

# STRUCTURAL ADHESIVES FOR WIND TURBINES

For certain applications, adhesives can work better than other fastening devices and technologies. Read on to learn how LORD has helped a turbine manufacturer refine its design.

By Anita LaFond



Anita LaFond is with Constructive Communications, which represents the LORD Corporation. Go online to [www.lord.com](http://www.lord.com).

**WHEN PEOPLE THINK OF** “wind power” they often picture huge wind farms with towers dotting the horizon, but there are other means of harnessing the power of the wind as well. A new alternative energy concept captures not only wind, but also exhausted air from mechanical equipment to produce usable energy. Wind turbines manufactured by Green Cycle Wind provide valuable energy output from both natural wind and waste wind energy, helping customers reduce their energy bills. The wind turbines feature “dual-source” technology, an alternative energy concept developed by Vince Blake, founder of Green Cycle Wind.

“The wind turbines utilize two production sources to generate electricity, natural wind and wind energy from mechanical/HVAC-equipment-produced

exhaust air,” Blake explains. “This technology combines the green principles of both wind energy and recycling. By recycling a mechanical waste product, we greatly reduce the need to depend on intermittent natural wind resources.”

## DESIGN CHALLENGES

During the design stage for various turbine applications Green Cycle Wind found that the original construction material for the turbines, galvanized steel panels, were too heavy and not strong enough for certain installations. The company switched to lightweight composite aluminum panels, which were more durable and could more easily be adapted to different applications.

When Green Cycle Wind changed its construc-



**Fig. 1: Green Cycle Wind's turbine utilizes both natural and waste wind sources to reduce energy bill costs for companies.**

sembly and other bonding applications where high strength and ease of use is required. For Green Cycle Wind's wind turbine models, LORD's adhesives are used in the manufacture and assembly of the core blade components and turbine housings.

### ADHESIVE ADVANTAGES

Structural acrylic adhesives are very high in shear strength, ranging from 1,000-4,000 psi, allowing them to be as strong as welding and most other conventional fastening methods. They maintain their strength over a wide temperature range as well: -40 to 170 degrees C. Unlike screws, bolts, or rivets that concentrate the stress at the point of attachment, adhesives spread the stress over the entire bond area. Adhesives act as a sealant by keeping out moisture and can compensate for dimensional irregularities by filling in gaps on poor fitting parts.

In assembly operations, adhesives are easier to use than mechanical fasteners or welding techniques. The adhesives are available in convenient cartridges with an applicator that permits instant application without measuring or hand mixing. Minimum surface preparation is required. There is no need to pre-drill holes and fill in over screw heads, and they eliminate rework caused by burning from welding operations. For Green Cycle Wind's wind turbines, the advantages of using LORD structural adhesives included:

- Improved assembly time;
- Elimination of stress concentrations caused by fasteners;
- Ability to mate complex joint designs, particularly at the blade area;
- Reduced noise and vibration;
- Environmental resistance.

### PERFECT SOLUTION

LORD was able to offer a complete solution for Green Cycle, not just the adhesive product. "Our solutions package included everything from adhesive selection to joint design, assembly process, and fixturing to process control and dispensing," according to Carlos Cruz, product assembly adhesives and coatings, market manager, Americas region. "Our

tion methods from galvanized steel to composite aluminum panels, the company also had to revise its turbine design and manufacturing procedures. The metal fasteners that held the original galvanized steel panels together were not only heavy but were prone to rusting and loosening, and they would not work well for the lightweight aluminum composite panels. In searching for a solution, Green Cycle Wind found that structural acrylic adhesives from LORD Corporation—a producer of general purpose and specialty adhesives and coatings—offered a solution that reduced weight while also providing benefits in reduced assembly time and corrosion protection.

LORD Corporation has extensive experience in supplying structural adhesives for product as-



Fig. 2: LORD collaborated with Green Cycle Wind to assemble components of their dual source wind turbine.



Fig. 3: LORD Corporation's new Maxlok adhesive is utilized in the construction of the dual source Green Cycle Wind turbine to improve joint design, reduce weight and reduce assembly design.

next-generation Maxlok acrylic adhesives were the perfect choice to meet Green Cycle Wind's challenging requirements including bonding dissimilar materials, improving durability and fatigue life, reducing weight reduction, and enhancing product aesthetics. We even provided R&D technicians to Green Cycle Wind, whose suggestions on how to manufacture the wind turbines saved them time and money over their previous methods."

LORD's technical service group helped its client implement the solutions package. "Reducing assembly costs and improving fatigue life were definitely the key drivers in the successful collaboration with Green Cycle Wind's turbine design," says Bob Zweng, global product integrator at LORD. "With our strong adhesive implementation know-how we were able to offer immediate input, sharing best practices with novel application processes and proven joint fabrication techniques."

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## BEYOND ADHESIVES

According to Blake, the partnership could not have been better. “They go beyond the typical customer service procedures that most companies pride themselves on,” he says. “It’s not just about ‘buy our adhesives.’ They truly collaborated with us every step of the way, showing us how to use the adhesives and offering ideas on how to market our products.”

Fast turnaround and expert technical-service material evaluations enabled Green Cycle Wind to quickly validate their finished product with confidence. “We have a long history of working with customers in a partnership mentality,” says Cruz. “LORD’s goal is to help customers improve their products by using the proper adhesive for the application. Their unique design and approach to the marketplace has great potential for exponential growth. This business relationship further demonstrates how we continue to expand and establish our presence in the wind energy market through innovative solutions.”

## TURBINE DEVELOPMENT

One of Green Cycle Wind’s wind turbine installations will be for a large, multinational company in the Chicago area. In this application the turbines will harness waste exhaust from four cooling towers that are below the ground. The turbines will be mounted at ground level, and all the energy harvested will be returned to the electrical system to power everything from the cooling towers to the building’s lighting system.

“The wind turbines operate in the same manner, whether they are taking exhaust from roof-mounted or below-ground equipment,” Blake says. “Our turbines are very adaptable to the surrounding environment, and they can be mounted behind a building, next to a building, or on top of a building.”

Currently, Green Cycle Wind is planning to build a full-scale manufacturing facility to produce wind turbines using structural adhesives. LORD Corporation is



Fig. 4: Green Cycle Wind’s turbine made with LORD Maxlok adhesives allows companies to implement green solutions.

# RESIDUAL STRESS MEASUREMENT

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**Fig. 5: LORD Corporation's sales and technical support allowed Green Cycle Wind to reduce costs and improve performance and durability for their wind turbine**

assisting the company with a complete adhesives solutions program that includes joint design support, application recommendations, adhesive dispensing, parts processing, automation, parts fixturing, and final assembly. At its plant in Schaumburg, Illinois, the company has built an active-demonstration turbine wind unit that explains the waste-energy recovery process and shows measurement of the new energy generated. The demo cell points out the various components included in the wind turbine assembly, including LORD structural adhesives.

Green Cycle Wind's wind turbines are generating a lot of interest for other applications as well. Commercial building structure engineers are considering using the wind turbines as a means to utilize green technology, recover wasted energy, and reduce future energy dependences. The wind turbines are easily adaptable to urban environments with no structural upgrades needed for roof installations.

"The 'waste' wind produced by mechanical/HAVC equipment that is used in our equipment is a consistent, predictable source compared to natural wind, which is intermittent," Blake says. "Our electric wind generators produce a steady, reliable source of electric energy that provides consistent savings on energy bills. Even in wind-poor areas the turbines will produce significant amounts of renewable energy."

#### BONDING PARTNERS

To bring the benefits of wind turbine energy to an even larger audience, Green Cycle Wind is working globally with partner agreements in South America, Europe, and Asia. LORD Corporation is working with Ellsworth Adhesives, a preferred distributor partner, to meet the requirements of its client's global initiatives. Relying on LORD's structural acrylic adhesives and support program, Green Cycle Wind is well on its way to becoming a leader in the alternative energy market, having learned that adhesives are the ideal bonding solution for its wind-turbine applications.



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