

Department for Business Innovation
and Skills

The UK Carbon Fibre Composites Industry

Market Profile

A study by NetComposites/Connectra
May 2009



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Author's Note

The author of this report wishes to make two introductory notes to this report

First of all, the author expresses his profound thanks to all those people in the carbon fibre composites industry in the UK and the rest of Europe who participated in this study by agreeing to be interviewed, both in person or by telephone. Many of these people, who are too numerous to mention by name, gave very generously of their time and ideas and some were even went as far as conducting further research after the interview and took more time to feed back further information. It is this generosity of interviewees that has enabled the author to pull together what is hopefully as accurate a picture of the industry as possible, taking into account the constraints of the study.

Secondly this study has been done at a moment in time when the industry is facing a downturn, with the fourth quarter of 2008 having shown a significant decrease in market demand. Such changes complicate accurate assessment of the market in the reference year of 2008 but everything possible has been done to reflect as accurately as possible the volumes and values of the carbon fibre composites sector in 2008.

This report was commissioned by BIS and executed by Gordon Bishop and Sue Halliwell at NetComposites in cooperation with Andrew Mafeld of the Connectra Group.

Introduction, Scope and Methodology

Introduction & Scope

In February of 2009, the UK Department of Business Enterprise and Regulatory reform commissioned NetComposites, in collaboration with Connectra, consultants specialised in the composites industries, to conduct a survey of the UK Carbon Fibre Composites industry.

The purpose of this study was to quantify the UK Carbon Fibre Composites market and to identify key opportunities and threats in the industry. This report summarises only the results of the work undertaken to quantify the UK Carbon Fibre Composites market.

Scope

The scope of the study included both large and small players in the UK Carbon Fibre Composites industry as well as all related processes and end uses.

Methodology

The study was based essentially on a combination of personal face to face and telephone interviews, usually of senior management or technical specialists at key companies in the industry. A total of 52 interviews were conducted, and a list of the companies interviewed is given in the appendix to this report (in a few companies more than one person was interviewed). The interviews were conducted during the months of February, March and April 2009. Additionally some desk research was conducted on areas where interview information provided insufficient background or detail.

Executive Summary

The Global Carbon Fibre Composites market is a relatively young, fast growing and technologically evolving market. New applications in the major end use markets of aerospace, renewable energy especially wind, automotive and general industry are expected to lead to significant and continued growth of this sector over the next decade

The production of Carbon Fibre Composite Components in the UK in 2008 is estimated to represent a turnover of some £ 390 mln with associated employment of some 18,000 people. The value of the carbon fibre composites component sector represents some 40% of the value of total composites production in the UK, glass being the larger part. The share of carbon fibre composites will continue to grow.

The UK has a strong and vibrant carbon fibre prepreg sector which serves both the UK as well as being a major exporter. Prepreg end uses which are strong in the UK are aerospace, Formula 1, specialty automotive and general moulding. The volume of carbon fibre processed in the UK represents some 2,500 tons (including continuous filament and imports of fabrics and prepreg) of which almost 50% ends up in the production of CF composite components in the UK and the rest is exported in the form of fabric or prepreg.

In the opinion of the persons interviewed in the course of this study, the UK's major area of strength in CF composites lies, from an end use perspective, in the areas of aerospace and specialty automotive and Formula 1. From a capability perspective the UK's main areas of strength lie in state of the art engineering design and analysis..

International competition in the CF based aerospace components sector will intensify as new plants with advanced composites manufacturing capability are opened in China, Malaysia, the Emirates, Turkey and Morocco.

Other EU member countries, notably Germany, Spain and France have been developing their advanced composites research and manufacturing capabilities via the setting up of dedicated clusters and technology parks. Significant recent investment has been made in these countries in automated manufacturing equipment.

1. Structure of the Value Chain

The Carbon Fibre Composites Industry has a particular structure which is important to be aware of because, as will be discussed in the next section, there is a high degree of integration in the industry. The main steps in the industry value chain are shown in the diagram below:

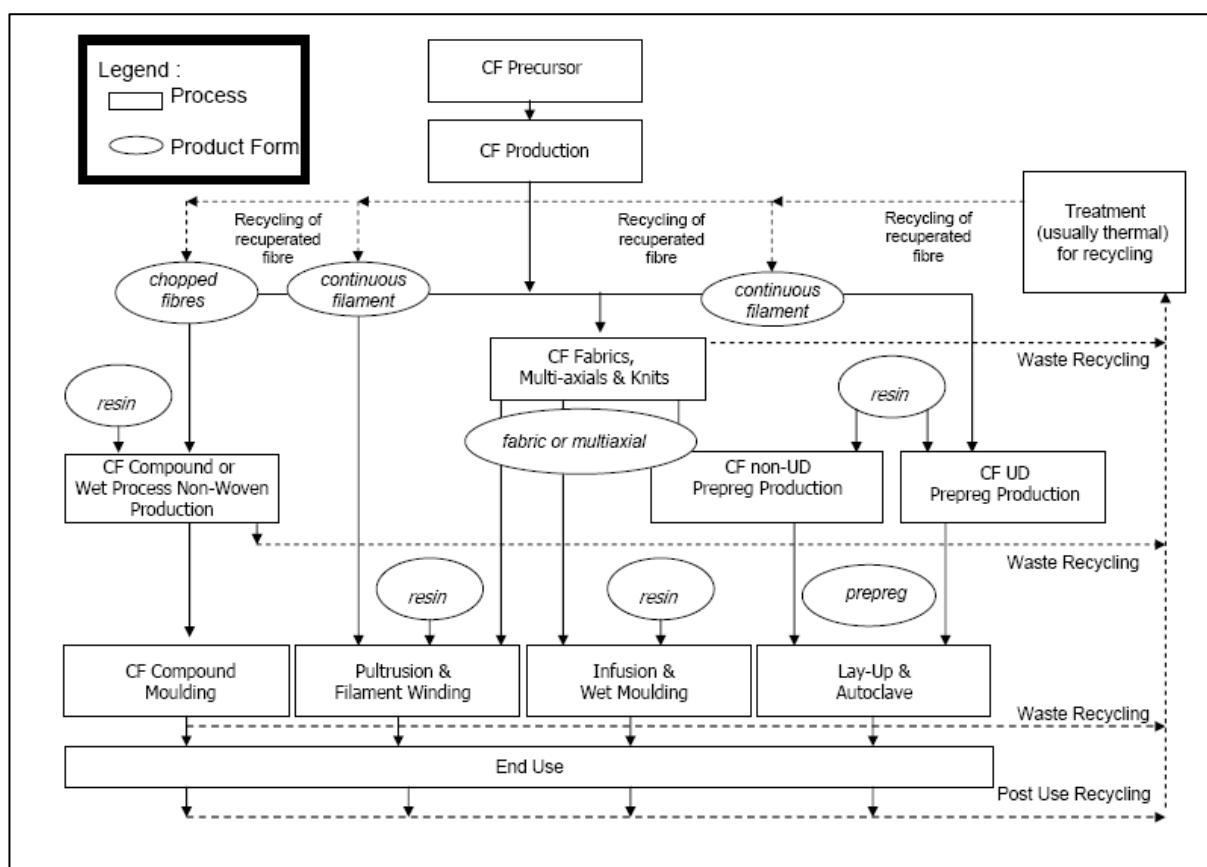


Fig 1: Key steps in the Carbon Fibre (CF) Composites Value Chain

As can be seen from the diagram above the chain starts with the production of carbon fibre precursor (for the most part Poly-Acrylonitrile or PAN as it is more commonly known). This

precursor is then used in the production of carbon fibre via an oxidation/carbonisation process.

The next key intermediate step in the value chain is the production of fabrics of either woven or multi-axial type. 3D knitted carbon fibre shapes are also used allowing placement of the reinforcement exactly where it is needed in 3D shapes.

Prepreg production is the next key step in the chain and has historically been and remains the main form of carbon fibre used by processors. Here one needs to distinguish between unidirectional (UD) prepgs which make use of continuous filament carbon fibre directly and fabric based prepgs. CF Prepgs are mainly based on epoxy resin but some thermoplastic prepgs based on high temperature resistant thermoplastics such as PEEK and PPS are also commercially available.

In parallel to prepg production there is also production, based on chopped carbon fibre, of either compounds or non-wovens (veils). Compounds of carbon fibre can be either thermoset based, such as sheet moulding compound, or thermoplastic based, used in conjunction with any one of a range of engineering thermoplastics (e.g. PA, PBT, PEEK, PPS etc). Carbon fibre veils are used in a variety of applications to give specific properties e.g. conductivity to composite parts.

At the final level of the chain, there are four main groups of carbon fibre composites manufacturing processes which can be distinguished:

- Compound moulding processes which can be based either on compression or injection moulding
- Processes which use continuous carbon-fibre filament to produce CF composites directly. The most common of these processes are pultrusion and filament winding and they are usually thermoset resin based. Sometimes prepgs are used in filament winding.
- Resin infusion, resin transfer moulding and wet moulding processes which generally use fabrics and/or multiaxials or possibly knitted inserts
- Prepg lay up (manual or automated) usually, but not always, followed by autoclave treatment

2. The Global Carbon Fibre Composites Industry

The focus of this report is on the UK Carbon Fibre Composites Industry but given the global nature of the Carbon Fibre Composites Industry it is useful to note the key global characteristics and particularities which impact the industry in the UK.

Large and Small Tow

One basic product aspect of carbon fibre which is important to be aware of in order to understand implications of some of the global industry characteristics and peculiarities, is the distinction between small and large tow carbon fibre.

Historically, carbon fibre production focused around, so called, small tow (tow being the number of individual fibres in a continuous bundle). These small tow products ranged from having 1,000 (1K) to 24,000 (24K) filaments. Those companies interested in promoting industrial (non-aerospace) applications of carbon fibre, and therefore interested in higher productivity processes (laying down more carbon/unit time) and a lower price of fibre, have promoted the use of large tow products, usually 24K and above. This distinction will be useful for interpreting some of the points below.

Production Capacity

A second aspect worth keeping in mind is that actual production rate of carbon fibre versus nameplate capacity of a carbon fibre production plant is usually of the order of 65-70%. This is due to a combination of factors such as frequency of product changes, set up times and the differing productivity of large and small tows.

Key Characteristics

The key characteristics and particularities of the global industry are therefore as follows:

1. Carbon Fibre Production is a highly concentrated global industry

The production capacity of the top three global carbon fibre producers in 2008 (Toray, Toho-Tenax and Mitsubishi-Rayon – all Japanese) exceeded 75% of global PAN-based small tow production capacity. Adding in the production capacity of the next two largest producers, Hexcel and Cytec, increased that share to almost 90%. Global small tow capacity represents some 80% of all (small and large) PAN-based carbon fibre capacity.

2. The Carbon Fibre Value Chain has a high degree of integration

The main carbon fibre producers have a high degree of upstream and downstream integration. Almost all the large players are integrated into precursor production on the one hand and into prepreg production on the other (prepreg is the leading product form used holding some 40% of the global market). In addition several of these companies are also integrated into the production of finished parts albeit in a relatively small way.

3. The Carbon Fibre Composites Industry is set to continue with high growth

Historically the carbon fibre composites industry has been growing steadily, with recent growth from 2000 to 2007 in the range of 15% p.a. There was a slight decline in 2008 due to the effects of the downturn of the 4th Qtr.. With the new developments in the aerospace industry coupled to growth in the use of carbon fibre in wind energy, automotive and other industrial uses it can be expected that carbon fibre consumption will continue to grow at a similar 15% average rate starting in 2010, if not higher, over the following five years. This figure includes the slight drop in global carbon fibre consumption in 2008 and probable further small drop in 2009.

4. The Carbon Fibre Industry has historically been cyclical

The history of the carbon fibre industry has been characterised by cycles, going from high capacity utilisation with associated supply difficulties and high prices to gluts due to new capacity with associated oversupply and falling prices. For example, during the last twelve months (1st Qtr 2008 – 1st Qtr 2009) the price of industrial grade carbon fibre has dropped some 40% from around 22 £/kg to 13 £/kg as a result of falling demand and new capacities coming on stream.

5. The Carbon Fibre Value Chain is both complex and fragmented

There is a high degree of complexity in the carbon fibre industry due to several factors. These include the wide range of product properties within the carbon fibre product range of the different producers, coupled to the range to tow counts. Additionally within the prepreg sector which dominates the market, there is a wide range of resin formulations adding to the possible permutations and combinations of carbon fibre and resin. Furthermore in the aerospace market product qualifications, which can take many years to attain, may mean that a carbon fibre producer who also makes prepreg may need to buy in a competitor's CF filament either directly or in the

form of a fabric in order to supply a particular aerospace application. The result is a complex weave of product trails coupled to a large number of specialty niche markets.

6. Carbon fibre is expensive compared to other reinforcement materials

Carbon fibre provides exceptional material properties but in spite of over thirty years of industrial development carbon fibre reinforced solutions remain relatively high cost, even though the cost of the fibre has come down over the years. In the USA a rule of thumb that has been used as a reference for many years is that for carbon fibre to breakthrough in a big way in such applications as automotive, its price needs to drop to 5 \$/lb. This compares to a glass fibre price of the order of 0.60 – 1.00 \$/lb, depending on the type and market conditions.

7. Carbon fibre usage is fragmented across multiple specific end use applications

Historically the carbon fibre industry has publicly reported usage of carbon fibre across three main end uses namely aerospace, sports and industrial. Within each of these three categories, however, there is a large number of actual applications e.g. the sports segment which accounts for about 20% of total global carbon fibre consumption has some 10 main applications ranging from golf clubs and fishing rods to archery. The same applies to the aerospace and industrial segments. Whilst this may have attractive aspects, particularly to carbon fibre producers, it means that very few carbon fibre processors outside of aerospace have a critical size large enough to bring large scale applications of carbon fibre to market e.g. in automotive

8. Publicly available information on the Carbon Fibre Value Chain is limited

The carbon fibre suppliers, on the one hand, are highly concentrated and for obvious reasons keep detailed market intelligence to themselves, barring a few industry overview presentations given at conferences. This means that from that end of the supply chain there is relatively little publicly available detailed information on the market. On the other hand the relatively large number of processors means that an overview of this industry sector is not available unless the data is synthesised from a survey, which is the case of this report.

In summary, for such a relatively small industry, in volume terms as compared say to glass fibre based composites, there is on the one hand a high degree of complexity in terms of products being offered and on the other a high degree of fragmentation in terms of end uses and associated applications. This means that one needs to be very careful about drawing general conclusions and that one needs to keep in consideration the whole carbon fibre value chain when looking at how the market will evolve.

The Global and European Market for Carbon Fibre

As indicated earlier, there is little publicly available and reliable information on the size of the global and regional carbon fibre markets. The information that is available does show significant variation with regards to estimates of the 2008 market, the situation being complicated by the significant drop off in the market in the last quarter of 2008

Several supplier estimates from late 2007 and mid 2008 put projected global carbon fibre consumption in 2008 (before the downturn) at some 33,000 – 35,000 tons. Definitions come into play here as well with that figure implicitly including pitch based carbon fibre as well as PAN based carbon. With the weak fourth quarter it is likely that actual 2008 global consumption of carbon fibre was in the range 28,000 – 30,000 tons.

Estimates of European consumption by industry players put Europe's share as a percentage of the global number vary between 33% - 40%, which would put the European volume for 2008 within a range of 9,200 – 12,000 tons on the basis of the above figures, with a mid point reference of some 10,600 tons.

3. The UK Carbon Fibre Composites Value Chain

Overview

The table below summarises the size of the UK Carbon Fibre Composites sector over the entire value chain:

Value Chain Step	# of companies in 2008	2008 turnover* (£mln)	Estimated Employment
Precursor manufacture	1	50	140
Carbon Fibre manufacture	1	20	180
CF Weaving, Multiaxial production & Knitting	5	30	200
CF Prepreg manufacture	5	100	1,400
CF Composite Part manufacture	150***	385	18,000**

* including exports

**includes Manufacturing, R&D, Design, Procurement, Engineering

***identified companies (excluding occasional users such as car body repair shops, hobby users etc)

Table 1: The UK Carbon Fibre Composites Sector

As can be seen from the table, the carbon fibre composite part manufacturing sector has a turnover of some £385 mln and the 150 companies identified as active in the sector employ some 20,000 people. A detailed breakdown of the structure of companies and employment in the CF composites industry is given in the next section of the study. It is estimated that there could be up to 100 occasional users of carbon fibre for composite applications but they have not been included in the list of 150 composite part manufacturers in the table.

The rest of the value chain, from precursor to prepreg manufacture, employs a further 2,000 people as well and has a cumulated sales value of £200 mln and is therefore not negligible in comparison to the composite part manufacturing sector.

UK Consumption of Carbon Fibre in Primary Manufacturing Processes

The UK is a significant importer of higher priced aerospace grade carbon fibre whilst its exports are for the most part industrial grade carbon fibre. Total UK direct consumption of carbon fibre in the form of continuous filament for processing into composites in the UK (and excluding fabric and prepreg imports) is estimated to have been some 2,060 tons with a value of some £64 mln. This is broken down by primary manufacturing process in the table below :

Process	Product Output	CF Input Form	2008 CF Consumption (tons)	£ mln	CF Avg £/kg
Compounding / Wet veil production	Compound / Veil	Chopped Strands	150	3	20
-Filament Winding/ Pultrusion	Composite part	Cont. Filament	450	9	20
Weaving and Multi-axial laying	Fabric	Cont. Filament	700	25	36
Prepreg manufacture	Prepreg	Cont. Filament	760	27	36
Total			2,060	64	31

* Table 2: The 2008 UK consumption of Carbon Fibre by Primary Processing Process

As can be seen from the table the largest use of imported carbon fibre is for prepreg manufacture, followed by weaving and multi-axial fabric production. There is one major application of continuous filament in pultrusion and some usage in filament winding. The usage of chopped fibres is relatively small and focused on specialty applications in veil and thermoplastic compounding.

UK CF Weaving & Multiaxial Production and Consumption

The UK has a handful of specialized weavers, the largest one being Sigmatex, who are reportedly the largest independent specialized carbon fibre weaver in the world. Other weavers, such as Formax, weave both glass and carbon fibre.

The table below shows the balance of production, imports and exports of CF woven fabrics, multiaxial fabrics and 3D knitted shapes:

UK Woven and Multiaxial Carbon Fibre Balance 2008			
	Tons of CF	£ mln	Fabric Avge £/kg
UK fabric production	700	30	43
UK fabric imports	200	10	50
UK fabric exports	200	9	45
UK fabric consumption	700	31	44

Table 3 UK Woven and Multiaxial Carbon Fibre Balance

As can be seen from the table, the UK consumption of CF fabrics is roughly in balance with the UK production. Overall consumption in the UK is estimated to have been some 700 tons of fabrics in 2008 with a sales value of some £31 mln..

UK Prepreg Production and Consumption

The UK has a significant production of prepreg with 5 companies having plants in the UK, namely Hexcel, Cytec, ACG, Gurit and Amber Composites. A significant part of the UK production of prepreg is exported. Hexcel, Cytec and Gurit have other prepreg plants in continental Europe.

It appears that in the UK the production of prepreg is split evenly between fabric based prepreg and unidirectional (UD) prepreg based on continuous filament. The table below summarises the balance of UK production, imports and exports:

UK CF Prepreg (UD and Fabric based) Balance 2008			
	Tons of prepreg*	£ mln	Avge £/kg
UK prepreg production	2,400	100	42
UK prepreg imports	400	22	55
UK prepreg exports	1,820	80	44
UK prepreg consumption	980	42	43
	* 60% CF + 40% epoxy		

Table 4 UK CF Prepreg (Unidirectional and Fabric Based) Balance 2008

As can be seen from the table the UK is a large exporter of prepreg, with just over one third of the UK production actually remaining in the UK. It should be noted that there is a large range of prepreg prices ranging from over £100/kg for high end aerospace grades down to £30/kg for industrial grades.

Summary of UK Carbon Fibre Flow through the Industry Chain

The chart below summarises the flow of carbon fibre through the value steps of the value chain:

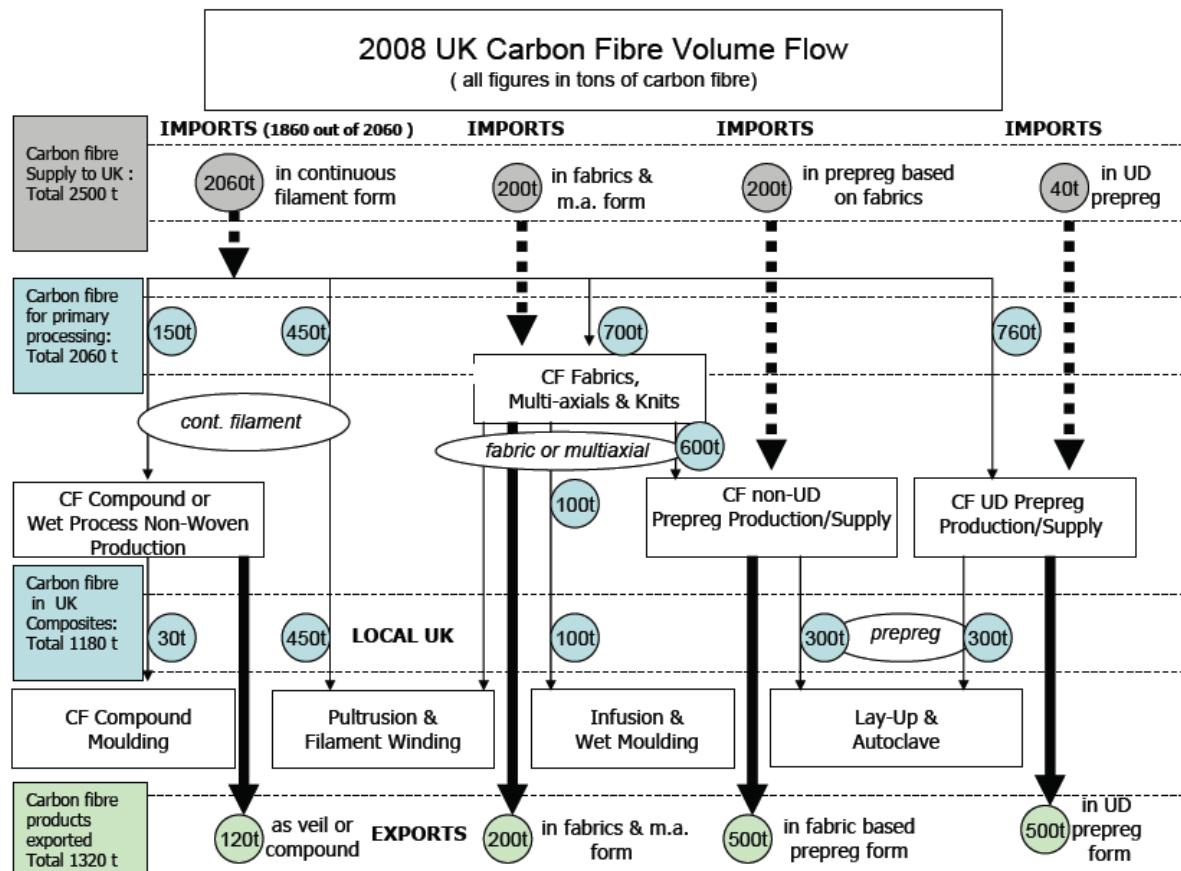


Table 5 – Flow of Carbon Fibre through the UK Carbon Fibre Value Chain

There are three levels at which the flow of carbon fibre through the UK value chain can be measured. The first level is the supply of 2,500 tons of carbon fibre to the UK processors made up of 200 tons of locally produced continuous filament, to which are added 1,860 tons of imported continuous filament. Other carbon fibre is supplied to the UK in the form of fabric imports (200 tons) and prepreg imports (400 tons).

At the second level, the carbon fibre used to actually make composites in the UK totals 1,180 tons consisting of 600 tons of prepreg, 100 tons of fabric, 450 tons of continuous filament and 30 tons of continuous filament in the form of chopped strands.

Additionally, at the third level, 1,320 tons of carbon fibre are exported from the UK after having been processed. This volume leaves the UK in the form of 1000 tons of prepreg exports, 200 tons of fabric and 120 tons of chopped strand based compound and veil.

UK Carbon Fibre Based Composites Production

The table below summarises the production volume of carbon fibre composites in the UK by process and product form in tons of composite produced:

UK production of CF composites by process and product form - 2008 (in tons of composite)					
Product Form	CF Compound (Thermoset or Thermoplastic)	Continuous CF Filament	CF Fabric, Multiaxial and Knitted	CF Prepreg (UD and fabric based)	Total
Process					
Compression & Injection Moulding	50	-	-	-	50
Pultrusion & Filament Winding	-	900	-	-	900
Wet Moulding & Infusion	-	-	200	-	200
Lay-Up w or w/o Autoclave	-	-	-	980	980
Total	50	900	200	980	2,130
CF content	50%	60%	50%	60%	

Table 6 : UK production volume of CF Composites by process and product form

As can be seen from the above table the two main forms of carbon fibre composite produced are those based on prepreg and those based on pultrusion/filament winding (in fact some 650 tons of annual composite production in the UK on the basis of pultruded spars for wind energy will disappear in 2009 and be replaced by the use of prepreg)

The End Use Volumes of UK produced Carbon Fibre based Composites

The table below shows the estimated split of UK CF composite production by major end use and product form:

UK production of CF composite parts by product form and end use – 2008 (in tons of composite)					
Product Form	CF Compound (Thermoset or Thermoplastic)	Continuous CF Filament	CF Fabric, Multixial and Knitted	CF Prepreg (UD and fabric based)	Total By End Use
End Use					
Aerospace/Defence	20	50	-	700	770
Automotive	10	50	40	150	250
Marine	-	60	100	-	160
Wind Energy	-	650	-	50	700
Industrial	10	50	40	50	150
Sports	5	20	-	20	45
Other	5	20	20	10	55
Total	50	900	200	980	2,130

Table 7: UK production of CF composite parts by product form and end use – 2008

As can be seen, the leading end use of CF composite parts produced in the UK is Aerospace with some 36% share of the volume of composite, followed closely by Wind Energy with some 33%. The Automotive, Marine and Industrial sectors are all about the same size, each with around 8% share.

The Value of UK Produced Carbon Fibre Based Composites by End Use

The table overleaf shows the estimated value of the composite parts produced by end use and product form. This estimated value is based on the volume of composite used with the value of the associated raw material product form estimated and then rendered as value of composite parts via an end use by end use estimate of the value added:

The table overleaf shows that the estimated value of all carbon fibre based composite parts produced in the UK is some £392 mln in 2008.

UK production of CF composites by product form and end use – 2008 (in £mln)					
Product Form	CF Compound (Thermoset or Thermoplastic)	Continuous CF Filament	CF Fabric, Multiaxial and Knitted	CF Prepreg (UD and fabric based)	Total By End Use
End Use					
Aerospace/Defence	2.0	8.0	-	297.0	307.0
Automotive	0.6	2.1	2.0	16.0	20.7
Marine	-	3.4	6.8	-	10.2
Wind Energy	-	27.3	-	5.2	32.5
Industrial	0.8	2.8	2.7	7.0	13.3
Sports	0.4	1.1	-	2.8	4.3
Other	0.4	1.1	1.4	1.4	4.3
Total	4.2	45.8	12.9	329.4	392.3

Table 8: UK production of CF composites by product form and end use – 2008

Comparison of Glass and Carbon Fibre based Composites Markets

The split between the glass and carbon fibre composites is given in the chart below :

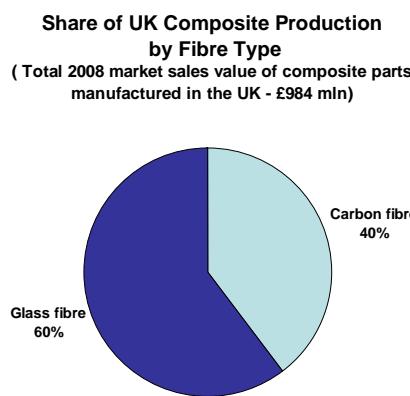


Fig 2 : Relative shares of glass and carbon fibre composites in the UK

As can be seen the carbon fibre composites market value represents some 40% of the combined glass and carbon fibre composites markets. This share is expected to continue growing.

4. The UK CF Composites Company Base

Employment

During the course of the study some 150 companies which manufacture carbon fibre composites in one form or another in the UK were identified. The companies are the regular and industrial users of carbon fibre and their number does not include the number of occasional users of carbon fibre such as repair shops etc. The number of such occasional users in the UK is estimated at anywhere between 50 and 100 and their total related employment at an estimated 200 people is not significant relative to the total of the industrial users.

The structure of this industrial carbon fibre composite processing community can be summarised in the following table:

Size of company	# of companies	# of employees	% of employees
Large (> 100 tpa)	11	10,200	57%
Medium (25 – 99 tpa)	25	2200	12%
Small (5 – 24 tpa)	48	3500	20%
Very small (< 5 t.p.a)	66	2000	11%
Total	150	17,900	100%

Table 9 The number of UK carbon fibre composite processors by size and employment

As can be seen from the table, the two groups of the larger companies, representing 36 companies employ 69% of the people in the carbon fibre composites sector in the UK,. The total number of people employed in the carbon fibre composites industry in the UK is estimated at just under 18,000 people. This includes manufacturing, design, R&D, engineering, procurement and assembly related personnel. For the larger aerospace groups

which also have significant metal component activities, interviews have yielded best estimates of the number of people related to composites activities alone.

Companies and Employees By End Use Segment

The same community of companies can be segmented by end use segment as shown in the table below:

Company End Use Segment	# of companies	# of employees	% of employees
Aerospace	59	14,000	78%
F1/Auto	34	1,300	7%
Marine	15	550	3%
Other transport	3	200	1%
Other (General moulding)	39	1,850	11%
Total	150	17,900	100%

Table 10 The number of UK CF composite processors by end use and employment

The table shows that 78% of the employees of the CF composites sector in the UK are in the aerospace segment and a further 7% in the F1/Auto segment. There are relatively few companies and employees in the Marine and Other Transport segments and the remainder is made up of a “General Moulding” category which employs some 11% of the people in the sector.

Companies by UK Region

The number of companies by UK Region is given in the table below (ranking of the regions is in order of total CF related employment as given in the next sub-section) :

	N.W	S.E	N.IRL	S.W	E	OTH	TOTAL
Large	4	2	1	3	1	0	11
Medium	2	10	1	2	4	6	25
Small	5	11	1	9	10	12	48
Very small	5	21	1	5	12	22	66
Total	16	44	4	19	27	40	150

Table 11 The number of companies by size and UK Region

As can be seen from the table the region with the largest number of companies is the South East but in terms of employment (see next chart) the North West is the largest region of employment even though it only has 16 companies active in CF composites. The high position of Northern Ireland, in spite of its few companies is due to the dominance of Bombardier in carbon fibre composites.

Employees by UK Region

The table below summarises the employment numbers in carbon fibre composites by region:

	N.W	S.E	N.IRL	S.W	E	OTH	TOTAL
Aerospace	3,930	2,561	2,650	2,142	1,237	1,480	14,000
F1/Auto	35	310	0	80	343	532	1,300
Marine	0	368	0	50	120	12	550
Transport (excl auto)	0	0	0	30	0	170	200
General Moulding	317	780	10	130	133	480	1850
Total	4,282	4,019	2,660	2,432	1,833	2,674	17,900

Table 12 The number of employees by end use and UK Region

As can be seen the North West Region is the largest in terms of employment in carbon fibre composites due to the dominance of the Aerospace sector F1/Auto is focused across two main regions and the “other” regions while Marine is heavily focused in the South East. General Moulding employment is spread across all regions.

5. Summary

The key elements to be drawn from this overview of the UK Carbon Fibre Reinforced Polymers market are as follows:

- Over the long term, the global carbon fibre composites market will continue to grow rapidly and develop new applications in aerospace, wind energy and automotive
- The market is characterised by the need to develop new, faster and more productive methods of producing carbon fibre composite based components and internationally a lot of work is being done to this effect
- The UK processes an estimated 2,300 tons of PAN based carbon fibre and consumes some 1230 tons the rest being exported in the form of fabric and prepreg
- As such the UK represents a significant and interesting processing centre and market for carbon fibre (Europe is estimated to have consumed of the order of 10,600 tons in 2008)
- The UK has a significant number of companies which are active at various levels of the carbon fibre composite value chain e.g. precursor producers, carbon fibre producers, weavers, prepreg producers, composites processors

Appendix 1: Companies Interviewed

- 1 ACG
- 2 Agusta Westland
- 3 Airbus Uk
- 4 AJR Consultants
- 5 Amber Composites
- 6 Bluestar Fibres
- 7 Bombardier
- 8 British Marine Federation
- 9 Brookhouse
- 10 Carbon Composites
- 11 Connect Composites
- 12 Corima
- 13 CTG
- 14 Cytec
- 15 Exel UK
- 16 Formax
- 17 French Composite Park
- 18 GE Aviation
- 19 Germany Trade & Invest
- 20 GKN-Aerospace
- 21 Gurit
- 22 Hexcel
- 23 Lectra
- 24 Menzolit Compounds Intl
- 25 Mitsubishi Rayon (Grafil)
- 26 Motor Industries Research Association
- 27 NCN
- 28 NCN
- 29 OCV
- 30 OCV
- 31 Porcher Composites
- 32 Primus-St. Bernard
- 33 QinetiQ
- 34 Recycled Carbon Ltd
- 35 Rolls Royce
- 36 Saertex
- 37 SGL
- 38 Sigmatex
- 39 Spirit
- 40 Technical Fibres Ltd
- 41 Toho-Tenax
- 42 Toray
- 43 TSB
- 44 UK Trade and Invest
- 45 University of Manchester
- 46 Vestas
- 47 Victrex
- 48 Zoltek