"After September 11th – A Look Into the Crystal Ball for the Composites Industry"

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What's the Effect upon Advanced Composites and FRP Composites?

September 11th will long be remembered in history for its effects not only on the United States but also on the international community for a wealth of reasons that continue to be observed well after the tragic event. Technology advances in the composite materials and structures area made some post-event assessment of the damage at the Pentagon obvious that aramid fiber-reinforced composite retrofits may have minimized certain types of damage. Considerable attention has been given to trying to understand the tragic events that resulted from the terrorist activities that day. Understandably we are still in the early stages of trying to reach firm conclusions and develop long term strategy for well into the future.

The purpose of this article was to try to look into the crystal ball and attempt to assess where advanced composites and FRP composites might be affected by the events of September 11th. Discussions with a number of attendees at the CFA Composites 2001 show, as well as material suppliers and fabricators, provided input to the thinking that went into this article. In some cases, material suppliers noted they are in a quandary trying to make long term forecasts with the industries in such turmoil. Consequently, we are not attempting to make firm predictions at this time. To do so would not be prudent in view of the market and industry instability. However, it appears reasonable to at least attempt to try to identify markets, materials and processes that might reasonably be expected to show growth.

Our approach was to divide things into three general market areas for consideration. The areas were: (1) markets that have previously been identified before September 11th, (2) markets that might be strengthened as a result of the terrorist activities, and, finally, (3) newly created markets as a result of terrorist activities. Lastly, it is important to recognize that the composites industry and the benefits it provides all of us, is international in scope and effect at all times. The technology associated with composite materials, fabrication methods, applications and infusion into the commercial market will and must go forward.

The three general areas noted above will undoubtedly have some degree of overlap. However, we have tried to place market topics as closely as possible into the most appropriate segment.

Markets Already Previously Identified

Infrastructure markets typically involve highway, bridges, building construction and related areas. These areas have been in a slow growth mode over the past several years with considerable emphasis on materials development, field certification, inspection methods development, and, generally, the establishment of confidence with government agencies and general contractors in the use of advanced materials and FRP composites. The use of materials and FRP processing in these areas will continue to grow. The biggest challenge still appears to be one of educating government entities and end users in the ability of composite materials to provide structural requirements, high performance, durability and unique properties with confidence and reliability. Certain areas will probably grow at a more significant rate – and they will be covered in subsequent sections.

Military and defense applications appear to have been targeted for more growth than in previous, recent presidential times since the era of President Reagan. They were apparently targeted for a degree of accelerated growth before the September 11th attacks. This is one of those markets that will likely be accelerated as a result of the terrorist activity. Consequently, we will talk about this area in more detail later.

Large tow carbon fiber, and, lower cost carbon fiber products, both are being pursued to arrive at high performance reinforcement fibers for commercial and industrial markets. Chopped fiber entry into the thermoplastics market has been fairly easy in recent years and growth in the automotive and transportation markets has seen measurable growth. Efforts on large tow systems and alternate carbon fiber precursors will continue to see growth and acceptance. Recent effort has demonstrated that proper process tooling can optimize large tow carbon fiber performance to much higher levels than previously achieved with conventional handling equipment.

Natural fiber composites have evolved in recent years as a low cost, moderate performance composite material. These materials certainly offer the low cost potential and often lightweight potential as well. In some applications they are competitive with glass fiber in terms of performance and cost aspects. With expanded development and demonstrated performance characteristics in FRP composites manufacturing processes, they should provide increased market usage in the commercial and industrial areas.

Low cost manufacturing methods are almost always pursued by those working in the commercial and industrial market segments because their end customers are often sensitive to the bottom line costs. Automotive and transportation markets classically have made decisions on material selection and processing methods based on the economics of the situation. Advanced composites efforts within the aerospace industry have continued to pursue `composites affordability' concepts in further reducing the end costs. These efforts have not yet strongly influenced the commercial market approach in this area.

Consequently, there may be some potential for incorporating aerospace technology at a future time.

Markets Strengthened by Terrorist Activities

Some composites opportunities may be elevated to stronger growth or new directions as a result of the September 11th terrorist activities. For the most part these are not necessarily new areas per se, but they are areas where it appears that significant emphasis and growth might occur. **Helicopters**, both military and commercial, might be expected to see growth because of their ability to respond quickly to needs in remote areas where landing areas are not clearly defined. Commercial helicopters appear to offer some opportunity because of their mobility, their availability at the corporate and personal level, and, their ability to rapidly respond to business requirements with schedule ease and less airport hassle. Manufacturing methods for helicopter components and structures might include thermoforming, sandwich structures, RTM, VARTM, SCRIMP™, pultrusion, filament winding and vacuum bagging technology – to mention but only a few. Opportunities for composites that utilize aramid, carbon, glass or organic fibers are certainly potential reinforcements. Stealth, mobility, and rapid response are obviously a key driver for the military side of these products.

Corporate, business and personal aircraft are expected to show significant growth once the security issues involving airspace control are resolved. The primary reasons are the fact that they are under the direct control of the owner/operator as far as scheduling, storage, maintenance and long-term economics. The fact that there are fewer hassles may be a deciding factor for those that can afford such aircraft. With the significant increase in fuel costs, airline tickets, scheduling problems, lost baggage, on-time departure delays, and numerous other factors, the use off these aircraft is appealing.

UAV's (Unmanned Air Vehicles) and reconnaissance air vehicles have received a lot of attention over the past 15-20 years. As one watches nightly CNN programs, and reads about these unique vehicles in open publications, it is obvious that these products offer quite a few advantages. Intelligence gathering and reconnaissance with these lightweight composite air vehicles, and long altitude dwell times, provide unique security and intelligence potential. Carbon and aramid fiber materials have considerable potential here. Thermoforming, resin infusion processes, and filament winding processing all would appear to have some degree of potential.

Shipping and cargo containers offer corrosion resistance, durability, strength performance and conformability options over conventional metal containers. The use of RTM, VARTM, SCRIMP™, UV-cure infusion, pultrusion and other conventional FRP processes have should these containers to be viable. Part count reduction and standardized fittings and lift attachments are another advantage. Weight savings offers more potential.

Light rail transportation has made significant inroads in the past 15 years within the metropolitan areas of cities with populations greater than 100,000. These short

distance trains and cars offer rapid movement of people at very respectable costs. While improvements in automotive products continues in an effort to achieve better fuel efficiency, light rate transportation offers more rapid growth in moving people from one point to another in metropolitan areas. Carpools, `diamond lanes' for multi-passenger cars, and improved fuel efficiency often are lost on the general public because of the inherent `love'' of the automobile and lack of infrastructure. However, municipal growth seems to be turning more to expanding light rail transportation and gaining more acceptance once the infrastructure and routing are developed. Consequently, it is easy to see increased systems development, the addition of more cars on the track; more trains per day and higher speeds. Pultrusion, resin infusion, conventional chop and spray, thermoforming, sandwich construction, lamination techniques and vacuum bagging might offer many opportunities in the future to potential fabricators.

Fire-resistant resins, improved flammability materials, and reduced smoke and toxicity materials will be required in future transportation and building construction systems. Considerable effort is ongoing now with these materials. However, the strong emphasis on improved `fire properties' and their designation in composite structures where people are routinely transported or housed, will continue to drive this market to developing better, higher performing resin systems. Current phenolic resin systems offer the primary advantages. Building construction may be required to significantly increase the performance of these materials after the September 11th incidents, which indicate the potential for these materials to improve the escape rate from buildings, subjected to fire. These materials have considerable potential for improving building safety through smoke reduction, insulation capability, and lowered toxicity levels.

Newly Created Markets as a Result of Terrorist Activities

Internal security and personal security as a result of the September 11th terrorist incidents are already being discussed at trade shows and conferences, in the newspapers and on the television. Each night CNN offers some insight on how we might expect to see changes to increase our personal and/or national security. Some airlines have already taken the initiative after only 4 short weeks to strengthen the cockpit door. The use of aramid fiber and composites to strengthen the door and metal hinges, and localized bars, has already been initiated. The size of the aircraft market will require a fairly long transition period. Composite retrofit will be a totally new market.

Shipping and cargo containers were mentioned earlier. However, the market is just now looking more seriously into development of materials, manufacturing and design concepts that will greatly strengthen containers while maintaining lightweight aspects. **Blast mitigation** – the ability to damp out a blast or focus the energy into other directions within the containment structure – is a rapidly expanding growth area. New manufacturing materials, processes, design codes and test methods are being developed as a result of terrorist activities using explosive materials.

Personal security in the form of aramid fiber and other organic fiber materials for vests, protective gear, personal automobiles, and other areas will require new efforts.

New materials, new resins, new fiber reinforcement forms and low cost manufacturing methods need development. When one thinks in terms of `personal' security, the issues pertaining to low cost manufacturing and very high production quantities become very evident. Reduced cycle times, thermoplastic composites processing, short cycle thermoset composites, thermoforming, low cost materials (resins, fibers), durable process tooling, and overall low cost production – are **all** critical elements of this particular area. Questions pertaining to the performance characterization of these new materials and processes must rectify static vs. dynamic loading inn the laboratory and the field.

Infrastructure has been mentioned previously as an ongoing market development area. However, there are indeed aspects of market growth that may result from the terrorist activities. For example, future building codes most likely will include more rigorous fire performance factors that may be favorable to FRP composites. The use of composites to reduce rapid heat buildup, act as insulators, provide additional structural strength and stiffness, and utilize their unique performance properties, may offer composites new opportunities to expanding markets. Composites also offer unique cosmetic architectural opportunities at the same time. They also provide formability and complex shape opportunities. Shaping for blast mitigation, column retrofit, improved crash worthiness, and numerous other features may offer unique opportunities.

Educational opportunities. Why education? Composites are not always accepted across all industries because they are not also fully understood by those using conventional materials such as steel, concrete, aluminum, wood where design data readily is obtained from standard handbooks and codes. The opportunity is there, and will be required, to train new industries as well as people already trained in other disciplines if we are to incorporate advanced composites and FRP composites into these areas successfully. Concrete and steel replacement is not easy unless the end user can be convinced that composites have a place either along side or as a replacement to the conventional material by demonstrating some performance factor of significance.

Protection for firemen, police, and EMT personnel is a distinct area of need. Some efforts and markets can be addresses independent of building collapse and structural problems pertaining to building design integrity. Composite breathing tanks and fire resistant composite systems with improved resins and tougher fibers offer some potential. Building escape systems and structures in high rise buildings where weight and structural performance both drive the design need to be looked at as a market and concept.

International Markets Affect the Composites Industry

Opportunities in this industry are not uniquely limited to the United States by any means. Composites are currently used on an international basis. And will continue to be so. Low income housing, portable buildings, portable structures and structures which can be rapidly built on-site have considerable potential. Technology for many of these projects and products exist internationally. The membership of trade associations, technical societies, universities, and government/private laboratories can be found in a

large number of countries. The technology available for pursuing advanced composites and FRP composite projects is international in scope.

Summary

We have attempted to provide at least a brief look at some of the markets and areas where advanced composites and FRP composites might be affected by the events of September 11th. The event, while tragic in terms of human lives lost and economic impact on an international scale, will certainly have an affect on the composites industry as a whole. From a composites industry standpoint, some markets and projects will obviously be slowed. On the other hand, the events of September 11th have clearly identified market segments and needs as a direct result of events that day. Some activities were on the back burner and may now be accelerated in terms of needs (cockpit door modifications). Some were just getting started and may now jump into a more rapid development (blast mitigation). In any case, there are a number of areas where it appears that the composites industry may have strong potential growth. Innovation and ingenuity will play a big role in how the composites industry responds to September 11th.

Acknowledgments:

The author wishes to thank the many people we talked to at the CFA Composites 2001 show in Tampa who provided various insights into the future composites needs and possible direction.

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