

Renewable and Biodegradable Insulation and Packaging Materials

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Environmental Problem

The shift in recent decades from limited natural resources to synthetic materials has opened many doors for innovative technologies and products that help with conservation efforts, including those being made in the insulation, packaging and structural core markets. Many of these products, however, present environmental challenges because of their petroleum base. They depend on foreign resources, are not biodegradable or otherwise recyclable, and have high transportation costs. Structural insulating panels and other components in the rigid board insulation industry are made using petrol-foams, such as expanded polystyrene and expanded polyurethane. The release of volatile chemicals (off-gassing) from hydrocarbon-based materials also poses health concerns.

SBIR Technology Solution

With support from EPA's Small Business Innovation Research (SBIR) Program, Ecovative Design LLC (Ecovative) has developed two materials: MycoBond™, a basic material to replace hydrocarbon-derived synthetics in packaging, insulation and structural cores, and Greensulate™, an insulating application of MycoBond™. Both materials use a technology that begins with growing the common white rot fungus on low-value agricultural byproducts, which are notoriously difficult to degrade or

otherwise remove from farms in an energy-efficient manner. Use of these agricultural byproducts to grow the fungus offers the added environmental benefit of creating a solution to regional agricultural waste disposal.

The fungus' vegetative mycelium, a tangled web made up of thousands of root-like strands that hold the hulls together, self-assembles into a prefabricated shape and creates a biocomposite that is at least as strong as conventional technologies. Growth occurs at room temperature and pressure, in the dark, for 5-7 days, requiring 10 times less energy and emitting 5 times less CO₂ than petroleum-derived equivalents. At the end of growth, the material is heated to kill the fungus and any resultant spores. MycoBond™'s primary composition of vegetative cells ensures easy biodegradability that conventional technologies cannot offer. Also, Ecovative's material does not off-gas like materials made with hydrocarbon-based synthetics.

The Mycobond™ technology can use rice and cottonseed hulls or other regional agricultural wastes, which are traditionally low-valued waste streams, as its primary building material. The growth of the Mycobond™ material acts as a secondary revenue stream for rural economies, can be produced and shipped regionally and thus limit emissions associated with feedstock transport, and offers an environmentally friendly use for previously unwanted agricultural waste.

Greensulate™ insulation, which applies the Mycobond™ technology to the building industry, now qualifies for a number of Leadership in Energy and Environmental Design (LEED) credits, which potentially can increase the value of real estate insulated with this technology. Ecovative also has complied with the American Standards for Testing

and Materials (ASTM) for thermal performance, structural integrity, biodegradability, and moisture properties for the Greensulate™ material. Greensulate™ insulation is available for demonstration projects, with examples in Troy, New York, and South Royalton, Vermont. It could potentially retail for one-half the cost of petrol-foams, reducing the customer's initial capital building expense.

Commercialization Information

Ecovative adapted the MycoBond™ fungal-based technology to produce EcoCradle™, a packaging material that was the first Ecovative product to enter the consumer market. Additional



Ecovative's eco-friendly packaging material, EcoCradle™, is custom molded for high-value products and is now being used by Dell and Steelcase.



MycoBond™ applications, including office furniture, lightweight vehicle panels, wind turbine blades, and boat and surfboard cores, currently are in development for future commercialization.

Ecovative has caught the eye of Fortune 500 and other large companies working in a myriad of industries. For example, Steelcase Inc. and Dell Inc. are using the EcoCradle™ material for product shipping. In addition, Ecovative is developing a product for the automotive sector with a concentration on replacing synthetic foams that dissipate energy (e.g., door panels and bumpers) and acoustic tiles (sound attenuation).

Company History and Awards

Ecovative Design, a materials science company based in Green Island, New York, was founded in 2007 with a “triple bottom line” business model: make products that are environmentally good for the planet, benefit the people who use them, and produce products that are financially sustainable. The company has received multiple grants, including the American Society of Mechanical Engineers Grant, National Collegiate Inventors and Innovators Alliance Grant, and New York State Research and Development Authority Grant. Ecovative was named a 2011 Technology Pioneer by the World Economic Forum in recognition of the company’s efforts to harness, adapt and use technology to change and improve the way businesses operate. With gaining interest in the company by eco-friendly consumers and Fortune 500 companies, Ecovative is emerging as a strong force in the packaging, construction materials, and insulat-

ing markets, offering an environmentally friendly option to consumers and industries alike.

SBIR Impact

- Conventional petroleum-based building insulation, packaging and construction materials are inherently unsustainable, dependent on foreign resources, and ultimately environmentally unfriendly.
- Ecovative developed the MycoBond™ technology and adapted it to make Greensulate™ and EcoCradle™ materials that offer eco-friendly options for the building insulation and packaging industries, respectively.
- MycoBond™ manufacture emits 5 times less CO₂ and uses 10 times less energy than conventional expanding polystyrene technologies. MycoBond™ makes use of regional agricultural waste streams, is biodegradable, and qualifies for LEED credits if used to insulate buildings.
- Fortune 500 and other large companies are using Ecovative products for their packaging needs, and plans are under way with other large companies to use MycoBond™ products for insulation and structural applications.

