Fiber-Reinforced Plastic Composites

US Industry Study with Forecasts for 2017 & 2022

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Fiber-reinforced plastic composites will continue to supplant conventional materials such as aluminum and steel due to their light weight, stiffness, corrosion resistance and design flexibility.

**US demand to rise 4.7% annually through 2017**

US demand for fiber-reinforced plastic (FRP) composites is forecast to climb 4.7 percent annually to 4.3 billion pounds in 2017, valued at nearly $23 billion. Demand will rebound from the moderate declines experienced over the course of the recession-impacted 2007-2012 period, when opportunities were restricted by a steep drop in construction activity, reduced motor vehicle output, and the collapse of the recreational boating market. These markets are anticipated to see renewed growth as economic conditions improve. In addition, FRP composites will continue to supplant conventional materials such as aluminum and steel due to a number of performance advantages, including light weight, stiffness, and corrosion resistance, as well as greater design flexibility and improved parts consolidation capabilities. However, advances will be threatened by saturated applications in many areas and the higher cost of FRPs compared to metal in long production runs.

**Motor vehicle, construction markets to offer best growth opportunities**

Motor vehicles and construction represent the leading outlets for FRP composites and will provide the best opportunities for growth through 2017, spurred by an improving outlook for vehicle output and a strong rebound in building construction activity. Together, these two markets will account for more than three-quarters of new demand for FRP composites through 2017. Ongoing efforts among automakers to enhance fuel efficiency will continue to drive composites demand as vehicle weight reduction -- which represents a key strategy utilized by OEMs to boost fuel economy -- is often accomplished through the use of lightweight composite materials. Advances in the construction sector will be propelled by rapid spending increases in the residential sector, which will generate demand for a variety of products, including fiberglass bathroom components and entry doors.

Prospects will also be bright in the small volume aerospace sector, driven by the expanding utilization of carbon fiber composites in the production of commercial airliners such as Boeing’s 787 DREAMLINER, which has more than 50 percent composite content. Rising consumer spending levels will bode well for composites used in the production of marine and consumer durables products. However, opportunities in the sizable electrical and electronics sector will be more limited, restricted by an anticipated decline in wind turbine installations from elevated 2012 levels, and by the dominance of offshore producers of computers, printers, and other electrical and electronic equipment.

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Glass fibers will continue to benefit from their good mechanical properties, chemical resistance, and low density. The price and performance levels of glass fibers are superior to those of steel and aluminum in many applications. While production is more complicated and line speeds are slower. Nevertheless, glass fiber-reinforced plastics are price competitive with steel and aluminum in small volume applications, where light weight or high levels of corrosion resistance are mandated.

Glass fibers’ attributes include increased stiffness, heat resistance, electrical insulation, and dimensional stability. Minor drawbacks include brittleness and a low tensile modulus of elasticity. Several types of glass fibers are used in composites. Electrical grade glass, also known as E-glass, is the leading type of glass fiber used in reinforced plastics due to its low cost and good water resistance. E-glass is suitable for a wide range of general purpose and electrical applications. Drawbacks include only fair alkali resistance and poor acid resistance. Chemical grade glass (C-glass) exhibits better resistance than E-glass in terms of water, alkali, and acid resistance, while S-glass -- the highest performance grade of glass fiber -- features high mechanical and tensile strength and is consequently used for advanced composites.

In glass fiber production, molten glass is extruded through holes at the base of the furnace to produce very thin glass fibers. These filaments are coated (sized) with chemicals to provide resistance or enhance compatibility with matrix resins in composites. The filaments are then gathered into strands and bundles of suitable diameters.
Sample Profile, Table & Forecast

COMPANY PROFILES

AGY Holding Corporation
2556 Wagener Road
Aiken, SC 29801
803-648-8351
http://www.agy.com

Sales: $173 million (2012, as reported to the SEC)
Americas Sales: $96 million (2012, as reported to the SEC)
Employment: 1,050 (2012, as reported to the SEC)
Key Products: E-glass, glass yarns, advanced glass products, and continuous filament mat

AGY Holding is a developer, producer and distributor of fiberglass reinforcements and yarns for electronic, telecommunication, automotive, industrial, recreational and military applications. AGY is majority owned by Kohlberg & Company LLC, a private equity firm with offices in New York and California. The Company operates through two segments: AGY US and AGY Asia.

The Company participates in the US fiber-reinforced plastic composites market via the AGY US segment, which posted sales of $146 million in 2012. The segment comprises AGY’s operations in the US, including the production and sale of glass fibers, rovings, yarn, and chopped strands. Specifically, AGY makes E-glass yarns, S-1 GLASS and S-2 GLASS advanced glass products, and continuous filament mat (CFM). Of the AGY US segment’s total sales in 2012, the aerospace market accounted for 29 percent, the industrial market for 28 percent, the electronics market for 18 percent, the continuous filament mat market for 11 percent, the construction market for eight percent, and the defense market for six percent.

TABLE IV-6
THERMOPластIC COMPOSITES DEMAND BY RESIN
(million pounds)

<table>
<thead>
<tr>
<th>Item</th>
<th>2002</th>
<th>2007</th>
<th>2012</th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRP Composites Demand</td>
<td>3185</td>
<td>3586</td>
<td>3455</td>
<td>4345</td>
<td>5060</td>
</tr>
<tr>
<td>% thermoplastics</td>
<td>43.8</td>
<td>43.1</td>
<td>46.9</td>
<td>46.6</td>
<td>46.0</td>
</tr>
<tr>
<td>Thermoplastic Composites Demand</td>
<td>1394</td>
<td>1547</td>
<td>1620</td>
<td>2025</td>
<td>2330</td>
</tr>
<tr>
<td>Nylon</td>
<td>385</td>
<td>436</td>
<td>495</td>
<td>632</td>
<td>735</td>
</tr>
<tr>
<td>Polyester</td>
<td>344</td>
<td>389</td>
<td>397</td>
<td>484</td>
<td>540</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>247</td>
<td>296</td>
<td>333</td>
<td>445</td>
<td>540</td>
</tr>
<tr>
<td>Styrenics</td>
<td>224</td>
<td>209</td>
<td>180</td>
<td>203</td>
<td>220</td>
</tr>
<tr>
<td>Polycarbonate</td>
<td>95</td>
<td>106</td>
<td>101</td>
<td>121</td>
<td>135</td>
</tr>
<tr>
<td>Other Thermoplastics</td>
<td>99</td>
<td>111</td>
<td>114</td>
<td>140</td>
<td>160</td>
</tr>
<tr>
<td>$/lb</td>
<td>2.39</td>
<td>2.85</td>
<td>3.26</td>
<td>3.75</td>
<td>4.25</td>
</tr>
<tr>
<td>Thermoplastic Composites Demand (mil $)</td>
<td>3335</td>
<td>4415</td>
<td>5280</td>
<td>7590</td>
<td>9850</td>
</tr>
</tbody>
</table>
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