

Value-added study on circular economy of spent activated carbon by thermal regeneration

1. **Title of Research** : Value-added study on circular economy of spent activated carbon by thermal regeneration

2. **Cross-School Research and**

Development Team Members

Department	Name	Position
Graduate Institute of Bio Resources (NPUST)	Wen-Tien Tsai	Professor
Department of Environmental Science and Occupational Safety and Health/Department of Pet Care and Grooming (Tajen Univ.)	Yu-Ru Lee	Associate Professor
JING LEEI ENTERPRISE CO., LTD.	Hsin-Wei Kuo	Factory director

3. **Content of Cross-School Research and**

Development

This research initiative aimed to investigate the thermal regeneration technology for spent activated carbon, with the objective of establishing a sustainable circular economy framework while concurrently enhancing its value-added applications across diverse sectors. Through collaborative efforts, we seek to integrate expertise from the fields of biorenewable resources, environmental science, and industry to address current bottlenecks in the

treatment of spent activated carbon. In addition, the project endeavored to reduce reliance on new resources, thus achieving the effective reuse of resources.

4. **Description of Industrial Needs and**

Research Result Applications

(1) Investigating the pore characteristics of spent activated carbon during thermal regeneration under different gases (N_2/CO_2) and heating rates. This work aimed to prevent the waste from entering incinerators and causing the unnecessary depletion of biorenewable resources.

Corresponding Requirement : To rapidly assess and analyze the characteristics of spent activated carbon by TGA, thus determining the optimal regeneration conditions.

(2) Adopting a laboratory-scale vertical carbonization activation furnace equipment to examine the pore characteristics of spent activated carbon after thermal regeneration. This work was performed to validate the applicability of the process.

Corresponding Requirement : To test laboratory-scale experiments by a vertical carbonization-activation furnace, gradually

applying to the plant after the optimal conditions determined.

(3) Analyzing the regenerated activated carbon's iodine value and investigating its performance in the wastewater treatment by adsorption process.

Corresponding Requirement : To establish the iodine value determination method for a rapid and accurate analysis of effectiveness in the thermal regeneration process.

(4) Assisting the collaborative enterprise in applying for certification from the Ministry of Economic Affairs for the resource regeneration green product (thermally regenerated waste activated carbon) .

5. Performance of Cross-School Research and Development

(1) Derived Product: Regenerated activated carbon product for wastewater treatment (Iodine value ≥ 800 mg/g) .

(2) Three students from NPUST engaged in thematic training on the circular economy of biomass-based waste materials.

(3) During the execution of this research project, collaboration was established with a partner participating in the Kaohsiung City Government's 2022 " Local Industry Innovation and Development Promotion (SBIR) Project " (project period : Aug. 1, 2022~July 31,

2023) . The selected partner, recognized by the Kaohsiung City Government's Economic Development Bureau for outstanding performance and alignment with net-zero carbon emissions and circular economy characteristics, has been designated as an exemplary company for promoting the 2022 Kaohsiung City SBIR project application. This recognition has been widely publicized in major media outlets. On November 15, 2023, the company received commendation as an outstanding partner from the Economic Development Bureau of the Kaohsiung City government.



Fig 1 : Collaborating Partners (Left : Factory director, Central : Chairman) .



Fig 1 : Thermogravimetric Analyzer (TGA) .