254.1	228.7*
2013	721.4	577.1
2018	1 898.5	1 708.6

* 228.7 Mt/year equals 1.93% of the world's emissions from power generation in 2008

MAIN MOULDING PROCESSES

INFUSION

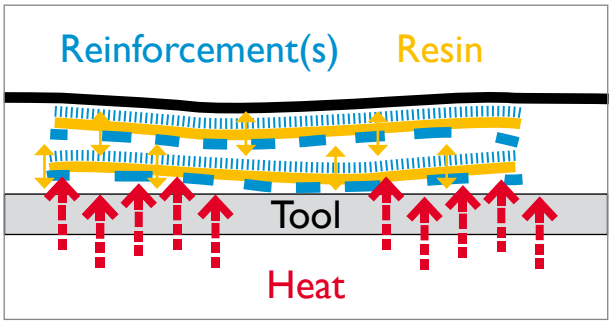
The Infusion process consists in impregnating one or several layers of reinforcement placed in a composite mould and covered by an air tight plastic film used as upper mould. The resin is drawn by vacuum into the reinforcement between mould and film and is not in contact with the air of the workshop (« closed mould » process). Once the resin is cured, the plastic film can be removed and should be thrown away after one use.



Reinforcements used in infusion are mainly Uni-Directional, Multiaxial, Woven Roving and Unifilo® mat but some 3 dimensional complexes can be used as well. A flow media can be laid on the top of reinforcements stack to help the resin to flow on the surface before impregnating layers in depth. For low thickness parts, surfacing flow media might not be necessary when reinforcement's in-plane permeability is high enough. Infusion allows to make very big parts such windmill blades, with glass content up to 70%.

PREPREGS

Prepregs are resin impregnated reinforcement fibres or fabrics. The resin reaction is initiated during the impregnation process already, but slowed down while cooling the material. A protective film is applied between the layers during winding and finally the materials are deep frozen for storage. At this low temperature, prepregs can be stored during months but have to be transported cooled. Before use, the roll goods are usually brought up to the desired temperature and cut into shape. The protective plastic film is removed and the layers are stacked into the tool according to the laminate design. To remove air entrapped between the prepreg material, it is sometimes necessary to use single layers of dry fabrics in between thicker laminates.



According to the desired laminate schedule, the material is usually covered by a peel ply, absorber fleece and vacuum film. After vacuum processing, the material is heated and cured. Very high quality laminates can be manufactured by using autoclaves with higher air pressure in order to compact the laminate and reduce air bubbles and voids and to increase the fibre fraction.

MARKET NEEDS

TRENDS AND DRIVERS

- Weight efficient strength and stiffness
- Shorter cycle time and improved infusion process
- High surface quality of manufactured blades
- Cost reduction/cycle time
- **Longer blades enable reduced cost per kilowatt hours**

. Design of blades greater than 45m in length is becoming more critical

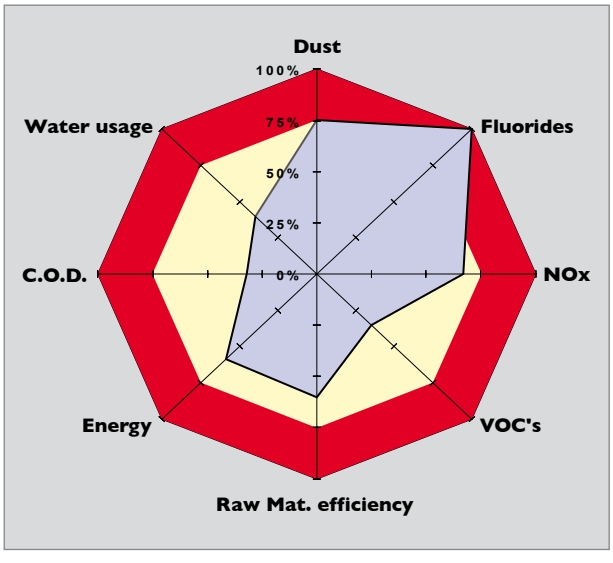
. High performance materials enable the manufacture of low weight blades greater than 45m

OCV™ SOLUTIONS

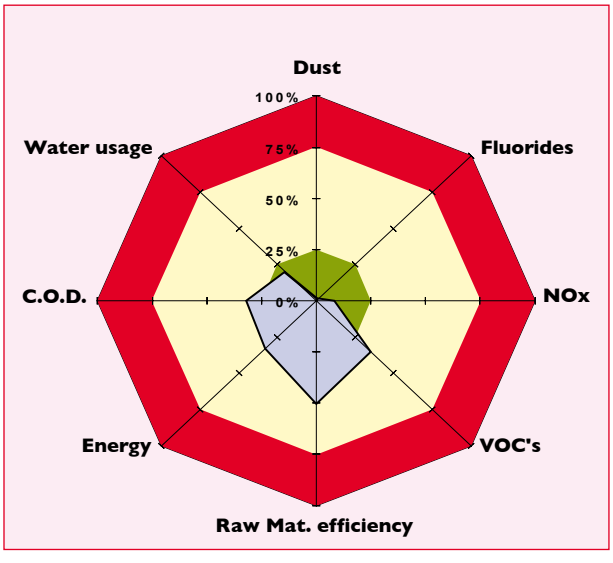
- High performance, WindStrand® reinforcement
- Advantex® glass
- Single-End rovings with controlled glass fiber tex
- New and customized fabrics designed for quick infusion, fast lay up and an optimized modulus/$ ratio
- Unifilo® continuous filament mat with unmatched permeability
- Light chopped strand mats and Non-Wovens

ADVANTEX® IS THE MOST ENVIRONMENTALLY FRIENDLY E-GLASS

Boron Traditional E-glass



Boron-free and Fluorine-free Advantex® glass

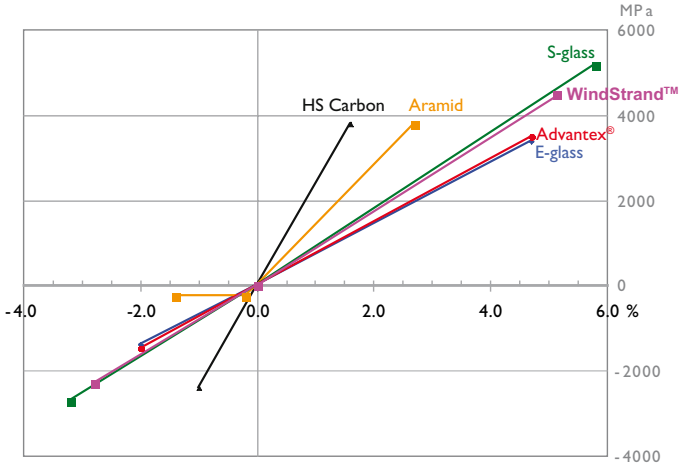


The above comparison was typical for OCV™ plant conversions. Actual results vary from plant to plant.

High | Medium | Low | Environmental Footprint

TECHNOLOGY TRENDS AND OCV™ INNOVATIVE SOLUTIONS

■ Stiffer blades, more power with the WindStrand™ solutions.



WindStrand™ SOLUTIONS

■ Enables blade manufacturers to reduce blade weight by up to 10%

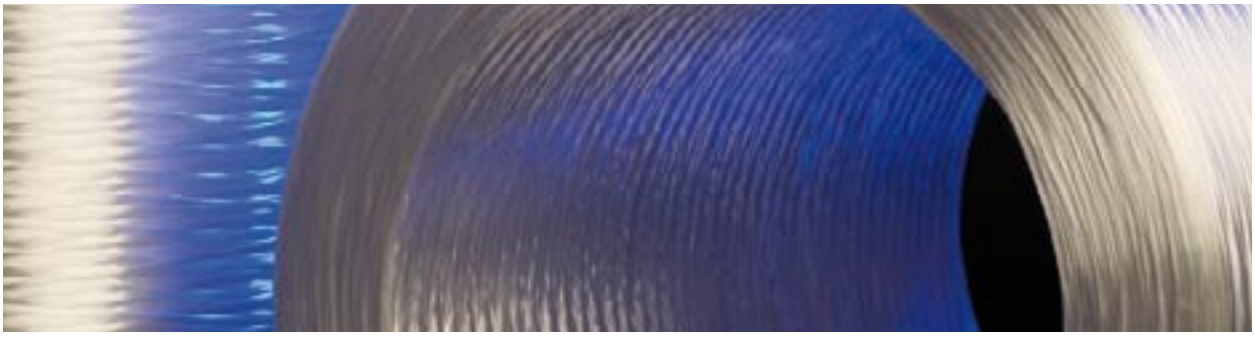
■ Enables up to 6% longer blades with **no** increase in weight

■ Provides opportunity to translate benefits into more Power

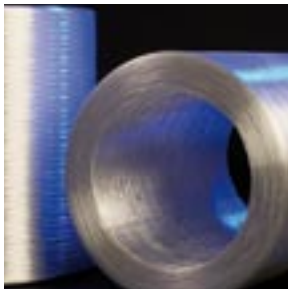
■ Ultimately resulting in a lower cost per Kwh

WindStrand™ glass benefits Vs conventional E-Glass are

- up to **15 %** Higher Stiffness = reduced deformation
- up to **35%** Higher Strength = increase load (Higher Wind Speeds)
- up to **15%** Higher Strain (elongation to failure) = higher deformation
- up to **50%** higher strain energy density = better impact & damage tolerance
- **>10X** enhanced fatigue live (@ same load !) = improved reliability, lower maintenance cost, …



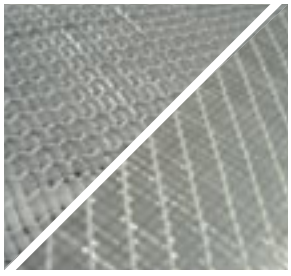
For 20 years OCV™ businesses have been leading the Way for Wind Energy with rovings and fabrics preferred by the largest wind blade manufacturers.
We provide full package solution for wind blades together with localized and global support for blade manufacture with various resin systems



WindStrand™ SOLUTIONS

High-Performance Reinforcements

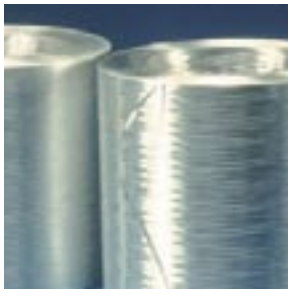
- The WindStrand™ Single-End roving is available in Tex ranging from 300 to 2400
- WindStrand™ fabrics are also available



MULTIAXIALS, UNIDIRECTIONALS

Specifically customized and designed for quick infusion, fast lay up and an optimized modulus/$ ratio.
Allow improved laminate performance in a blade

- OCV™ Multiaxials are made up of two or more layers of unidirectional fibers stitched together with a light polyester thread. We also offer multiaxials that are powder-bonded instead of stitched
- OCV™ Unidirectionals are stitched, woven and hot-melt, in full width or tape form



SINGLE-END ROVINGS

Easy processing and optimized resin compatibility for increased mechanical properties

LAMINATE PROCESSING	RESIN COMPATIBILITY	PRODUCT
Fabrics - Infusion	UP - VE - EP	SE1200 - 111A
	EP	SE1500
Prepregs	EP - VE	R25H

UNIFILO® CONTINUOUS FILAMENT MATS

Easy processing and optimized resin flow to reduce moulding cycle time

PRODUCT	WEIGHT (g/m^2)	PROCESSING
U816	225 - 300 - 450 - 600	General purpose
U850	300	Enhanced resin flow

NON-WOVENS

Normally used to improve surface finish and this resin rich surface which help the bond behind the gel coat if one is applied

PRODUCT	WEIGHT (g/m^2)	FIBRE TYPE	FIBRE DIAMETER (micron)
M524	20 to 70	ECR	13
M524	25 to 70	C	12.5
Tailor made product available on request			
Infusion: Insoluble binder ECR30H/3 or ECR50H/3 or dry C33 (30, 50, 33 g/m^2)			
Hand Laminating: M524 C64, drapable char. but soluble in styrene, rapid wet out			
RTM: M524 ECR30A or ECR50A, acrylic binder slowly soluble in styrene			

CHOPPED STRAND MATS

Very easy impregnation, good surface appearance, and excellent compatibility with polyester, vinyl-ester, and epoxy resins

PRODUCT	WEIGHT (g/m^2)	BINDER
MP113	100-150300-450-600	Powder
MP123	225-300-450-600	Powder

Multi-purpose chopped strand mats, held together by a powder binder which is extremely soluble in styrene

YOUR GLOBAL PARTNER FOR COMPOSITE SOLUTIONS

OCV™ Reinforcements

OCV™ Technical Fabrics

OCV™ Non-Woven Technologies

- Facilities in 15 countries worldwide
- More than 9,000 employees
- More than 15 languages
- 39% of Owens Corning revenue
- www.owenscorning.com/composites

OCV™ Reinforcements | OCV™ Technical Fabrics | OCV™ Non-Woven Technologies

www.owenscorning.com/composites

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Conception - Réalisation : QUALIgraph'