VIETNAM NATIONAL UNIVERSITY, HANOI
VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM
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INFORMATION ON DOCTORAL THESIS

1. Full name: Vu Ngoc Linh 2. Sex: Male

3. Date of birth: 19/01/1996 4. Place of birth: Hanoi

5. Admission decision number: 1200/QĐ-CTSV Dated 29/12/2020

6. Changes in academic process:

- Appointment of Additional Supervisor: Dr. Nguyen Hong Nam – University of Science and Technology of Hanoi – Vietnam Academy of Science and Technology (Decision No. 145/QĐ-ĐT dated March 11, 2022).
- Extension of Study Duration: 2 years (24 months) (Decision No. 1442/QĐ-ĐHCN dated December 29, 2023).
- Adjustment of PhD Dissertation Title: "Study on the Characteristics and Applications of Gas and Micro-Nano Structured Solid Products from the Gasification of Macadamia Residues" (Decision No. 130/QĐ-ĐHCN dated January 16, 2025).

7. Official thesis title: Study on the characteristics and applications of gas and micronano structured solid products from the gasification process of macadamia by-products

8. Major: Nanomaterials and Devices 9. Code: 944012801.QTD

10. Supervisors:

Supervisor: Prof.Dr. Nguyen Nang Dinh

Co-supervisor: Dr. Nguyen Hong Nam

11. Summary of the **new findings** of the thesis:

The dissertation analyzed and compared the physicochemical properties, thermal behavior, and application potential of macadamia nutshells and husks, highlighting their suitability as feedstocks for biomass gasification technology. The results show that both types of residues have low moisture and ash content, high fixed carbon content, and superior calorific values (18.25 MJ kg^{-1} for husks and 21.5 MJ kg^{-1} for nutshells), underscoring their potential to replace wood or conventional biomass sources.

The dissertation elucidated the gasification process of macadamia residues in a reactive gas environment (20 % CO_2 + 20 % H_2O + N_2), identifying three distinct stages and analyzing the composition of syngas produced at each stage. Additionally, the calorific values of the resulting syngas were obtained. The findings indicate that syngas from macadamia nutshells has a high H_2/CO ratio (1.12), suitable for the Fischer-Tropsch liquid fuel conversion process, while syngas from macadamia husks exhibits more stable composition with high calorific value.

At the experimental scale, the study demonstrated that the energy conversion efficiency of macadamia residues reached 61.5 % in a commercial gasification system, comparable to other common biomass types. The dissertation also investigated the properties of gasification char on an experimental scale, revealing a high specific surface area of 37.8 $m^2\ g^{-1}$ and a total pore volume of 0.0375 $cm^3\ g^{-1}$.

Moreover, the research evaluated the CO_2 and dye adsorption capacity of by-products from the gasification process, contributing to the potential practical applications of these residues in environmental remediation. The dissertation provides detailed data on the physicochemical characteristics, gasification kinetics, and material structure of macadamia residues, enriching the field of biomass conversion research and the development of nano-carbon materials.

12. Practical applicability, if any:

The findings of this dissertation are significant in determining the feasibility and effectiveness of synthesizing micro-nano structured carbon materials for pollutant adsorption from macadamia residues through biomass gasification for energy production. The successful synthesis of high-performance adsorbent materials from macadamia residues using gasification technology demonstrates the potential to utilize this promising biomass resource efficiently and sustainably, while simultaneously producing high-quality fuel gas.

The investigation into the transformation and properties of both syngas and gasification char throughout the conversion process contributes crucial insights into the applicability of both products, thereby promoting the development of macadamia residue gasification technology.

13. Further research directions, if any:

- Research and synthesize catalysts to enhance H_2 production and reduce tar formation during the gasification of macadamia residues.

- Investigate and evaluate catalysts for the gasification of macadamia residues to improve the properties of gasification char (specific surface area, pore volume), thereby enhancing the adsorption capacity of the material.

- Examine suitable catalysts for the gasification of macadamia residues to improve the CO_2 selectivity of gasification char, thereby increasing adsorption efficiency.

14. Thesis-related publications:

1. Vu Ngoc Linh, Nguyen Van Dong, Nguyen Hong Nam, "*Investigation on gasification of agricultural wastes: the case of macadamia husk*", (2021), Vietnam Journal of Chemistry, 59(5), 599-605, 10.1002/vjch.202100011
2. Nguyen Van Dong, Vu Ngoc Linh, Tran Van Bay, Nguyen Hong Nam, "*CO2 capture by biochar from macadamia nut shell*", (2022), Journal of Science and Technology-Hanoi University of Industry, 58(4), 126-129, P-ISSN 1859-3585
3. Nguyen Van Dong, Tran Van Bay, Nguyen Hong Nam, Vu Ngoc Linh, "*Solid waste from macadamia nutshell gasification: Potential use as adsorbent*", (2022), Journal of Science and Technology-Hanoi University of Industry, 58(5). 93-96, https://doi.org/10.57001/huih5804.46
4. Vu Ngoc Linh, Nguyen Nang Dinh, Nguyen Van Dong, Tran-Nguyen Phuong Lan, Nguyen Viet Hoai, Dinh Thi Mai Thanh, Nguyen Hong Nam, "*Evolution of properties of macadamia husk throughout gasification: Hints for a zero-waste energy production system*", (2023), Biomass and Bioenergy, 171(106735): 1-14, 10.1016/j.biombioe.2023.106735
5. Vu Ngoc Linh, Nguyen Nang Dinh, Dinh Thi Mai Thanh, Nguyen Hong Nam, "*Cascading use of macadamia nutshell for production of energy and adsorbents through biomass gasification*", (2023), Industrial Crops and Products, 206, 117662, 10.1016/j.indcrop.2023.117662
6. Vu Ngoc Linh, Nguyen Thu Phuong, Le Phuong Thu, Dinh Thi Mai Thanh, Nguyen Hong Nam, "*Physico-chemical properties of macadamia nut shell post-gasification residues and potential agricultural application*", (2024), Vietnam Journal of Science and Technology, 62(1), 58-67, 10.15625/2525-2518/18001
7. Vu Ngoc Linh, Nguyen Nang Dinh, Han Triet Vien, Tran-Nguyen Phuong Lan, Nguyen Hong Nam, "*Heterogeneous solid residue from macadamia nut processing as viable feedstock for high-temperature gasification*", (2024), Journal of the Energy Institute, 117(17):101769, 10.1016/j.joei.2024.101769

Vu Ngoc Linh, Dinh Thi Mai Thanh, Nguyen Thu Phuong, Le Phuong Thu, Do Thi Hai, Nguyen Trung Dung, Nguyen Hong Nam, "*Exploring adsorbent potential: Investigating the characteristics of macadamia husk char from pilot-scale gasification*", (2024),

Vietnam Journal of Catalysis and Adsorption, the 12th Vietnam National Conference on Catalysis and Adsorption, 13(4): 20-25, 10.62239/jca.2024.068