2023 年度 試験研究助成 一覧

＜インドネシア＞

No	大学名 University	研究テーマ Project Title	研究者 Researcher
1	インドネシア大学 UNIVERSTIAS INDONESIA	Synthesis and Azo Dye Photodegradation Performance Optimization of Agricultural Waste-based Mesoporous Silica-TiO2/RGO Composite Thin Film to Improve Water Quality 農業廃棄物ベースのメソポーラスシリカ Tio2/rGO 複合薄膜による水質改善を目的としたアゾ染料の合成と光分解性能の最適化	Dr. Ir. Jaka Fajar Fatriansyah, Ph.D.
2		Production of Carbon Nanofibers from Empty Fruit Bunches as Electrode Material for Supercapacitors via Thermal Chemical Vapor Deposition and Electrospinning 熱化学気相成長法とエレクトロスピニング法によるスーパーキャパシタ用電極素材としての空果房からのカーボンナノファイバーの製造	Eny Kusrini, Ph.D.
1	バンドン工科大学 INSTITUT TEKNOLOGI BANDUNG	MgO-PVDF-HFP Nanofiber Composite Incorporating Waste-Based Polymer for Sustainable Carbon Dioxide Adsorption and Separation in Natural Gas Processing and Environmental Remediation 天然ガス処理における持続可能なCO2吸着／分離、及び環境改善を目的とした、破棄物ベースのポリマーを混合した酸化マグネシウム・フッ化ビニリデン・6フッ化プロピレンのナノファイバー	Prof. Ir. Muhammad Ali Zulfikar, Ph.D., IPP.
2		Towards a visible light-driven non-oxideative coupling of methane; Synergetic effect of Ga2O3-deorated Ti3C2 MXene. 光駆動型非酸化メタンカップリングに向けて:酸化ガリウムを配されたTi3C2MXene の相乗的効果	Dr. Grandprix Thomryes Marth Kadja, M.Si.
1	ボゴール農業大学 INSTITUT PERTANIAN BOGOR	Development of environmental monitoring system based on IoT to address global warming impact on society. 地球温暖化による社会への影響に対処するためのIoTを活用した環境モニタリングシステムの開発	Muh. Taufik
2		Synthesis of Carbon Nanoparticles (C-dots) Fast-Growing Wood Sawdust Waste by Hydrothermal Method and Its Application for Wastewater Treatment Process 水熱法による成長の早い木材おがくず廃棄物のカーボンナノ粒子(Cドット)の合成と排水処理プロセスへの応用	Istie Sekartining Rahayu
3		Mapping Agricultural Practices and Predicted Contaminated Areas by Heavy Metals at the Surroundings Gold Mining in Nanggung District ナングン区の金採掘における農業慣行と予測された重金属による汚染地域のマッピング	Dyah Retno Panuju

No	大学名 University	研究テーマ Project Title	研究者 Researcher
4	ボゴール 農業大学	Product Development and Feasibility Testing of Microbial Fuel Cell (MFC) in Java to produce electricity, increasing rice production, and reducing carbon emission. 発電、コメの増産、二酸化炭素排出削減をもく的とした、ジャワ島における微生物燃料電池（MFC）の開発と実現可能性検討	Dwi Andreas Santosa
5	INSTITUT PERTANIAN BOGOR	Spatial analysis of Greenhouse Gas Emissions towards Low-Carbon City Development in DKI Jakarta Province DKIジャカルタ州における低炭素都市開発に向けた温室効果ガス排出量の空間分析	Luisa Febrina Amalo

＜マレーシア＞

No	大学名 University	研究テーマ Project Title	研究者 Researcher
1	サラワク 大学 UNIVERSITI MALAYSIA SARAWAK	Optimizing energy of retrofitted milling machine through investigation of backlash characteristics バックラッシュ特性の調査による、後付けフライス盤のエネルギー最適化	Dr. Noor Hisyam Noor Mohamed
2		Optimal design of membrane cryogenic distillation process for Nitrogen Rejection Unit process 窒素回収装置用膜式低温蒸留プロセスの最適設計	Dr Norfamila Che Mat
3		Socio-Environmental Impact of Small Hydropower on Sarawak's Rural Livelihoods: Insights from Japan's Experience 小水力発電のサラワク農村生活への社会・環境影響 ：日本の経験からの考察	Then Yi Lun
4		Electrocoagulation Treatment of Palm Oil Mill Effluent (POME) Discharged as a Recycle Feed Water for Palm Oil Mill Boiler. パームオイルミルボイラーのリサイクル供給水として排出されるパームオイルミル排水（POME）の電気凝固処理	Dr Nazeri Abdul Rahman
5		Energy and Performance Evaluation of Congestion-Aware Routing Mechanism for Wireless Network-on-Chip ワイヤレスネットワークオンチップにおける輻輳を考慮したルーティング機構のエネルギーと性能評価	Asrani bin Lit
6		Integration of IoT and AI for Efficient Demand Response and Energy Management in Smart Homes: A Sustainable Energy Approach スマートホームにおける効率的なデマンドレスポンスとエネルギー管理のための IoT と AI の統合： 持続可能なエネルギー・アプローチ	Nazreen bt Junaidi

FINAL REPORT

OSAKA GAS FOUNDATION OF INTERNATIONAL

CULTURAL EXCHANGE

Year 2023/2024

SYNTHESIS AND AZO DYE PHOTODEGRADATION PERFORMANCE OPTIMIZATION OF AGRICULTURAL WASTE-BASED MESOPOROUS SILICA-TIO_2/RGO COMPOSITE THIN FILM TO IMPROVE WATER QUALITY

Principal Investigator:

Dr. Ir. JAKA FAJAR FATRIANSYAH, M.Sc., IPM, ASEAN Eng

Department of Metallurgical and Materials Engineering

Faculty of Engineering

UNIVERSITY OF INDONESIA

DEPOK

2024

RESEARCH SUMMARY

1. Research Project Title	:	Synthesis and Azo Dye Photodegradation Performance Optimization of Agricultural Waste Based-Mesoporous Silica-TiO_2/rGO Composite Thin Film to Improve Water Quality
2. Principal Investigator		
a. Name	:	Jaka Fajar Fatriansyah
b. Rank/Status	:	Associate Professor
c. Main Field of Specialization	:	Materials Science and Engineering
d. Department	:	Metallurgical and Materials Engineering
e. Faculty	:	Engineering
3. Summary	:	In this research proposal, TiO_2-functionalized thin films were synthesized using spin coating method for photodegradation of methylene blue and methyl orange dyes. After exposuring to the 10 ppm MB and MO solutions for four hours at a pH of 7, the synthesized mesoporous silica/TiO_2 thin film exhibited the best removal performance compared to the mesoporous silica thin film and TiO_2 thin film, with removal percentages of 77.90% and 17.19% for MB and MO, respectively.
4. Field of Disciplines	:	Green Materials for Wastewater Treatment
5. Research Location	:	Depok, Indonesia
6. Time of Research Project	:	12 months

Depok, 30th August 2024

Researcher

Dr. Ir. Jaka Fajar Fatriansyah, M.Sc., IPM

NIP. 198506202018031001

FINAL REPORT

OSAKA GAS FOUNDATION OF INTERNATIONAL CULTURAL EXCHANGE

Year 2023/2024

Production of Carbon Nanofibers from Empty Fruit Bunches as Electrode Material for Supercapacitors via Thermal Chemical Vapor Deposition and Electrospinning

Principal Investigator:

Eny Kusrini, Ph.D.

Department of Chemical Engineering
Faculty of Engineering

UNIVERSITAS INDONESIA

DEPOK

2024

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RESEARCH PROPOSAL SUMMARY

The rapid growth of the palm oil industry generates significant amount of wastes such as empty fruit bunches (EFB) and palm oil shell (POS). These waste can used as raw materials for production of carbon material based that having high-value materials. This research aims to explore the utilization of biomass waste from oil palms as a precursor for production of activated carbon (AC) and carbon nanofiber (CNF). These carbon materials were used as electrode material for supercapacitor applications. The carbon material products were characterized using FTIR, XRD, BET, FESEM-EDX, TGA. Electrochemical properties was determined using three-electrode cells to evaluate capacitance through cyclic voltammograms and galvanostatic charge-discharge curves. On the other hand, lignin was isolated from POS, and utilized to produce CNF as electrode material for supercapacitor. This carbon was produced from EFB through nitrogen-doping with melamine and activation with potassium chloride (KCl) using the hydrothermal pyrolysis method via pyrolysis process at temperatures of 750 - 950°C. The XRD analysis indicates that the carbon materials possess an amorphous structure with minor variations in crystallite size, primarily at higher pyrolysis temperatures. N_2 adsorption-desorption analysis shows that higher pyrolysis temperatures lead to an increase in surface area, particularly in micropore surface area. FESEM of carbon materials showed uniform morphologies that dominated by micropores, and they are well-interconnected each other to allow electrolyte ions access. Energy-dispersive X-ray spectroscopy (EDS) confirmed the elemental compositions, indicating an increase in carbon content with higher pyrolysis temperatures. All nitrogen-doped carbon materials (AC) exhibit electric double-layer capacitance (EDLC) behaviour. AC 950°C showed the highest specific capacitance of 389.122 F/g at a current density of 1 A/g, which was strongly influenced by the pyrolysis temperature and nitrogen doping, as well as the highest energy and power densities. These porous carbon materials from EFB are potential used as electrode materials for supercapacitor application. The potential of porous carbon materials that derived from EFB as a promising electrode material for supercapacitors. This study also contributed to the development of sustainable energy storage materials, addressing the increasing demand for renewable energy solutions.

Keywords: Biomass waste; Activated carbon; Electric double-layer capacitance; Supercapacitor

Research Report

Osaka Gas Foundation of International Cultural Exchange

(OGFICE)

Research Title

MgO-PVDF-HFP Nanofiber Composite Incorporating Waste-Based Polymer for Sustainable Carbon Dioxide Adsorption and Separation in Natural Gas Processing and Environmental Remediation

Principal Investigator:

Prof. Ir. Muhammad Ali Zulfikar, Ph.D., IPP.

Academic Unit

Research Division	:	Analytical Chemistry
Faculty/School	:	Faculty of Mathematics adn natural Science

INSTITUT TEKNOLOGI BANDUNG

November 2024

I. IDENTITY PAGE

1. Title : MgO-PVDF HFP Nanofiber Composite Incorporating Waste- Based Polymer for Sustainable Carbon Dioxide Adsorption and Separation in Natural Gas Processing and Environmental Remediation
2. Relevance of Topic : Global environmental problems
3. Research Period : November 2023 – November 2024

4.1. Principal Investigator:

a. Full Name : Prof. Ir. Muhammad Ali Zulfikar, M.Si., Ph.D., IPP
b. Academic Rank : Professor
c. NIP : 197112211997021003
d. Current Position : Professor at Analytical Chemistry Research Group
e. Academic Unit : Chemistry Department, Faculty of Mathematics and Natural Sciences, ITB
f. Office Address/E-mail: Jl. Ganesa No. 10 Bandung 40132, zulfikar@chem.itb.ac.id
g. Home Address/Phone: Jl. Dago Pojok No. 92C, 081573115099

4.2 Members of the Team :

No	Name and Academic Rank	Field of Experties	Institution	Alocation of Time	
				Hrs/week	Months
1.	Dr. Nurrahmi Handayani	Analytical Chemistry	Institut Teknologi Bandung (ITB)	30	10
2.	Dr. Eng. Muhamad Nasir	Environmental Nanotechnology	National Research and Innovation Agency (BRIN)	30	10

4.3 Research Assistants/Students (mention names when available):

No	Name	Departement and NIM	Alocation of Time	
			Hrs/week	Hrs/week
1.	Asnan Rinovian	Research Center for Nanoscience and Nanotechnology, NIM: 28721004	30	
2.	Natalia Devita	Department of Chemistry, ITB	40	

5. Approved budget : Rp 85.000.000,00

Approved by,
Head of Analytical Chemistry Research Group

Prof. Ir. Muhammad Ali Zulfikar, M.Si., Ph.D,
NIP. 197112211997021003

Bandung, 7 Maret 2025
Principal Investigator

Prof. Ir. Muhammad Ali Zulfikar, M.Si., Ph.D,
NIP. 197112211997021003

I. EXECUTIVE SUMMARY

1. **TITLE OF RESEARCH** : **MgO-PVDF HFP Nanofiber Composite with Waste-Based Polymer for Sustainable CO_2 Adsorption and Separation in Natural Gas Processing and Environmental Remediation**

2. **HEAD OF RESEARCH TEAM** :
   Prof. Ir. Muhammad Ali Zulfikar, M.Si., Ph.D,

3. **TEAM MEMBERS** :

   Dr. Nurrahmi Handayani, S.Si., M.Si.

   Dr.Eng. Muhamad Nasir

   Asnan Rinovian, S.Si., M.Si.

   Natalia Devita, S.Si., M.Si.

4. **OFFICIAL ADDRESS** : Jl. Ganesha 10 Bandung 40132

5. **EXTENDED ABSTRACT** :

The increasing concentration of carbon dioxide (CO_2) in the atmosphere has raised significant environmental concerns, particularly in relation to climate change and industrial emissions. One of the major contributors to CO_2 emissions is the natural gas industry, where the presence of CO_2 reduces the energy efficiency of the gas and contributes to environmental degradation. Therefore, the development of efficient, sustainable, and cost-effective CO_2 adsorption and separation materials is critical for addressing this challenge. This research aims to develop a **MgO-PVDF HFP nanofiber composite** incorporating waste-based polymers for enhanced CO_2 adsorption and separation in natural gas processing and environmental remediation. The integration of waste-derived polymers such as **polyvinyl chloride (PVC) or polystyrene** into the polyvinylidene fluoride hexafluoropropylene (PVDF-HFP) matrix represents an innovative approach to promoting circular economy principles while simultaneously tackling the problem of plastic waste accumulation.

The project involves the **synthesis of MgO nanoparticles from seawater bitterns**, an abundant and underutilized byproduct of salt production, thereby adding an eco-friendly dimension to the material synthesis process. The nanofiber composite will be fabricated using the **electrospinning technique**, which allows for the creation of high-surface-area fibers with enhanced porosity, essential for effective CO_2 adsorption. MgO nanoparticles will be incorporated into the polymer matrix to **improve the structural stability and adsorption efficiency** of the material. The presence of MgO, known for its high basicity and strong affinity for acidic gases like CO_2, is expected to significantly enhance the adsorption capacity of the composite.

A comprehensive **characterization of the nanofiber composite** will be performed using techniques such as **Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), X-ray diffraction (XRD), and Brunauer-Emmett-Teller (BET) surface area analysis**. These techniques will provide insight into the composite's **chemical structure, morphological properties, crystallinity, and porosity**, ensuring that the material meets the required specifications for adsorption applications. Additionally, the adsorption performance and CO_2 separation efficiency of the **MgO-**

PVDF HFP-waste polymer nanofiber composite will be evaluated under varying experimental conditions, including different temperatures, pressures, and CO_2 concentrations. The material's reusability and regeneration potential will also be assessed to ensure long-term applicability in industrial settings.

The expected outcomes of this research include:

- The **development of a novel, high-performance CO_2 adsorption material** with enhanced separation efficiency, suitable for natural gas processing and environmental applications.
- The **utilization of waste-based polymers**, contributing to sustainable material development and waste reduction strategies.
- The **valorization of seawater bitterns** for the synthesis of MgO nanoparticles, offering a cost-effective and eco-friendly approach to material fabrication.
- The dissemination of findings through **peer-reviewed journal articles, conference proceedings, and prototype demonstrations**, paving the way for future industrial applications.

By integrating **advanced nanotechnology, waste valorization, and sustainable material design**, this study has the potential to make a significant impact on CO_2 capture technologies, promote circular economy initiatives, and enhance the sustainability of natural gas processing. The findings from this research will contribute to the development of next-generation adsorption materials and support efforts toward achieving global climate change mitigation goals.

6. LIST OF RESEARCH OUTPUT

2 International Journal

1.5 International proceeding conference

1 prototype

Research Report

Osaka Gas Foundation of International Cultural Exchange

(OGFICE)

Towards a visible-light driven non-oxidative coupling of methane: Synergetic effect of Ga_2O_3-decorated Ti_3C_2 MXene

Principal Investigator:

Dr. Ir. Grandprix T. M. Kadja

Academic Unit

Research Division : Inorganic and Physical Chemistry

Faculty/School : Mathematics and Natural Sciences

INSTITUT TEKNOLOGI BANDUNG

November 2024

I. IDENTITY PAGE

1. Title : Towards a visible-light driven non-oxidative coupling of methane: Synergetic effect of Ga_2O_3-decorated Ti_3C_2 MXene
2. Topic : Energy
3. Research Period : 09/25/2023–09/25/2024

4.1. Principal Investigator :

a. Full Name : Dr. Ir. Grandprix T. M. Kadja
b. Academic Rank : Assistant Professor
c. NIP : 199303312018031001
d. Current Position : Assistant Professor
e. Academic Unit : Division of Inorganic and Physical Chemistry
f. Office Address/Phone/Fax/E-mail : Jalan Ganesha no. 10, Bandung 40132

4.2 Members of the Team:

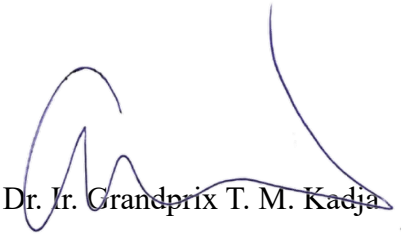
No	Name and Academic Rank	Field of Expertise	Institution	Allocation of Time	
				Hrs/week	Months
1	Dr. Ainul Maghfirah	Inorganic Chemistry	Institut Teknologi Bandung	6	12
2	Dr. Munawar Khalil	Nanomaterials	Universitas Indonesia	6	12

4.3 Research Assistants/Students (mention names when available):

No	Name	Departement and NIM	Alocation of Time	
			Hrs/week	Months
1.	Noerma J. Azhari, M.Si.	Chemical Engineering, 33021009	10	12

5. Approved budget : IDR 93,000,000

Bandung, 07 March 2025
Principal Investigator



Dr. Ir. Grandprix T. M. Kadja

I. EXECUTIVE SUMMARY

1. **TITLE OF RESEARCH** : Towards a visible-light driven non-oxidative coupling of methane: Synergetic effect of Ga_2O_3-decorated Ti_3C_2 MXene
2. **HEAD OF RESEARCH TEAM** : Dr. Ir. Grandprix T. M. Kadja
3. **TEAM MEMBERS** : Dr. Ainul Maghfirah; Noerma J. Azhari, M.Si.; Dr. Munawar Khalil
4. **OFFICIAL ADDRESS** : Jalan Ganesha no. 10, Bandung 40132, Indonesia

5. **EXTENDED ABSTRACT** :

The development of efficient photocatalysts for photocatalytic non−oxidative coupling of methane is crucial for sustainable energy applications. In this study, we synthesized Ti_3C_2 MXene nanosheets decorated with Ga_2O_3 nanoparticles to enhance photocatalytic performance. The incorporation of MXene significantly altered the electronic structure of Ga_2O_3, reducing its bandgap from 4.2 eV to 2.8 eV, thereby extending its light absorption into the visible range. The Ti_3C_2 MXene acts as a photogenerated electron reservoir, effectively inhibiting electron-hole recombination and enhancing charge separation efficiency. As a result, the Ga_2O_3/Ti_3C_2 composite exhibited a substantial increase in photocatalytic activity, with ethane (C_2H_6) and hydrogen (H_2) production rates of 0.11 μmol/h and 0.21 μmol/h, respectively, compared to pristine Ga_2O_3, which produced only 0.05 μmol/h and 0.12 μmol/h. These findings highlight the potential of MXene-based hybrid materials for advanced photocatalytic applications in renewable energy conversion.

6. **LIST OF RESEARCH OUTPUT**

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2023/2024

Final Report

Development of Environmental Monitoring System Based on IoT to Address Global Warming Impact on Society

1. Muh. Taufik

Center for Environmental Research, IPB University

2. Mudrik Haikal

Department of Geophysics and Meteorology, IPB University

Submitted to:

Center for Environmental Research

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2024

General Information

Title : Development of Environmental Monitoring System Based on IoT to Address Global Warming Impact on Society

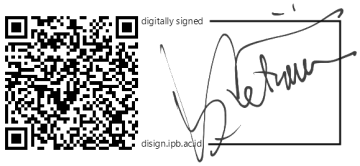
Researchers:

1 Name : Dr. Muh Taufik
Institution : Center for Environmental Research, IPB University
Address of institution : Jl. Lingkar Kampus, Kampus IPB Dramaga, Bogor 16680

2 Name : Mudrik Haikal
Institution : Study Program of Applied Meteorology, IPB University
Address of institution : Jl. Lingkar Kampus, Kampus IPB Dramaga, Bogor 16680

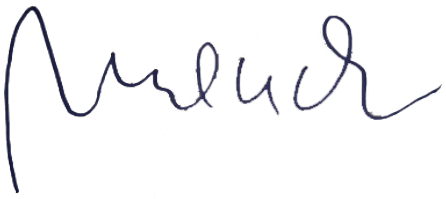
Bogor, 27 November 2024

Center for Environmental Research,
IPB University,
Director,



Dr. Yudi Setiawan, SP., M.Env.Sc

Principal Investigator,



Dr. Muh Taufik

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VI. Conclusion

IoT has emerged as a powerful tool in the fight against global warming. Its ability to provide real-time, actionable insights is transforming how society understands and addresses environmental challenges. Future research should focus on enhancing the affordability and accessibility of IoT-based systems, ensuring they can be deployed at scale to benefit diverse communities worldwide.

Our next plan involves conducting data analysis and comparing the performance of the devices under development with the CCROM device. Subsequently, we will initiate an advanced coding process to calibrate all manufactured devices. Following calibration, the devices will be strategically installed in predetermined locations across Bogor (Figure 5) to capture spatial environmental conditions. With four distributed devices, our goal is to represent rural, urban, and suburban areas. Once data from various locations is gathered, the next step will involve conducting further analysis to understand how Bogor's environment is influenced by current global warming conditions. This analysis may shed light on potential impacts on local social conditions.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2023/2024

Final Report

Synthesis of Carbon Nanoparticles (C-dots) from Hydrothermally Growing Fast Sawdust Waste and Its Application for Waste Water Treatment Process

1. Dr. Istie Sekartining Rahayu, S.Hut, M.Si
IPB University
2. Prof. Dr. Ir. I Wayan Darmawan, M.Sc.F.Trop
IPB University
3. Esti Prihatini, S.Si, M.Si
IPB University
4. Rohmat Ismail, S.Si
IPB University
5. Gilang Dwi Laksono, S.Hut, M.Si
IPB University
6. Vera Indriaswari
IPB University

Submitted to:

Center for Environmental Research

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2024

GENERAL INFORMATION

Title : Synthesis of Carbon Nanoparticles (C-dots) from Hydrothermally Growing Fast Sawdust Waste and Its Application for Waste Water Treatment Process

Researchers:

1 Name : *Dr. Istie Sekartining Rahayu, S.Hut, M.Si*
Institution : *IPB University*
Address of institution : *Department of Forest Products, Faculty of Forestry and Environment, IPB University, Kampus IPB Dramaga, Jl. Raya Dramaga, Bogor – Indonesia, Phone +62-818937736, E-mail: istiesr@apps.ipb.ac.id*

2 Name : *Prof. Dr. Ir. I Wayan Darmawan, M.Sc.F.Trop*
Institution : *IPB University*
Address of institution : *Department of Forest Products, Faculty of Forestry and Environment, IPB University, Kampus IPB Dramaga, Jl. Raya Dramaga, Bogor – Indonesia*

3 Name : *Esti Prihatini, S.Si, M.Si*
Institution : *IPB University*
Address of institution : *Department of Forest Products, Faculty of Forestry and Environment, IPB University, Kampus IPB Dramaga, Jl. Raya Dramaga, Bogor – Indonesia*

4 Name : *Rohmat Ismail, S.Si*
Institution : *IPB University*
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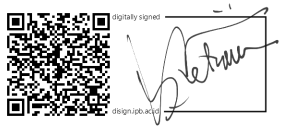
5	Name	: *Gilang Dwi Laksono, S.Hut., M.Si*
	Institution	: *IPB University*
	Address of institution	: *Department of Forest Products, Faculty of Forestry and Environment, IPB University, Kampus IPB Dramaga, Jl. Raya Dramaga, Bogor – Indonesia*
6	Name	: *Vera Indiraswari*
	Institution	: *IPB University*
	Address of institution	: *Department of Forest Products, Faculty of Forestry and Environment, IPB University, Kampus IPB Dramaga, Jl. Raya Dramaga, Bogor – Indonesia*

Bogor, 27 November 2024

Center for Environmental Research,
IPB University,
Director,



Dr. Yudi Setiawan, SP., M.Env.Sc

Principal Investigator,

Dr. Istie Sekartining Rahayu, S.Hut, M.Si

EXCECUTIVE SUMMARY

Carbon dots (C-dots) are zero-dimensional nanomaterials with excellent fluorescence and metal adsorption properties. In this study, carbon dots (C-dots) were synthesized from fast-growing wood sawdust waste using a hydrothermal method. The objective of this research is to characterize C-dots derived from fast-growing wood sawdust with the addition of a passivation agent using a hydrothermal method and to evaluate the efficacy of the synthesized C-dots as a sorbent for dyes and Pb, as well as a Pb detector in water. The synthesis of C-dots has been successfully demonstrated through the observation of blue fluorescence in solution. The optical properties testing yielded absorbance peaks within the ultraviolet wavelength range (200-400 nm), indicative of electron excitation within the chemical bond. The formation of C-dots is corroborated by the results of the FTIR test, which demonstrates the existence of functional groups on the surface of C-dots. The fluorescence spectrum exhibits the highest emission intensity value at a wavelength of 454 nm. Fast-growing wood sawdust-derived C-dots demonstrated efficacy in dye and Pb (II) metal adsorption, exhibiting high adsorption capacity for metal ions. This study revealed that the concentration of Pb metal and Cu metal in river water can be reduced by using C-dots. Different formulations exhibited varying degrees of effectiveness in Pb metal and Cu metal adsorption.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2023/2024

Final Report

Mapping Agricultural Practices and Predicted Contaminated Areas by Heavy Metals at the Surroundings Gold Mining in Nanggung District

1. Dyah Retno Panuju

2. Indri Hapsari Fitriyani

3. Sri Malahayati Yusuf

4. Awfa Septiyan

5. Nendah Istighfarini Azis

IPB University

Bogor Indonesia

Submitted to:

Environmental Research Center

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

November 2024

GENERAL INFORMATION

Title : Mapping Agricultural Practices and Predicted Contaminated Areas by Heavy Metals at the Surroundings Gold Mining in Nanggung District

Researchers:

1 Name : Dr. *Dyah Retno Panuju*
Institution : *Dept. of Soil Science and Land Resources, Bogor Agricultural University*
Address of institution : *Jl. Meranti Kampus IPB Dramaga, phone: +62-251-8629360, fax: +62-251-8629358*

2 Name : *Indri Hapsari Fitriyani, MSi*
Institution : *Dept. of Soil Science and Land Resources, Bogor Agricultural University*
Address of institution : *Jl. Meranti Kampus IPB Dramaga, phone: +62-251-8629360, fax: +62-251-8629358*

3 Name : *Dr. Sri Malahayati Yusuf*
Institution : *Dept. of Soil Science and Land Resources, Bogor Agricultural University*
Address of institution : *Jl. Meranti Kampus IPB Dramaga, phone: +62-251-8629360, fax: +62-251-8629358*

4 Name : *Awfa Septiyan*
Institution : *Study Program of Land Resources Management, Bogor Agricultural University*
Address of institution : *Jl. Meranti Kampus IPB Dramaga, phone: +62-251-8629360, fax: +62-251-8629358*

5 Name : *Nendah Istighfarini Azis*
Institution : *Study Program of Land Resources Management, Bogor Agricultural University*
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Bogor, November 2024

Environmental Research Center,
IPB University,
Director,

Dr. Yudi Setiawan, S.P., M.Env.Sc

Principal Investigator,

Dr. Dyah Retno Panuju

TABLE OF CONTENT

V. CONCLUSION

There were seven land units and four land capability classes in Bantarkaret and Cisarua. Predominant land use in Bantarkaret and Cisarua were paddy fields and upland. There are large forest areas In the Southern part of Bantarkaret, while settlements spread over two villages as small acreages. Cisarua Village has better land capability at class III dominated by Dystrudands, meanwhile the majority of land in Bantarkaret was categorized as class V with dominant soil type Undorthents. About 50% of both villages are recommended for agricultural activities.

Zone-1, the closest area to state-owned gold mining, has the highest soil acidity with a variability of pH as the highest among groups. Moreover, the highest C-organic content was found in the second buffer zone. Heavy metal content distributed variably at the research site with copper content higher than cadmium. Mercury content was identified at zone-2. The range of Cd and Cu considered as safe, nonetheless the mercury found on a site was far higher than the standard permissible content. The Shannon entropy in the mining area had the highest variability, while entropy in rice fields varied across zones and entropy of settlement was the least among land uses. PCA revealed that copper content was in association with organic carbon and clay. The higher organic carbon and clay content, the higher the possibility of copper in the mining area would likely be found. In addition, the cadmium was in association with stability index. The higher the stability index, the higher the possibility finds cadmium in the soil located in mining areas.

Spatial lag regression resulted in a quite reliable model to understand heavy metal contents and the properties of soil with coefficient of determinant at 0,78. Textures, water content, organic carbon, cadmium and neighborhood contributed positively to copper content. Whereas soil structure, bulk density and pores as well as soil acidity (pH) and phosphor contributed negatively to copper content.

Most village inhabitants are farmers with multiple livelihood activities. Some of Bantarkaret inhabitants are illegal miners, although many have returned to do farming. Six cropping patterns identified in Bantarkaret and Cisarua, i.e. 2x paddy, 3x paddy, 2x cassava, 2x sweet potato, and banana, however most preferred cropping differed between both villages. A suitability analysis should be performed to confirm and map land suitability of various plants cultivated by inhabitants.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2023/2024

Final Report

Product Development and Feasibility Testing of Microbial Fuel Cell (MFC) In Java to produce electricity, increasing rice production, and reducing carbon emission

Prof. Dr. Ir. Dwi Andreas Santosa, MS. (Biotech Center IPB);

Dr. Ir. Untung Sudadi, M.Sc. (Dept. Soil Science and Land Resources IPB);

Dr. Wilhelmus Terang Arga Sanjaya, S.Si, M.Si (Biotech Center IPB);

Hadi Wisa Nugraha, M. Si. (ICBB)

Submitted to:

Center for Environmental Research

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2024

General Information

Title : Product Development and Feasibility Testing of Microbial Fuel Cell (MFC) In Java to produce electricity, increasing rice production, and reducing carbon emission

Researchers:

1 Name : Prof. Dr. Ir. Dwi Andreas Santosa, MS
Institution : Biotech Center IPB
Address of institution : Jl. Kamper, Babakan, Dramaga, Bogor Regency, West Java 16680. Tel +628129639467; e-mail: biotech@apps.ipb.ac.id

2 Name : Dr. Ir. Untung Sudadi, M.Sc.
Institution : Departement of Soil Science and Land Resource
Address of institution : Jl. Kamper, Babakan, Dramaga, Bogor Regency, West Java 16680. Tel +628129639467; e-mail: biotech@apps.ipb.ac.id

3 Name : Dr. Wilhelmus Terang Arga Sanjaya, M.Si
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Address of institution : Jl. Kamper, Babakan, Dramaga, Bogor Regency, West Java 16680. Tel +628129639467; e-mail: biotech@apps.ipb.ac.id

3 Name : *Hadi Wisa Nugraha, M.Si*
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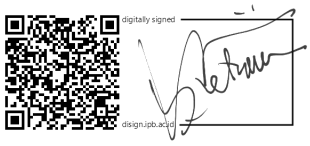
Address of institution : Komplek ICBB Jl. Cilubang Nagrak No 62, Situgede, West Bogor, Bogor, West Java. 16115. Tel. +622518423003; email: gm@icbb.or.id

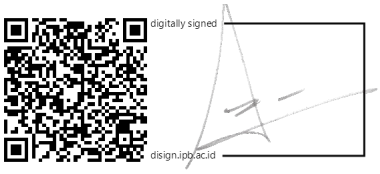
Bogor, 17 December 2024

Center for Environmental Research,
IPB University,
Director,



Dr. Yudi Setiawan, SP., M.Env.Sc

Principal Investigator,



Prof. Dr. Ir. Dwi Andreas Santosa, MS

EXECUTIVE SUMMARY

Indonesia's heavy reliance on fossil fuels to meet its electricity demand, accounting for 87% of national electricity needs in 2021, poses significant challenges as the population and economy continue to grow. This increasing demand is prompting the Indonesian government to implement strategic programs aimed at reducing dependence on fossil fuels, with a particular focus on the agricultural sector. Rice cultivation is a crucial part of the Indonesian economy, with a total paddy field area of 10.41 million hectares in 2022. However, rice production faces stagnation due to climate change, land degradation, pest infestations, and the decreasing effectiveness of synthetic fertilizers and pesticides. Additionally, the intensification of paddy field practices has led to increased methane emissions, and sustainable agricultural practices are proving to be economically unprofitable. To address these challenges, the concept of Microbial Fuel Cells (MFCs) has emerged as a promising solution. MFC technology provides a renewable and environmentally friendly energy source by harnessing organic materials in the cathode space, which microbes decompose to release electrons and generate electricity. While MFCs have the potential to contribute to energy generation, their relatively small electricity output requires further technological advancements to make them competitive with other energy sources. The IPB Research Team has made notable progress by developing MFC systems capable of generating electricity from paddy fields. Paddy fields, rich in organic matter and microbial activity, present a unique opportunity for harnessing microbial-generated electricity. Over the course of five years, the IPB Research Team successfully developed a tool for generating electricity from paddy fields, resulting in multiple publications and patents. In November 2021, the team received a patent for the world's first MFC device specifically designed for this purpose. This invention was also recognized as one of Indonesia's 113 most innovative achievements in 2021. The application of Plant Microbial Fuel Cells (PMFCs) in rice fields provides an opportunity to integrate renewable energy technologies with agricultural practices, potentially improving both energy generation and agricultural productivity. Key to the success of PMFCs is the role of microbial communities in the soil, which play a vital part in nutrient cycling and ecosystem stability. Aquatic plants, such as *Pistia stratiotes*, have been shown to significantly impact microbial dynamics in paddy fields, promoting the proliferation of beneficial microorganisms. These plants also help mitigate environmental contaminants, such as heavy metals and pesticide residues, which are common in agricultural settings. As research continues, optimizing PMFC technology and understanding the complex interactions within rice field ecosystems will be crucial for advancing sustainable energy generation and improving agricultural outcomes.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2023/2024

Final Report

Spatial Analysis of Greenhouse Gas Emissions towards Low-Carbon City Development in Jakarta Province

1. Luisa Febrina Amalo

Center for Environmental Research, IPB University

2. Pungki Ari Wibowo

Center for Environmental Research, IPB University

3. Prita Ayu Permatasari

Center for Environmental Research, IPB University

Submitted to:

Center for Environmental Research

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2024

General Information

	Title	:	Spatial Analysis of Greenhouse Gas Emissions towards Low Carbon City Development in Jakarta Province
	Researchers	:	
1	**Name**	:	Luisa Febrina Amalo, S.Si., M.Si
	Institution	:	Center for Environmental Research, IPB University
	Address of institution	:	Jl. Lingkar Kampus, Kampus IPB Dramaga, Bogor 16680
2	**Name**	:	Pungki Ari Wibowo, S.Si., M.PWK
	Institution	:	Center for Environmental Research, IPB University
	Address of institution	:	Jl. Lingkar Kampus, Kampus IPB Dramaga, Bogor 16680
3	**Name**	:	Prita Ayu Permatasari, SP., M.Si
	Institution	:	Center for Environmental Research, IPB University
	Address of institution	:	Jl. Lingkar Kampus, Kampus IPB Dramaga, Bogor 16680

Bogor, 27 November 2024

Center for Environmental Research,
IPB University,
Director,

Dr. Yudi Setiawan, SP., M.Env.Sc

Principal Investigator,

Luisa Febrina Amalo, S.Si., M.Si

VI. Conclusion

The conclusions of this study are as follows:

1. The greenhouse gas (GHG) emission intensity of Jakarta Province (Direct Emission) in 2010, 2014, 2018, and 2022 amounted to 20,769 thousand tons CO2eq, 24,657 thousand tons CO2eq, 30,725 thousand tons CO2eq, and 29,266 thousand tons CO2eq, respectively. The five main contributors to GHG emissions are (1) the transportation sector, (2) power generation, (3) manufacturing industries, (4) solid waste in landfills, and (5) residential areas. In terms of spatial distribution, the highest GHG emissions were recorded in North Jakarta, followed by East Jakarta, South Jakarta, West Jakarta, and Central Jakarta. The land-use types contributing the most to emissions include coal-fired power plants, roads, and residential and activity areas.
2. Alternative spatial planning policies to reduce GHG emissions and achieve a low-carbon, climate-resilient city in Jakarta Province are generally formulated through two approaches: (1) converting high-emission spaces into low-emission spaces and (2) improving the efficiency of high-emission space utilization. The spatial planning of Jakarta Province is divided into four zones: (1) protection areas, (2) strict control areas, (3) moderate control areas, and (4) reduction areas.

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	**:**	OPTIMIZING ENERGY OF RETROFITTED MILLING THROUGH INVESTIGATING OF BACKLASH CHARACTERISTIC
	Ketua Penyelidik ***Project Leader***	**:**	DR NOOR HISYAM BIN NOOR MOHAMED
	Fakulti/Institut ***Faculty/Institute***	**:**	ENGINEERING
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	PROF. DR ABDULLAH YASSIN DR ABANG MOHAMMAD NIZAM ABANG KAMARUDDIN
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	1 JAN 2024
	Tempoh Projek ***Project Duration***	**:**	12 BULAN
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM10,000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 9,430.30

C. Pencapaian Keseluruhan
Overall Achievement
Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki..
Describe the achievements in relation to the original objectives, hypothesis and research problems.

This study investigates the amount of backlash due to feed rate and cutting speed, and to compare the amount of backlash produced by different types of workpiece samples (UHMWPE, carbon steel, Aluminum) by milling process using the retrofitted milling machine.

Cutting speed effect to backlash quantity resulted that the backlash decreases as the cutting speed (50-850 mm/min) increases for both UHMWPE and carbon steel samples. Meanwhile, the feed rate effect (150-300 mm/min) resulted an increase of the backlash amount as the feed rate was increased for both UHMWPE and carbon steel.

The findings also emphasize the that backlash during milling is significantly influenced by the material properties of the workpiece. Factors such as density, stiffness, self-lubricating characteristics, and deformation behavior play a crucial role in determining the extent of backlash. Recognizing how these properties affect backlash is essential for optimizing milling parameters and achieving high precision and quality in machined components.

D. Pencapaian Utama
Key Findings

Backlash in coupling components of machine tools is a key factor contributing to premature wear and reduced operational lifespan. This study investigates the backlash characteristics of ultra-high molecular weight polyethylene (UHMWPE), carbon steel, and aluminum under varying cutting speeds and feed rates. The results underscore the significance of monitoring backlash as a means to assess component degradation, optimize machinability, extend tool life, and enhance the overall energy efficiency of the machining process.

E, Hasil Penyelidikan
Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	
√	Kertas persidangan antarabangsa *International conference papers*	1
	Makalah dalam jurnal tempatan *Local journal papers*	
	Makalah dalam jurnal antarabangsa *International journal papers*	
	Monograf atau buku	

	Book/monograph	

Lain-lain/*others* (sila nyatakan/*please specify*)

This study has been presented at Engineering Conference (ENCON 2024) 14-16 February 2024 and the findings are under process for possible publication opportunity.

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

F. Pengecaman Output
Output Identification

Sila tandakan penerangan yang berkaitan pada senarai berikut:
Please tick the relevant description as given below:

	Suatu sumbangan besar kepada bidang ilmu yang berkaitan *A major contribution to knowledge (new knowledge) in the respective discipline*
	Suatu sumbangan kecil tetapi bermakna kepada bidang ilmu yang berkaitan *A minor but important contribution to knowledge in the respective discipline*
	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*
√	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*
	Suatu sumbangan besar kepada kerangka polisi pengurusan/garis panduan *A major contribution to management policy framework/guidelines (in relevant areas)*
	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
	Suatu bahan yang baik/sesuai untuk hebahan atau pameran *A good/suitable material for showcasing/publicizing/exhibition*

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

(Beri huraian ringkas yang tidak melebihi 400 perkataan dan dalam bahasa yang mudah, bagi maksud hebahan hasil penyelidikan ini melalui media massa dan 'Unimas Research Update')
(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

Backlash in the coupling components of machine tools is a critical factor contributing to accelerated wear and a reduction in machine lifespan. This research explores the behavior of backlash in relation to cutting parameters, offering insights into how material properties and process settings impact performance, durability and energy efficiency of machine in general.

The study focuses on ultra-high molecular weight polyethylene (UHMWPE), carbon steel, and aluminum workpieces, assessed through a series of milling experiments using a retrofitted CNC milling machine. By analyzing the effects of varying cutting speeds (50–850 mm/min) and feed rates (150–300 mm/min), the research quantifies the amount of backlash generated during the milling process.

Key findings reveal that increasing cutting speed leads to a noticeable decrease in backlash for both UHMWPE and carbon steel samples. In contrast, increasing feed rate results in greater backlash in the same materials. These trends underline the importance of carefully balancing process parameters to mitigate backlash and its associated mechanical stresses.

Moreover, the study highlights that backlash is strongly influenced by the intrinsic material properties of the workpiece—such as density, stiffness, self-lubrication, and deformation behavior. Understanding these relationships is vital for optimizing machining parameters, enhancing tool life, improving surface finish, and ultimately achieving greater energy efficiency in manufacturing. This work contributes to the broader goal of advancing precision machining through data-driven insights into material and process interactions.

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:
- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

Researchers are required to submit to the Research Centre:
- *This form in both hard- and soft-copies*

16 APRIL 2025

…….	……
Tandatangan (Penyelidik Utama) Signature (Principal Researcher)	**Tarikh** Date

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	:	OPTIMAL DESIGN OF MEMBRANE CRYOGENIC DISTILLATION PROCESS FOR NITROGEN REJECTION UNIT
	Ketua Penyelidik ***Project Leader***	:	DR NORFAMILA CHE MAT
	Fakulti/Institut ***Faculty/Institute***	:	DEPARTMENT OF CHEMICAL ENGINEERING AND ENERGY SUSTAINABILITY, FACULTY OF ENGINEERING
	Ahli Kumpulan Penyelidik ***Research Team Members***	:	DR NORFAMILA CHE MAT TS SHERENA SAR-EE
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	:	26TH OCTOBER 2023
	Tempoh Projek ***Project Duration***	:	1 TAHUN
	Peruntukan Yg. Diluluskan ***Budget Approved***	:	RM 10,000
	Perbelanjaan Terkini ***Expenditure To-Date***	:	RM 1,038

C. Pencapaian Keseluruhan
Overall Achievement
Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki..
Describe the achievements in relation to the original objectives, hypothesis and research problems.

The project aimed to address key challenges in natural gas processing by developing a novel hybrid process design for handling high nitrogen content. Our approach integrated membrane separation technology as a pre-separation step with conventional cryogenic distillation, hypothesizing that this combination would reduce energy requirements and processing costs while offering a smaller footprint compared to conventional cryogenic distillation process.

We began by developing descriptive analytics models to understand the operational characteristics of conventional cryogenic distillation in nitrogen removal. This foundational analysis established performance baselines and documented process behaviors, helping us identify critical parameters for meeting pipeline specifications prior to implementing the membrane separation process. During the first half of 2024, we enhanced the conventional nitrogen rejection unit (NRU) by implementing a vapor recuperative heat pump system and designing refrigeration loop that combined CO_2 refrigeration with an N_2-C_3H_8 process. This enhancement improved energy efficiency compared to the standard C_3MR refrigeration process while reducing cooling energy requirements and carbon footprint. To validate system reliability, we developed a predictive model that evaluated the cryogenic NRU's performance under varying nitrogen feed concentrations. Our testing confirmed consistent achievement of pipeline nitrogen specifications across diverse nitrogen feed concentration and natural gas feed flow rate.

In the second half of 2024, we advanced to developing a first-principles mathematical model for gas permeation and successfully integrated it with conventional cryogenic distillation to create a hybrid membrane-cryogenic process. We automated the process analysis by interfacing commercial membrane simulators with Python programming, enabling efficient parameter optimization. Given the challenge of high computational time associated with multi objective optimization, we developed a surrogate model to emulate the process behavior. Through this surrogate-based multi objective optimization, we demonstrated that our hybrid process could achieve pipeline nitrogen specifications while requiring less energy and lower gas processing costs compared to conventional cryogenic NRU processes.

-

D. Pencapaian Utama
Key Findings

1. **Hybrid Process Design:**
   A novel hybrid process design was developed by integrating membrane separation technology as a pre-separation step with conventional cryogenic distillation. This combination demonstrated reduced energy requirements, lower processing costs, and a smaller footprint compared to the conventional cryogenic distillation process.

2. **Descriptive Analytics and Baseline Performance:**
   Descriptive analytics models were created to understand the operational characteristics of conventional cryogenic distillation for nitrogen removal. These models identified critical parameters required to meet pipeline specifications and established performance baselines prior to implementing the membrane separation process.

3. **Enhanced Conventional NRU:**

- A vapor recuperative heat pump system and a refrigeration loop combining CO_2 refrigeration with an N_2-C_3H_8 process were designed for the conventional nitrogen rejection unit (NRU).
- These enhancements significantly improved energy efficiency, reduced cooling energy requirements, and lowered the carbon footprint compared to the standard C_3MR refrigeration process.

4. **Predictive Model Development:**
   A predictive model was developed to assess the cryogenic NRU's performance under varying nitrogen feed concentrations and natural gas flow rates. Testing confirmed consistent achievement of pipeline nitrogen specifications across diverse operating conditions.
5. **First-Principles Mathematical Model and Automation:**
   A first-principles mathematical model for gas permeation was developed and integrated with conventional cryogenic distillation to create the hybrid membrane-cryogenic process. Automation of process analysis was achieved by interfacing commercial membrane simulators with Python programming, enabling efficient parameter optimization.
6. **Surrogate Model for Optimization:**
   To address high computational costs associated with multi-objective optimization, a surrogate model was developed to emulate process behavior. This surrogate-based optimization demonstrated that the hybrid process could meet pipeline nitrogen specifications while achieving lower energy consumption and reduced gas processing costs compared to the conventional cryogenic NRU process such as Pressure Swing Adsorption.

E, Hasil Penyelidikan
Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	1
	Kertas persidangan antarabangsa *International conference papers*	

	Makalah dalam jurnal tempatan *Local journal papers*	
	Makalah dalam jurnal antarabangsa *International journal papers*	
	Monograf atau buku *Book/monograph*	

Lain-lain/*others* (sila nyatakan/*please specify*)

- A book chapter on methods for predicting the performance of the conventional cryogenic distillation process in handling large variations in nitrogen content in natural gas was submitted for the UNIMAS Faculty of Engineering Undergraduate Research Book Project in August 2024
- An extended abstract on the new superlearner Machine Learning Model to predict the performance of the hybrid membrane NRU process and its multiobjective optimization with comparison to conventional Pressure Swing Adsorption (PSA) was submitted on 7th February 2025 to the 4th Energy Security & Chemical Engineering Congress (ESChE 2025), taking place August 12-14, 2025. A notification of acceptance is expected by April 15, 2025 (tentative date). This conference proceedings will be Scopus-indexed
-

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

F. Pengecaman Output
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	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*
✓	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*
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	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
	Suatu bahan yang baik/sesuai untuk hebahan atau pameran

	A good/suitable material for showcasing/publicizing/exhibition

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

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(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

High nitrogen content in natural gas significantly diminishes its quality and market value. While conventional cryogenic distillation remains the industry standard for nitrogen removal, its substantial energy consumption and operational costs pose increasing challenges. This is particularly relevant in today's environmentally conscious market and volatile natural gas pricing environment. Our approach integrates advanced membrane gas separation technology with traditional cryogenic systems, proposing a conceptual hybrid solution that aims to reduce both carbon footprint and energy requirements.

The conceptual process design proposed in this project explores nitrogen removal efficiency while maximizing natural gas quality through systematic parameter optimization. Specifically, by reducing the load on conventional cryogenic columns, this system has the potential to achieve substantial cost savings and enhanced energy efficiency without compromising output quality. Through detailed modelling and optimization studies, we're developing a framework that could enable gas producers to adapt swiftly to market demands, anticipate operational challenges, and deliver pipeline quality natural gas with improved sustainability metrics.

Our research aims to provide natural gas producers with valuable insights into this hybrid technology concept, offering potential pathways toward reduced emissions, lower processing costs, and superior product quality. This development represents a promising direction in smart, sustainable gas processing technology, supporting operators in meeting future industry demands

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:
- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

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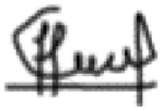
- *This form in both hard- and soft-copies*



10 April 2025

…….. ……

Tandatangan (Penyelidik Utama) **Tarikh**

Signature (Principal Researcher) Date

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	:	Socio-Environmental Impact of Small Hydropower on Sarawak's Rural Livelihoods: Insights from Japan's Experience
	Ketua Penyelidik ***Project Leader***	:	Ir Ts Dr Then Yi Lung
	Fakulti/Institut ***Faculty/Institute***	:	Fakulty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	:	Ir Dr Abadi bin Chanik @ Azhar Ir Dr Hazrul bin Mohamed Basri Profesor Ts. Dr. Wan Azlan bin Wan Zainal Abidin
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	:	1 Jan 2024
	Tempoh Projek ***Project Duration***	:	12 months
	Peruntukan Yg. Diluluskan ***Budget Approved***	:	RM10,000
	Perbelanjaan Terkini ***Expenditure To-Date***	:	RM8684.45

C. Pencapaian Keseluruhan
Overall Achievement

Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki..
Describe the achievements in relation to the original objectives, hypothesis and research problems.

The research achieved its objective of assessing socioeconomic changes by demonstrating significant improvements in income levels, occupational diversity, and access to technology in

Kampung Assum and Kampung Parang after the installation of Small Hydropower Projects (SHP). Both villages showed enhanced living standards, reflected in quality of life indices of 1.1 for Kampung Assum and 1.05 for Kampung Parang, based on the Ohito community index. The objective of evaluating environmental implications was partially achieved by identifying changes in river management practices and potential ecosystem impacts in the study areas, although further research is needed for a more detailed analysis. The objective of leveraging Japan's experience in small hydropower development was met by adapting lessons and models, such as the Ohito community index, to assess and improve project outcomes in Sarawak, demonstrating the relevance of international expertise. The hypothesis that SHP implementation has both short-term and long-term socioeconomic effects was validated through observed improvements in income, job opportunities, and quality of life. The hypothesis that SHP projects have environmental implications was supported by preliminary findings on river management and ecosystem changes, though these need further investigation for a comprehensive understanding. The hypothesis that Japan's small hydropower experience can inform effective implementation in Sarawak was confirmed, as the study demonstrated how Japan's models and tools could be adapted to enhance project sustainability and impact in rural areas. The research question on the socioeconomic impacts of SHP projects was answered by identifying clear improvements in livelihoods, including better income distribution, enhanced job structures, and increased access to information technology. The question on the environmental implications of SHP projects was partially answered, with initial findings on river management and ecosystem adjustments highlighting areas for future study. The question on how Japan's experience informs Sarawak's SHP projects was addressed by showcasing the applicability of Japan's innovative approaches, such as rural community indices, to Sarawak's local context, ensuring effective implementation and sustainable outcomes.

D. Pencapaian Utama
Key Findings

The key findings of the study include significant improvements in income levels, occupational patterns, and access to information and communication technology in Kampung Assum and Kampung Parang following the installation of Small Hydropower Projects (SHP). The quality of life indices for Kampung Assum and Kampung Parang were measured at 1.1 and 1.05, respectively, using the Ohito community index from Japan, indicating a positive impact of electrification on rural development. Electrification reduced workloads and enhanced living standards, with increased adoption of modern appliances and improved access to services and opportunities. Environmental changes were observed in river management practices and ecosystem dynamics, suggesting both opportunities and challenges in maintaining sustainability. The application of Japan's small hydropower experiences provided valuable insights into the implementation, sustainability, and effectiveness of SHP projects in Sarawak, demonstrating the adaptability of international best practices to local contexts.

E, Hasil Penyelidikan
Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	

	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	
	Kertas persidangan antarabangsa *International conference papers*	1
	Makalah dalam jurnal tempatan *Local journal papers*	
	Makalah dalam jurnal antarabangsa *International journal papers*	
	Monograf atau buku *Book/monograph*	

Lain-lain/*others* (sila nyatakan/*please specify*)

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

Then, Y.L., Law, H.Y.H. & Chanik, A.A., 2025. Socioeconomic Impact of Small Hydropower on Rural Livelihoods in Sarawak: Insights From Japan's Experience. 2024 IEEE 22nd Student Conference on Research and Development (SCOReD), 19-20 December, pp. 95–99. (In press)

F. Pengecaman Output
Output Identification

Sila tandakan penerangan yang berkaitan pada senarai berikut:
Please tick the relevant description as given below:

/	Suatu sumbangan besar kepada bidang ilmu yang berkaitan *A major contribution to knowledge (new knowledge) in the respective discipline*
	Suatu sumbangan kecil tetapi bermakna kepada bidang ilmu yang berkaitan *A minor but important contribution to knowledge in the respective discipline*
	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*

	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*
/	Suatu sumbangan besar kepada kerangka polisi pengurusan/garis panduan *A major contribution to management policy framework/guidelines (in relevant areas)*
	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
/	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
	Suatu bahan yang baik/sesuai untuk hebahan atau pameran *A good/suitable material for showcasing/publicizing/exhibition*

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

(Beri huraian ringkas yang tidak melebihi 400 perkataan dan dalam bahasa yang mudah, bagi maksud hebahan hasil penyelidikan ini melalui media massa dan 'Unimas Research Update')
(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

Researchers from Universiti Malaysia Sarawak (UNIMAS) have conducted an insightful study on the socioeconomic impact of Small Hydropower Projects (SHP) on rural communities in Sarawak, drawing lessons from Japan's successful experience in small hydropower development. The study focused on two villages, Kampung Assum and Kampung Parang, and explored how electrification has transformed local livelihoods. Researchers found notable improvements in income levels, job opportunities, and the adoption of modern technologies like lighting and electrical appliances. These changes have not only enhanced the quality of life but also reduced workloads, making daily life more manageable for residents. Using the Ohito community index, a tool developed in Japan to assess the living standards of small communities, the researchers evaluated the quality of life in both villages. Kampung Assum scored 1.1, slightly higher than Kampung Parang's 1.05, highlighting the positive but varied impacts of small hydropower initiatives. The findings also revealed how access to electricity opens doors to better education, communication, and business opportunities, fostering overall community development. While the study primarily focused on socioeconomic outcomes, it also acknowledged environmental implications, such as changes in river management and ecosystem dynamics, emphasizing the need for careful planning to balance development and sustainability. By incorporating Japan's expertise in small hydropower, the research showcases how international best practices can be adapted to local contexts to improve project effectiveness and sustainability. These insights can guide future rural electrification projects, ensuring that they bring long-term benefits to underserved communities. The study underscores the transformative power of clean, renewable energy in bridging development gaps in rural areas. It also highlights the importance of

international collaboration and knowledge-sharing in addressing global challenges like energy access and sustainability. This research, presented at the 2024 IEEE Student Conference on Research and Development (SCOReD), reflects UNIMAS' commitment to advancing sustainable solutions for rural development in Sarawak. It provides valuable recommendations for policymakers, development practitioners, and communities seeking to harness the potential of small hydropower to improve livelihoods and foster inclusive growth.

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:

- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

Researchers are required to submit to the Research Centre:

- *This form in both hard- and soft-copies*

16 January 2025

……. …….

Tandatangan (Penyelidik Utama)
Signature (Principal Researcher)

Tarikh
Date

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	**:**	Electrocoagulation Treatment of Palm Oil Mill Effluent (POME) Discharged as a Recycle Feed Water for Palm Oil Mill Boiler
	Ketua Penyelidik ***Project Leader***	**:**	Dr Nazeri Abdul Rahman
	Fakulti/Institut ***Faculty/Institute***	**:**	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	1. Professor Ir Dr Siti Noor Linda bt Taib 2. Professor Ir Dr Abdullah bin Hj Yassin 3. Dr Dayang Salyani binti Abang Mahmood 4. Ms Allene Albania Linus 5. Mr Calvin Jose Jol 6. Mr Chieng Kwong Ming
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	1 January 2024 – 31 March 2025
	Tempoh Projek ***Project Duration***	**:**	15 months (1 year and 3 months)
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM 10,000
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 3,800

C. Pencapaian Keseluruhan
Overall Achievement
Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki..
Describe the achievements in relation to the original objectives, hypothesis and research problems.

The research project entitled "Electrocoagulation Treatment of Palm Oil Mill Effluent (POME) Discharged as a Recycle Feed Water for Palm Oil Mill Boiler" was conducted to evaluate the feasibility of using electrocoagulation system for the treatment of treated palm oil mill effluent discharged as feedwater for the palm oil mill boiler. Correspondingly, the research addressed three main objectives, particularly (1) experimental application of electrocoagulation system, (2) modelling of the treatment process, and (3) economic evaluation.

1. **Objective 1: Treatment of Palm Oil Mill Effluent (POME) Discharged by using Electrocoagulation System with Aluminium Electrodes**
   This objective was achieved by conducting laboratory-scale electrocoagulation experiments by utilizing aluminium electrodes in a monopolar parallel configuration. The study investigated the effects of varying operational parameters, particularly electric current, electrode spacing, and treatment time. In this study, the optimal condition for electrocoagulation system for the treatment of POME discharge was achieved at 5 A of electric current, 1.0 cm of electrode spacing, and 40 minutes of treatment. Additionally, the electrocoagulation treatment system could remove 98.60% of colour, 95.00% of turbidity, 93.33% of COD, 91.67% of TSS, and 73.26% of TDS from treated POME. Although the treated TDS value remained above the Bau Palm Oil Mill Boiler Water Standard of less than 100 mg/L, the significant reduction highlights electrocoagulation system potential as a pre-treatment process which is valuable for rural palm oil mill where access to advanced water treatment infrastructure being limited.

2. **Objective 2: Formulation of Kinetic and Statistical Models for the Treatment of POME Discharged as Feed Water for Boiler Using Electrocoagulation.**
   The electrocoagulation treatment of treated POME from Bau Palm Oil Mill was modelled using the Langmuir isotherm and pseudo-second order kinetics with R^2 values of 0.975 and 0.99, respectively. Additionally, the response surface methodology (RSM) and ANOVA confirmed that electric current, electrode spacing, and treatment time as significant parameters with optimal conditions at 5 A, 1.0 cm electrode spacing, and 40 minutes. These models demonstrated strong predictive accuracy (R^2 = 0.96) which enables efficient process optimization and providing a solid database for real-world application and scale up in palm oil mill wastewater treatment.

3. **Objective 3: Economic Evaluation of the Electrocoagulation Treatment to treat Treated POME as feed water for palm oil mill boiler.**
   The electrocoagulation system demonstrated a cost-effective solution with an operational cost of RM 7.54/m^3, based on aluminium consumption of 0.019 kg/m^3 and energy consumption of 1.62 kWh/m^3. This is notably lower than conventional chemical coagulation (RM 7.82/m^3). The 73% reduction in TDS, although above the palm oil mill boiler standard, indicates substantial water quality improvement. As such, the integration of post-treatment processes could enable full compliance which subsequently makes electrocoagulation a practical and affordable option for sustainable wastewater reuse in rural Sarawak palm oil mills.

Overall, the study partially validated the hypothesis that electrocoagulation could treat POME to meet boiler feedwater standards. While full compliance with TDS requirement was not achieved, the treatment resulted in notable improvements in water quality and demonstrated significant cost advantages. The findings directly address the core research problem of limited access to affordable and efficient wastewater treatment technologies within the palm oil industry.

D. Pencapaian Utama
Key Findings

1. **High Contaminant Removal Efficiency**
   The electrocoagulation treatment system demonstrated high removal efficiencies by achieving 98.60% for colour, 95.00% for turbidity, 91.67% for total suspended solids (TSS), and 93.33% for chemical oxygen demand (COD).

2. **Identification of Optimal Operating Condition for Electrocoagulation System**
   The optimal operating conditions were identified at an electric current of 5 A, 1.0 cm of electrode spacing, and 40 minutes of treatment time.

3. **Cost-Effective Operation**
   The economic analysis revealed that the electrocoagulation system incurred a lower operational cost (RM 7.54/m^3) compared to conventional chemical coagulation (RM 7.82/m^3), due to the absence of chemical additives and efficient coagulant generation through aluminium electrodes.

4. **Boiler Feedwater Standards Achieved**
   The treated POME successfully met boiler feedwater standards for several parameters, specifically colour, turbidity, TSS, and COD.

5. **Practical for Rural Deployment**
   The electrocoagulation system featured simple fabrication, low maintenance requirements, and minimal operational complexity which makes it suitable for deployment in Sarawak rural areas.

E, Hasil Penyelidikan
Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	
✓	Kertas persidangan antarabangsa *International conference papers*	**2**
	Makalah dalam jurnal tempatan *Local journal papers*	
	Makalah dalam jurnal antarabangsa *International journal papers*	

	Monograf atau buku *Book/monograph*	

Lain-lain/*others* (sila nyatakan/*please specify*)

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

1. Abdul Rahman, N., Jose Jol, C., Albania Linus, A., Parabi, A., Jose Jol, E., Kwong Ming, C., Parabi, A.S.L., James, A., Shamsol, N.S., John, S.B., Jitai, A.A., Abang Abdul Hamid, D.F.A. (2024f). Electrocoagulation Treatment of Treated Palm Oil Mill Effluent Discharged as Feed Water for Palm Oil Mill Boiler. In: International Conference on Advanced Science, Engineering, and Technology (INCASET 2024), 21st December 2024, Bayou Lagoon Park Resort, Melaka, Malaysia

2. Abdul Rahman, N., Albania Linus, A., Jose Jol, C., James, A.B., Jose Jol, E., Parabi, A.S.L., Shamsol, N.S., John, S.B. (2024g). Treatment of Sago Mill Effluent (SME) in Sarawak by Batch Electrocoagulation System. In: International Conference on Advanced Science, Engineering, and Technology (INCASET 2024), 21st December 2024, Bayou Lagoon Park Resort, Melaka, Malaysia

F. Pengecaman Output
Output Identification

Sila tandakan penerangan yang berkaitan pada senarai berikut:
Please tick the relevant description as given below:

	Suatu sumbangan besar kepada bidang ilmu yang berkaitan *A major contribution to knowledge (new knowledge) in the respective discipline*
✓	Suatu sumbangan kecil tetapi bermakna kepada bidang ilmu yang berkaitan *A minor but important contribution to knowledge in the respective discipline*
	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
✓	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*
✓	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*
	Suatu sumbangan besar kepada kerangka polisi pengurusan/garis panduan *A major contribution to management policy framework/guidelines (in relevant areas)*
✓	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
✓	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
✓	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
✓	Suatu bahan yang baik/sesuai untuk hebahan atau pameran *A good/suitable material for showcasing/publicizing/exhibition*

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

(Beri huraian ringkas yang tidak melebihi 400 perkataan dan dalam bahasa yang mudah, bagi maksud hebahan hasil penyelidikan ini melalui media massa dan 'Unimas Research Update')
(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

A recent research initiative by Universiti Malaysia Sarawak (UNIMAS), through its Electrocoagulation Research Group, has pioneered a breakthrough in sustainable wastewater treatment by introducing electrocoagulation treatment system for palm oil mill effluent (POME) wastewater recovery. This initiative offers a practical solution for the palm oil industry to reuse wastewater efficiently and cost-effectively, while reducing environmental impact and conserving freshwater resources. POME is a liquid waste generated during palm oil processing. It contains high levels of suspended solids, colour, and organic pollutants, which makes it unsuitable for water reuse without proper treatment. Conventional methods such as reverse osmosis are often too costly and impractical for small or rural mills. As such, the UNIMAS Electrocoagulation Research Group conducted this study using treated POME from Bau Palm Oil Mill in Sarawak to evaluate electrocoagulation system as a feasible alternative for boiler reuse application. The electrocoagulation treatment system utilizes direct current power supply to aluminium plate electrodes in order to produce in-situ aluminium hydroxide coagulants that effectively remove contaminants from wastewater. Additionally, the treatment system effectively removed more than 98% of colour, 95% of turbidity, 91% of total suspended solids (TSS), and 93% of chemical oxygen demand (COD) from the treated POME at an optimal setting of 5 A, 1 cm of electrode spacing, and 40 minutes of treatment time. Although the treated water met most boiler feedwater standards, the total dissolved solids (TDS) remained slightly above the required limit. A post-treatment system such as advanced filtration may be necessary to ensure full compliance. Despite this issue, the electrocoagulation system demonstrated a lower operational cost of RM 7.54 per cubic meter compared to traditional chemical treatments. Besides, the electrocoagulation treatment system is well-suited for deployment in Sarawak rural areas with limited infrastructure due to its simple design, easy to operation, and requires low maintenance. As such, this project supports Malaysia's national agenda for sustainable industrial practices and underscores the commitment of UNIMAS to address real-world environmental challenges through research-driven innovation.

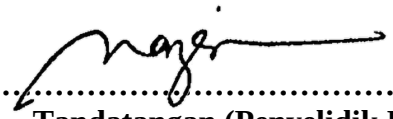
Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:

- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

Researchers are required to submit to the Research Centre:

- *This form in both hard- and soft-copies*



…….

Tandatangan (Penyelidik Utama)
Signature (Principal Researcher)

5 May 2025

……

Tarikh
Date

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	**:**	**Energy and Performance Evaluation of Congestion-Aware Routing Mechanism for Wireless Network-on-Chip**
	Ketua Penyelidik ***Project Leader***	**:**	Asrani Lit
	Fakulti/Institut ***Faculty/Institute***	**:**	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	Shamsiah Suhaili Nazreen Junaidi Shirley Rufus
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	27 October 2023
	Tempoh Projek ***Project Duration***	**:**	1 Year (1 January 2024 – 31 December 2024)
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM 10, 000
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 6, 599
C.	**Pencapaian Keseluruhan** ***Overall Achievement*** Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki.. *Describe the achievements in relation to the original objectives, hypothesis and research problems.*		

The overall performance has been successfully achieved in alignment with the objectives, formulated hypotheses, and identified research problems. Thr outcomes addressed the aims of the study, validate the proposed hypotheses, and provide insights into the research challenges which has been validated by the experimental work.

D. Pencapaian Utama
Key Findings

The primary aim of this investigation was to conduct a comprehensive evaluation of multicore system performance in the specific context of NoC and WiNoC architectures, both implemented within a 64-core mesh network. This evaluation encompassed the analysis of their behavior under varying synthetic traffic scenarios, including random, shuffle, butterfly, and transpose traffic patterns. The conclusion drawn from the simulation results is that the WiNoC architecture provides better performance, characterized by enhanced capabilities at higher PIR saturation loads, improved network throughput, and minimized latencies.

E, Hasil Penyelidikan
Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	
/	Kertas persidangan antarabangsa *International conference papers*	1
	Makalah dalam jurnal tempatan *Local journal papers*	
/	Makalah dalam jurnal antarabangsa *International journal papers*	1
	Monograf atau buku *Book/monograph*	

Lain-lain/*others* (sila nyatakan/*please specify*)

-

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

Lit A., Suhaili S., Junaidi N., Rufus S. and Hashim N.I. (2024). Performance Analysis of Distance-Based Wireless Transceiver Placement for Wireless NoCs with Deterministic Routing. ECTI Transactions on Electrical Engineering, Electronics, and Communications, 22(2), 1.

Lit A., Junaidi N., Suhaili S., Rufus S., Ramlee N.A. and Mahyan F. (2024). Evaluating NoC and WiNoC Architectures for Multicore Architecture Performance. 2024 International Conference on Green Energy, Computing and Sustainable Technology, GECOST 2024, 1(1), 235-239.

F. Pengecaman Output
Output Identification

Sila tandakan penerangan yang berkaitan pada senarai berikut:
Please tick the relevant description as given below:

	Suatu sumbangan besar kepada bidang ilmu yang berkaitan *A major contribution to knowledge (new knowledge) in the respective discipline*
	Suatu sumbangan kecil tetapi bermakna kepada bidang ilmu yang berkaitan *A minor but important contribution to knowledge in the respective discipline*
	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
/	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*
	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*
	Suatu sumbangan besar kepada kerangka polisi pengurusan/garis panduan *A major contribution to management policy framework/guidelines (in relevant areas)*
	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
	Suatu bahan yang baik/sesuai untuk hebahan atau pameran *A good/suitable material for showcasing/publicizing/exhibition*

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

-

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

(Beri huraian ringkas yang tidak melebihi 400 perkataan dan dalam bahasa yang mudah, bagi maksud hebahan hasil penyelidikan ini melalui media massa dan 'Unimas Research Update')
(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

To mitigate potential scalability challenges in future many-core architectures' on-chip communication systems, the wireless Network-on-Chip (WiNoC) design concept has arisen as a compelling choice. It offers a viable approach to address these issues effectively. This paper delves into an extensive analysis of the performance evaluation concerning Network-on-Chip (NoC) and Wireless Network-on-Chip (WiNoC) configurations within the framework of a 64-core multicore system. The study encompasses a thorough evaluation across four synthetic traffic profiles, namely random, shuffle, butterfly, and transpose traffic distributions, offering a comprehensive understanding of their impact on system performance.This evaluation involved a thorough analysis of data transmission latency, the efficiency of network data throughput, and the amount of energy consumed. In order to substantiate our conclusions, we conducted simulations encompassing the 64-core mesh-based NoC and WiNoC architectures. These simulations were executed utilizing the Noxim simulator, a well-recognized tool acclaimed for its capacity to provide cycle-accurate simulations. Analyzing the simulation outcomes, it becomes evident that the 64-core WiNoC architecture performs better in terms of network performance. This is evident from its ability to handle heavier workloads and achieve lower delays in all traffic situations, when compared to the 64-core NoC architecture.

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:
- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

Researchers are required to submit to the Research Centre:
- *This form in both hard- and soft-copies*

January 14, 2025

…….	……
Tandatangan (Penyelidik Utama) Signature (Principal Researcher)	**Tarikh** Date

RINGKASAN LAPORAN AKHIR
GERAN PENYELIDIKAN OSAKA GAS
END OF OSAKA GAS
GRANT REPORT SUMMARY

A.	**Tajuk Projek** ***Project Title***	**:**	**Integration of IoT and AI for Efficient Demand Response and Energy Management in Smart Homes: A Sustainable Energy Approach**
	Ketua Penyelidik ***Project Leader***	**:**	Nazreen bt Junaidi
	Fakulti/Institut ***Faculty/Institute***	**:**	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	1. PM Ts. Dr. Rohana Sapawi 2. PM Dr. Kuryati Kipli 3. Dr. Asrani Bin Lit 4. Nurul 'Izzati Binti Hashim **5.** Shirley Anak Rufus
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	1 JAN -31 DEC 2024
	Tempoh Projek ***Project Duration***	**:**	12 MTHS (1 YR)
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM 10 000
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 7 868

C. Pencapaian Keseluruhan
Overall Achievement
Huraikan pencapaian berbanding objektif, hipotesis serta permasalahan asal yang diselidiki..
Describe the achievements in relation to the original objectives, hypothesis and research problems.

The project successfully achieved its objectives:

1. **Energy Management System**: Developed and implemented an IoT-enabled smart home system integrating demand response capabilities for real-time energy control and grid stability.
2. **Machine Learning Integration**: Utilized the XGBoost algorithm to predict energy consumption patterns with high accuracy (R^2 score of 0.9412), enabling optimized energy usage and cost reduction.
3. **User-Friendly Interface**: Integrated the Smart Life app for seamless real-time monitoring, automation, and user engagement, resulting in a 20% reduction in electricity costs.

The hypothesis that IoT and machine learning can enhance energy efficiency and support grid stability was validated. The research addressed key problems by effectively integrating demand response mechanisms, achieving accurate energy predictions, and ensuring scalability and usability. This contributes significantly to sustainable energy management in smart homes.

D. Pencapaian Utama

Key Findings

1. **Successful Integration of IoT and Demand Response**:
   - The system effectively incorporated IoT-enabled devices (e.g., smart plugs, switches, meters) to monitor and control energy consumption in real time.
   - Demand response strategies were implemented, enabling energy adjustments during peak periods and supporting grid stability.
2. **Machine Learning for Energy Optimization**:
   - The XGBoost algorithm accurately predicted energy consumption patterns (R^2 score: 0.9412).
   - Energy usage optimization based on predictions reduced peak demand and overall energy costs.
3. **Enhanced User Experience**:
   - The Smart Life app provided real-time energy monitoring, automation, and control, increasing user engagement and convenience.
   - Users reported significant benefits, including a 20% reduction in electricity bills through automated energy-saving actions.
4. **Scalability and Modularity**:
   - The system's modular design, based on Zigbee protocols, ensures scalability and adaptability for various home configurations and future device integrations.
5. **Environmental and Cost Benefits**:
   - The system demonstrated the potential to reduce carbon footprints by lowering energy consumption and optimizing usage.
   - Cost savings were significant enough to offset initial investment costs within the first year.
6. **Prototype Validation**:
   - Real-world testing of the prototype showed reliable energy management, quick response times, and safety features (e.g., circuit breakers) for user protection.

These findings highlight the feasibility of integrating IoT and machine learning in smart homes to improve energy efficiency, reduce costs, and enhance grid reliability.

E, Hasil Penyelidikan

Deliverables

Sila tandakan item yang berkaitan pada senarai berikut:
Please tick the relevant items below:

	Item	Bilangan/*Number*
	Kertas teknikal/bersiri dalaman *Internal technical/serial papers*	
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	
	Kertas persidangan antarabangsa *International conference papers*	1
	Makalah dalam jurnal tempatan *Local journal papers*	
	Makalah dalam jurnal antarabangsa *International journal papers*	
	Monograf atau buku *Book/monograph*	

Lain-lain/*others* (sila nyatakan/*please specify*)

Sila senaraikan maklumat (pengarang, tahun, tajuk, jurnal/penerbit, jilid, halaman) bagi penerbitan/tesis yang dihasilkan (jika ada).
Please specify the publications (authors, year, title, journal/publisher, volume, page nos.) (if any)

F. Pengecaman Output
Output Identification

Sila tandakan penerangan yang berkaitan pada senarai berikut:
Please tick the relevant description as given below:

	Suatu sumbangan besar kepada bidang ilmu yang berkaitan *A major contribution to knowledge (new knowledge) in the respective discipline*
/	Suatu sumbangan kecil tetapi bermakna kepada bidang ilmu yang berkaitan *A minor but important contribution to knowledge in the respective discipline*
	Suatu sumbangan besar kepada teknologi/ciptaan/algoritma dalam bidang yang berkaitan *A major contribution to technology/invention/algorithm or a tangible product*
/	Suatu sumbangan kecil tetapi bermakna kepada teknologi/ciptaan/algoritma berkaitan *A minor but important contribution to relevant technology/invention/algorithm*
/	Terdapat potensi yang baik untuk kajian lanjutan ke arah pemasaran *There is a good potential for further R & D and commercialization*

	Suatu sumbangan besar kepada kerangka polisi pengurusan/garis panduan *A major contribution to management policy framework/guidelines (in relevant areas)*
	Suatu sumbangan kecil tetapi bermakna kepada kerangka polisi pengurusan/garis panduan *A minor contribution to management policy framework/guidelines (in relevant areas)*
/	Sesuai untuk dijadikan bahan pengajaran/*case stud*y atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
	Suatu output yang baik dan berpotensi untuk memenangi hadiah penyelidikan *A quality output that has a potential for winning a research award*
/	Suatu bahan yang baik/sesuai untuk hebahan atau pameran *A good/suitable material for showcasing/publicizing/exhibition*

Lain-lain/*Others* (Sila nyatakan/*Please specify*)

G. Sinopsis Hasil Penyelidikan bagi Tujuan Promosi
Synopsis for Promotional Purposes

(Beri huraian ringkas yang tidak melebihi 400 perkataan dan dalam bahasa yang mudah, bagi maksud hebahan hasil penyelidikan ini melalui media massa dan 'Unimas Research Update')
(Please provide a synopsis not exceeding 400 words, in a not-too-technical language, for the purpose of promoting this research findings through the mass media and Unimas Research Update).

A groundbreaking research project at Universiti Malaysia Sarawak (UNIMAS) has developed an innovative energy management system for smart homes, showcasing the potential of combining Internet of Things (IoT) technologies and artificial intelligence (AI) to create smarter, more energy-efficient households. This project addresses critical challenges such as rising electricity costs, inefficient energy usage, and the need for grid stability during peak demand periods.

The system integrates smart plugs, meters, and switches that can monitor and control energy consumption in real-time. Using a machine learning algorithm called XGBoost, the system predicts energy consumption patterns with high accuracy, allowing for optimized energy use tailored to user preferences. Paired with the Smart Life mobile app, homeowners can remotely monitor and manage their devices, automate daily routines, and receive real-time energy consumption updates.

One of the study's key highlights is the potential for significant savings, with homeowners reducing their electricity bills by up to 20%. This is achieved by automating energy-saving actions, such as turning off unused devices or adjusting appliances to operate during non-peak hours. Additionally, the system's modular design ensures it can be easily scaled to fit various home sizes and configurations.

Beyond household benefits, this research supports global sustainability efforts by reducing carbon footprints and promoting energy efficiency. The findings have broad implications, from improving residential energy systems to contributing to national energy conservation goals.

This pioneering work demonstrates the feasibility of smart energy management systems and opens up exciting opportunities for further research, including integration with renewable energy sources and adaptive learning models. It also highlights the potential for commercializing smart home solutions, providing a pathway to smarter, greener living for all.

UNIMAS remains committed to advancing technologies that address real-world challenges while contributing to a sustainable future. This research underscores the university's dedication to innovation and its role as a leader in the development of cutting-edge solutions for modern living.

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:

- Borang ini dalam kedua-dua bentuk bercetak dan elektronik

Researchers are required to submit to the Research Centre:

- *This form in both hard- and soft-copies*

13 January 25

…….. ……

Tandatangan (Penyelidik Utama) **Tarikh**

Signature (Principal Researcher) Date