NC STATE College of Textiles

JTATM Journal of Textile and Apparel, Technology and Management

Volume 9, Issue 2, Spring2015

Forecasting on Composites – Markets, Products, and Demands

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ABSTRACT

Composites consist of a unique combination of filler and matrix materials that can be tailored to fit a diverse range of applications. This paper describes the current markets, products and demands in the composite industry and provides insight into where the future of the industry is headed. This is achieved through market analysis of the composites industry and a breakdown of the market based on end use applications. Examples of the current products in each segment are provided along with analysis of each market segment based on current trends and innovations.

Keywords: Composite, composite market, composite applications, glass fiber, carbon fiber

Introduction

Today's competitive textile market demands stronger, lighter, and safer materials. Fiber reinforced composites allow many of these challenges to be met. They have unique advantages over traditional materials such as high strength, high stiffness, long fatigue life, and low density that allow their use in a variety of applications (Daniel & Ishai, 2006). Manufacturing companies are looking for an edge on their competitors. Two of the current trends in industry where composites succeed are weight reduction and cost reduction of materials. It is important to understand these trends and what materials have the best advantage for a given application. Knowledge of this can be gained through marketing studies which predict future trends in products and markets. This paper describes the current markets, products and demands in the composite industry and provides insight into where the future of the industry is headed. First, a brief background on composite materials will be given followed by market analysis of composites, and a breakdown of the market based on end use applications. Examples of the current products in each segment are provided along with analysis of each market segment based on current trends and innovations.

Composites

Composites are a combination of two materials, the filler and the matrix, that optimize and leverage the advantages of each. The choice of material for the filler and the matrix is determined by the desired combination of properties, intended

application, and method of manufacture. The most common type of composite is a fiber reinforced composite in which the filler is a fiber. Fibers typically have a high stiffness and are denser than the matrix (Askeland & Phulé, 2006; Hull & Clyne, 1996). They are implemented to be the main load support thus increasing the modulus and limiting deformation of the overall material. The other component of the composite, the matrix, contributes to the toughness, maintains the desired fiber spacing, transfers loads from the matrix to the fiber, protects the fiber from damage, and prevents cracks in the fiber from propagating throughout the entire composite (Askeland & Phulé, 2006; Sperling, 2001).

The first composite with a fibrous reinforcement was designed by the Egyptians who made bricks out of a mud matrix with straw filler. Today, we have come a long way from mud and straw. There are hundreds of different fiber and resin combinations. The most common composite in use is glass fiber with an epoxy resin matrix. Carbon fibers, although expensive compared to glass fibers, also find many uses in today's market. Applications of these composites are expanding every year. They are found in the aerospace, transportation, marine, energy, infrastructure, biomedical, and recreational industries. Common end uses for each industry have been provided in table 1. The end uses range from common tennis rackets to high end military aircraft.

Table 1. End Uses of common composites

Aerospace	Transportation	Marine	Energy	Construction	Biomedical	Sporting
Aircraft Military Spacecraft Electronics	Automotive parts Automobile, truck, rail car frames	Ship structure	Wind turbine Offshore drilling Gas pipeline	Infrastructure Pipes Structural Buildings Bridges	Prosthetic devices Artificial limbs	Tennis Rackets Golf Clubs Fishing poles Skis Bicycles Paddles

Market Growth

The market study focuses mainly on the US composite market, and does not include biomedical composites. As illustrated in Figure 1, the composites industry has experienced steady growth over the past several years and is expected to continue on this path. The US composite materials market grew by 6.3% in 2014 to reach $8.2 billion in value. This market is expected to grow 4.9 percent in 2015 and it is expected to reach $12 billion by 2020 with a compound annual growth rate of 6.6 percent (CAGR) (Mazumdar, 2015). Globally the US is the second largest market for composites after China in terms of volume consumption. A summary of the Lucintel's *Growth Opportunities in the Chinese Composites Market 2013-2018* study featured in Composite World claims that China will continue to be a leader in composites, racking up significant growth over the next five years to reach an estimated $11.5 billion in 2018 (Composites World, 2015). The combined increases of these two markets will also have a positive effect on the global market during the next few years.

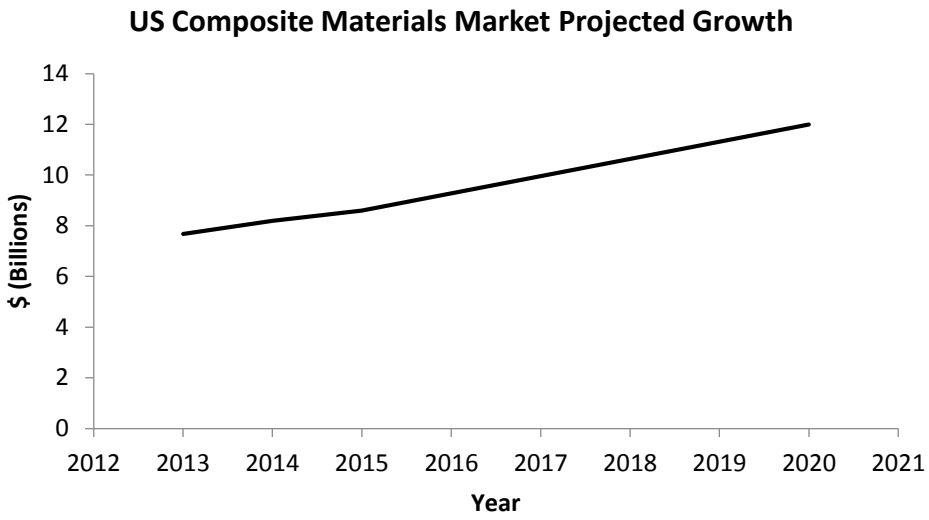

Figure 1. Demand in the US market is expected to reach $12 billion by 2020,

End Product Markets

The composite market is made up of several subindustries, and the success of these industries directly influences the health of the composite industry as a whole. One of the best ways to judge an industry's strength is to look at end product demand. High demand leads to a healthy market and demand for composites end products reached $21.2 billion in 2014 (Mazumdar, 2015). As mentioned, composites have several application areas. The graph in figure 2 shows the breakdown of the composites market by application industry. The top three market segments in 2014 by volume were transportation, aerospace, and construction. Near equal growth is expected in all market through 2020. By this time it is projected that approximately 65 percent of US composite growth by value will be driven by the same top three industries (Mazumdar, 2015). Further analysis of the driving application industries for composites will help identify current the products, demands, and innovations that may lead to future growth.

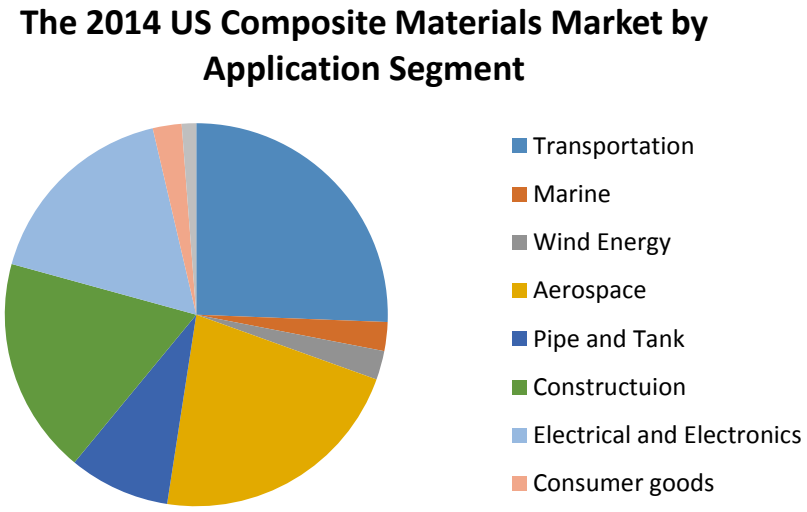

Figure 2. The US composite markets segmented by application for the year 2014,

Transportation

Composites are used in various forms in the transportation industry, including automotive parts and automobile, truck, and rail car frames. Demand for composites in the US automotive industry grew by 6.3 percent in 2014 due to increasing use of fiberglass composites in interior, exterior, and underbody applications. Carbon fiber composites were also used in high performance vehicles, such as F1 racecars, adding to this demand (Mazumdar, 2015).

The use of composites in vehicles is fueled by industry regulations such as the corporate average fuel economy (CAFE) standard in the United States and the European Union Automotive Fuel Economy (UNEP) standard (Mazumdar, 2015). Both of these standards push toward increasing the fuel efficiency and reducing the carbon footprint of vehicles. Reducing weight on cars is one of the main ways to meet these standards. Composite materials, with their high strength to weight ratios, are a front runner for this task. The use of carbon fiber and glass fiber reduces vehicle weight and, as a result also increases fuel efficiency and lower carbon dioxide emissions. The push to create lighter vehicles has led automakers such as BMW, Mercedes, Ford and GM to incorporate carbon composites in mass volume cars (Mazumdar, 2015).

Aerospace

Composite material consumption has increased significantly in the commercial aerospace sector, from 5 to 6 percent in the 1990s to more than 50 percent in today's advanced aircraft programs. The Boeing 777, Boeing 787, Airbus A380 and Airbus 350XWB are all aircraft that take advantage of the durable, light weight composite materials (Daniel & Ishai, 2006). Carbon fibers with epoxy resin composites are desirable in military aircraft, such as the B-2 bomber. Small unmanned air vehicles are also made almost entirely of composites. The Helios, used by NASA for environmental research is composed of carbon and Kevlar fiber composites (Daniel & Ishai, 2006). Composites provide numerous advantages in this segment. They are lightweight with higher strength than competing materials, which results in improved fuel efficiency, an increase in passenger carrying capacity, low emissions and low maintenance costs.

Within aerospace, composite materials demand grew by 10.7 percent in 2014 (Mazumdar, 2015). Composites usage, and thus the market will continue to grow because of increased production of advanced aircraft models. Innovation trends in aerospace include increasing the use of carbon composites and introducing more nanocomposite applications. One example is that Lockheed Martin has committed to replacing approximately 100 composite or metal components with carbon nanoreinforced polymers throughout the F-35's airframe (Mazumdar, 2015).

Construction

Construction and infrastructure developments are a more recent application development than aerospace application. In this segment, composites are being used to reinforce structural members against earthquakes, to produce structural shapes for buildings and bridges, and to produce pipes for oil and water transport (Daniel & Ishai, 2006). Although this market is one of the largest segments, composite usage is low compared to more traditional materials such as steel and concrete. The large volume observed in the composite market, however, is mainly due to the number applications amiable within the field such as grating, rebar, handrails, structural profiles, utility poles and bridges allow this market to remain large.

The market for this grew 5.3 percent in 2014 and it appears that there will be further growth in the future (Mazumdar, 2015). The United States will need to invest significantly

in the repair and maintenance of its old infrastructure. For example, there are 147,870 deficient bridges requiring repair (Mazumdar, 2015). An interesting innovation within this category is structural health monitoring in which a sensor is embedded in a structure such as a bridge, to monitor and detect damage. Composites are the perfect material for embedding sensors, due to their structure. Increased interest in this field will lead to increased demand in structural composites.

Energy

Pipes and tanks

Composites are also making a large impact on various energy fronts. There are many composite applications in the oil and gas industry, including grating, tethers, drill pipes, glass-reinforced epoxy pipes and frac balls and plugs. In offshore oil drilling installations, composites are also used in the drilling risers (Daniel & Ishai, 2006). Increased use of these applications led to demand for composite materials growth of 5.2 percent in 2014. This market is also expected to grow in the future because the U.S. government and private players are expected to invest more to set up new pipelines to transport crude oil and gas (Mazumdar, 2015).

Wind energy

Wind energy is another segment where composites are a great fit, and demand for renewable energy sources is large due to environmental concerns. The growing offshore wind market compels blade manufacturers to use advanced materials, such as composites, that can reduce system weight without compromising mechanical properties (Mazumdar, 2015). Carbon fiber and fiber glass composites have been used in blades of wind turbine generators. They offer significant weight reduction and increased blade stiffness, which in turn raise the level of energy output. There is a growing trend toward developing one-piece and modular wind blade technology. This trend can only be achieved with composite materials because of the processing and sheer size of the component. As energy concern continues to increase, demands for materials in this market are also expect to grow.

Conclusions

Composites have excellent performance benefits in many markets, especially aerospace where composites have quickly become the material of choose. Continued trends toward automation, streamlining of composite manufacturing methods and development of new material forms should make composites more user-friendly, and more cost-effective. This will encourage their use in greater quantities in existing markets and make them even more attractive to new industrial and consumer driven markets (Composites World, 2015). Like most industries, manufacturers will continue to seek faster cycle times, better product quality, and lower processing costs. Notable efforts are expected in the development of better weaving techniques for high performance fiber such as carbon fiber in order to meet these goals. Environmental concerns will continue to be a great issue requiring a solution of lightweight materials with good mechanical properties. As these goals are met, the future composite market is expected to be highly competitive, and companies with innovation capability will likely thrive.

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