

## **Assoc. Prof. Ming-Kai Chen Partners with Lv De Bao to Develop High-Efficiency Microbial Enzymes for Glass Fiber Recycling**

Associate Professor Ming-Kai Chen from the Department of Chemistry has developed a high-efficiency microbial enzyme degradation technology capable of recycling glass fiber-reinforced thermoset plastics (GRP) waste. The research was conducted in collaboration with the Taiwan Composites Association, Tamkang University's Office of Research and Development, the Department of Chemistry, and Lv De Bao Environmental Technology Co., Ltd. The results were presented on October 24 at HC305 in the Hsu Shou-Chlien International Conference Center. Researcher Rong-An Wu from the Industrial Development Bureau of the Ministry of Economic Affairs praised the innovation, noting that it generates no wastewater or smoke, operates at low temperatures without consuming significant energy, and enables recycled glass fibers to be reused, achieving a goal of zero emissions.

Associate Professor Po-Shen Pan, Chief of the Research and Industry-Collaboration Section and Director of the Champion Incubator Center highlighted that Tamkang University's comprehensive academic departments can assist companies with technology verification, deepening industry-academia collaboration, and securing government funding for robust support. Secretary-General Chueh Chao of the Composites Association emphasized the growing usage of GRP, citing examples like the decommissioning of first-generation wind turbines in Penghu, abandoned fishing boats at Donggang Harbor, and large storage tanks in the petrochemical industry. These items are bulky and lightweight but cause significant environmental damage when discarded. The new technology offers a promising solution, and the association is prepared to help businesses obtain government licenses to facilitate broader applications.

Currently, Taiwan lacks proper disposal methods for GRP waste, which is either crushed and landfilled or incinerated, leading to severe environmental pollution. Large volumes of old and waste materials accumulate, creating public nuisances. Assoc. Prof. Chen explained that

GRP' s chemical structure is difficult to decompose and can even enter the food chain, posing risks such as reproductive system cancers, reduced fertility, and increased feminization in males if humans consume contaminated plants or animals.

To address this challenge, Tamkang University established a Biosafety Committee and a Level 2 laboratory dedicated to this research. Using microbial enzyme technology, Assoc. Prof. Chen disrupted GRP' s stable, dense chemical structure, achieving efficient degradation. The process removes over 99% of the resin from glass fiber surfaces, and the resulting wastewater is filtered and recycled. Xin-Yi Ouyang and Yi-Zhen Wang, Chemistry seniors, conducted an on-site experiment, demonstrating visible results within just 30 minutes.

Kuo-Cheng Huang, Executive Director of Lv De Bao Environmental Technology, stated that the technology has undergone rigorous testing with remarkable results. The process separates inorganic materials and organic resins using microbial enzymes and physical methods, producing water-soluble small molecules that are easily metabolized without polluting the environment. The remaining inorganic material can be modified and recycled for reuse.

Participants, including senior environmental engineer Guang-Zheng Liao from Tien Li Offshore Wind Technology, environmental safety officer Li-Chung Lin from Thermolysis Co., Ltd., Deputy General Manager Yuan-Chang Lin from Hwa Jinn F. R. P., researcher Zhe-Wei Shih from Eternal Materials, and Chairman Peng-Yu Chen of Yutian Nano Materials, actively raised questions. Lv De Bao General Manager, Jing-Kai Lee noted that detailed cost calculations have been completed, showing that the optimized use of microbial enzymes significantly reduces costs. The enzymes can be tailored to different composite material properties, enabling rapid industrial adoption. Chueh Chao expressed hope that the technology could soon be commercialized to fulfill its mission of addressing environmental pollution.



1. Associate Professor Ming-Kai Chen from the Department of Chemistry, in collaboration with Lv De Bao Environmental Technology, unveiled a high-efficiency microbial enzyme. The achievement was recognized by Chueh Chao (left), Secretary-General of the Taiwan Composites Association, and Rong-An Wu, Research Fellow at the Industrial Development Bureau of the Ministry of Economic Affairs.



Assoc. Prof. Po-Shen Pan (back row, second from left), Chief of the Research and Industry-Collaboration Section; Assoc. Prof. Ming-Kai Chen (front row, second from left) from the Department of Chemistry; Kuo-Cheng Huang (front row, third from left), Executive Director, and Ching-Kai Lee (back row, third from left), General Manager of Lv De Bao Environmental Technology, jointly presented their recognized achievement.



At the press conference, the Taiwan Composites Association invited multiple companies to attend and learn about this innovative environmental technology.



Xin-Yi Ouyang and Yi-Zhen Wang, senior students from the Department of Chemistry, conducted an experiment on-site and demonstrated results within just half an hour.