Technology Brief

RECYCLING ADVANCED COMPOSITES

This technology brief describes the results from a study of high-value applications for finely ground recycled composites from the aerospace industry. Tests were conducted to determine if the addition of ground composite materials to epoxy resins would increase the strength of finished products. Recycled composite materials that add strength to finished products would allow the substitution of lower priced recycled fibers for virgin fibers, substantially lowering production costs.

Key Words

Materials: Ground composites.

Technologies: Resin Formulation.

Applications: Water-ski and snow ski manufacturing.

Abstract: Results of testing show increases in strength of epoxy and urethane foam with the addition of ground composite materials.

Background

Composite manufacturers supplying product to the aerospace industry generate composite waste materials that consist of fiber reinforced plastics. When disposed in landfills, these plastics have an almost infinite life. The waste consists of both composite edge trimmings and uncured pre-preg scrap. The composite edge trimmings are cured pre-preg materials that are trimmed from finished parts. Pre-preg is a woven fiber (fiberglass, graphite, or Kevlar) that has been dipped in a resin for use in composite lay-up. It can cost as much as $60 per sq. yd., and as a highly engineered material, potentially has a high resource value.

Because of the high cost of the composite raw materials and the potential value of the fibers for other reinforcement applications, composite manufacturers have been looking for alternatives to disposal. If the composite material can be efficiently ground, there is potential for using the recovered fibers in reinforcement applications, instead of the high-cost virgin fibers.

During the grinding process, some of the plastic that surrounds the reinforcing fiber is separated and has potential applications for use as a filler.

Technical Constraints

Two technical issues dominate efforts to recycle composite materials. The first is development of a grinding process that will separate the fibers from the plastic. The second is incorporating the recycled fibers into a resin system without adversely effecting the properties of the resin. When recycled fibers are added to a resin, the fibers effect its viscosity. If the resin viscosity is increased too much, it will be hard to process using standard production techniques. Because the fibers are completely surrounded by the plastic resin in the composite material, finding a process to separate the fibers from the plastic, and then process the fibers to short enough length to be used in a different resin system, required looking at a wide variety of shredding and grinding equipment.

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Technical Assistance

The first phase of the project focused on the evaluation of the equipment required to grind scrap composite and pre-preg material into short fiber lengths. Kevlar and graphite fibers were obtained by separating samples of Kevlar and graphite composites from the waste stream. The material was ground into fiber lengths ranging from 0.5mm to 2.0mm. The short fiber lengths were required so the resin would pass through the small orifices of the processing equipment.

In the second phase of the project, formulas incorporating different percentages of fibers in the resin, different fiber lengths, and different types of fiber (Kevlar and graphite) were studied. Wet-out is how well the resin wets the fibers. Mixing techniques and percentage of fiber additions were controlled to ensure proper wet-out. The reinforcement benefits of the fibers will be maximized only if the fibers completely wet-out. Additionally, viscosity was monitored during formulation development. Resin processing will only occur if the resin is thin enough, usually at a viscosity below 55,000 cps.

The third phase of this project tested the strength of the resins with fiber additions when compared to resins with no fiber additions.

Project Results

Phase one of the project determined that the equipment to process the waste composite material into fibers required a two step operation consisting of pre-shredding and then processing the shredded material through a hammermill. The production of the shorter fibers required multiple passes through the hammermill which reduced the throughput.

Phase two of the project determined that fiber additions greater than 1% of total batch weight produced viscosities greater than 55,000 cps. For one small company, the potential for fiber use may reach 5,000 pounds per year.

In phase three the results showed the strength of the epoxy resin was increased by 16% with the addition of 1% fibers with fiber lengths less than 0.5mm. In a related project, urethane foam strength was increased by 14% with addition of 0.5% fibers with lengths less than 0.5mm.

The results demonstrate the potential value of the recycled fibers as reinforcement additives to two different resins. Even with relatively small percentage additions significant strength improvements were achieved. This work opens up opportunities to explore other resin systems that might benefit from fiber additions for reinforcement. This work also opens possible opportunities to process and recover fibers from waste composite materials from boat manufacturing, tub and shower manufacturing, and other composite manufacturing operations.

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The work in this project was performed by Art Molnar a composite consultant in conjunction with QCM Company. QCM Company, located in Kent, Washington, manufactures textile inks and epoxy resin systems. The epoxy resin systems are used by ski manufacturers and also as adhesives for road marker application.

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For More Information

For a copy of the report, *Recycling Advanced Composites,* use the CWC Publication Order Form or call (206) 443-7746. For more information call email info@cwc.org or visit the CWC Internet Website at www.cwc.org.

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