2020 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	Optical Depth Ranging for In Pipe Inspection and Navigation (ORION) on Natural Gas Transmission Mains （天然ガス配管における光学式管内点検用装置の開発）	Agung Shamsuddin Saragih, MS.Eng, PhD
2		Bioenergy Integration in Indonesia: Assessment of Mobile Rice Husk Gasifier Using LCA Method （インドネシアにおけるバイオエネルギー統合 LCA 法による移動式籾殻ガス化炉の評価）	Dr. Ir AdiSurjosatyo, M.Eng.
1	バンドン工科大学 INSTITUT TEKNOLOGI BANDUNG	Solar-Energy-Mediated Conversion of Methane to Methanol （太陽エネルギーによるメタンからメタノールへの変換能力の研究）	Wibara Hendra Saputera,S.Si.,M.Sc.,Ph. D.
2		Development of Perovskites and Graphene Based Photoelectrochemical Cells for CO2 Reduction in Big City （ペロブスカイトの開発とグラフェンとの複合体による CO2 還元のための光電気化学セルの作成）	Rachmat Hidayat, S.Si.,M.Eng., Ph.D
1	ボゴール農業大学 INSTITUT PERTANIAN BOGOR	Impact of Covidl 9 Pandemic on the horticultural supply chain in West Java Province （西ジャワ州における COVID-19 パンデミックの園芸作物サプライチェーンへの影響）	Gilang Munggaran
2		Relation of Mobility Index to Land Surface Temperature During Covid-19 Pandemic in Java Island, Indonesia. （インドネシア・ジャワ島における Covid-19 流行時の人の移動度指数と地表面温度の環境変化の関係）	Arif Kumia Wijayanto
3		The Effect of lncreasing Detergent Use on Changes in Water Quality and Biota during the Covid-19 Pandemic. （Covid-19 パンデミック時の洗剤・石鹸等の使用増の水質や生物相の変化に及ぼす影響）	Bagus A Utomo

＜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	Study on the effects of microwave radiation conditions and mixture components on metal oxide adsorbents' microstructures towards potential H2S removal applications. H2S 除去用途に向けた金属酸化物吸着材の微細構造に及ぼすマイクロ波照射条件と混合成分の影響に関する研究	Nur Amalina Shairah binti Abdul Samat
2		Investigation of Rainfall-induced Slope Failure Mechanisms along Sarawak Road サラワク州道路における降雨による斜面崩壊メカニズムの解明	Dayangku Salma bt Awang Ismail
3		Estimating Carbon Emissions from Transportation sector: A case study in UNIMAS 輸送部門からの炭素排出量の推定.(UNIMAS のケーススタディ)	Mohamad Raduan bin Kabit
4		Investigation of Tribological Properties of Modified Surface Shipping Hull with Reduced Friction for Energy Efficient Shipping Hulls Inspired by Shark and Snake Skins Topography サメとヘビの皮の地形を利用したエネルギー効率の高い船体を目指した摩擦を低減した表面改質船体のトライボロジー特性の検討	Ir Dr Mohd Danial Ibrahim
5		Rotary drying machine for palm oil mill sludge パーム油製造所のスラッジのための回転式乾燥機の開発	Rudiyyanto Philman Jong
6		Fuel efficiency enhancement using fuzzy logic-based energy management strategy ファジィロジックを用いたエネルギー管理による燃費向上	Mohamad Faizrizwan Bin Mohd Sabri

RESEARCH REPORT

OSAKA GAS FOUNDATION
OF INTERNATIONAL CULTURAL EXCHANGE
Year 2020/2021

OPTICAL DEPTH RANGING FOR IN-PIPE INSPECTION AND NAVIGATION (ORION) ON NATURAL GAS TRANSMISSION MAINS

Principal Investigator:

Agung Shamsuddin Saragih, MS.Eng, PhD.

Department of Mechanical Engineering

Faculty of Engineering

UNIVERSITY OF INDONESIA

EXECUTIVE SUMMARY

The iteration of design concepts has been the basis of the ORION robotic platform development. The research incline toward the use of Off-The-Shelf (OTS) parts, which highly reduced the development cost and time, though restricted flexibility of the robot design became a major limitation. ORION latest progress gives reach-out up to 80% of OTS.

The robot utilized a dual-drive caterpillar type mechanism for its mobility. This driver module construction of the robot is relatively simple; it only consists of three major parts connected with a series of bolts that can be assembled and disassembled with ease. The Additive Manufacturing (AM) approach was used for the fabrication of the prototype. In this case, ABS plastic is used for the main material of the custom chassis model, fabricated using Fused Deposition Modelling (FDM) techniques. The static stress simulation shows that the 3D printed model can withstand a load of more than 10 kg.

In terms of navigational control, the system mainly uses IMU and encoder sensors to obtain odometry data. A PID controller scheme was utilized to maintain centered stable movement of the robot inside the pipe. From the experiment, it is indicated that the system with PID control has a better response and outcome compared to the program that does not. Using a Ziegler-Nichols tuning method, it is found the PID values that give the most acceptable response for 650 mm pipe is K_p= 30, K_i = 10, and K_d = 2.5, while for 800 mm pipe is K_p= 60, K_i = 20, and K_d = 5. Based on the design analysis, only two design parameters can be achieved: mobility and steerability. Further development should take other parameters into consideration to realize the desired result.

The research put forward the potential use of stereo depth sensory cameras to provide simplicity, accuracy, and robustness in pipeline inspection. The utilization of intelligent algorithms for image processing namely YOLO as a Convolutional Neural Network (CNN)-based algorithm demonstrates the feasibility of the system to identify pipe defects which focuses on corrosion and cracking defects (which are the two most common defects found in steel pipes). The approach used proved to be robust and able to correctly detect multiple defects in

the test images. The testing performed on 100 images of both corrosion and cracks shows that the model achieved 64% accuracy and 59.4% precision, while the test was measured using AP75 metrics. Furthermore, it is found that executing YOLO real-time using CPU processing only produces around 1 FPS. A more suitable result can be achieved using GPU processing.

The subsequent experiment was conducted to determine the accuracy of the depth measuring capabilities of the camera. Two tests were conducted for short-range and long-range measurements. Based on the result obtained, it was found that for short-range, the best camera setting is high-resolution with filters enabled; while for long-range, the best camera setting is high-resolution with default setting (filters disable). Given an embedded system, settings need to be further adjusted to provide good accuracy without sacrificing much processing power of the computer. Nevertheless, compared to a surface profiler, the depth camera's accuracy is still significantly low. Moreover, it is not able to detect depth changes for a fine contour surface. The most accurate reading can be obtained when the difference in depth is between 10 mm to 500 mm

The solution for communication needs to be addressed. For the robot to operate un-tethered or without any connecting wire, a method of fast wireless data transmission is required. The emergence of new light transmission technology, such as Visible Light Communication (VLC), presents feasibility for IPIR advancement since it can deliver ultra-fast data transmission with high bandwidth (Zhou et al., 2019). VLC can be utilized in an area where Radio Frequency (RF) cannot be reached, especially in complex environments such as underground, underwater, or air. Besides its high transmission rate, other strong points of VLC such as high energy efficiency, durability, and lightweight form factor, make it a viable option for the robot.

FINAL REPORT

OSAKA GAS FOUNDATION OF INTERNATIONAL CULTURAL EXCHANGE

Year 2020/2021

TITLE:

Bioenergy Integration in Indonesia: Assessment of Mobile Rice Husk Gasifier using LCA method

Principal Investigator:

Prof. Dr. Ir. Adi Surjosatyo, M.Eng.

Department of Mechanical Engineering Faculty of Engineering

THE CENTER FOR SCIENCE AND TECHNOLOGY RESEARCH (CSTR)

UNIVERSITY OF INDONESIA

DEPOK, 2020

ABSTRACT

Biomass gasification is a hot topic as renewable energy technology for its wide range of application and capability to be integrated as waste to energy technology as well. Laboratory of biomass gasification of Indonesia has designed a micro scale rice husk gasifier to serves 10 kW of electricity of agricultural sector. Rice husk is a biomass type derived from rice mill residue. Rice husks can be processed into other forms of energy, one with biomass gasification. Rice Husk Gasifier is created to convert the chemical energy stored in rice husk into electricity. Implementing the technology could help rice husk industry to save energy as well as managing the waste. One of the products created using gasifier technology called biochar can be used to improve soil fertility and increase crops yield. Life Cycle Assessment (LCA) is a method to analyse the quality of this technology and what and how rice industry will be benefit from integrating such product. 10 kW Fixed Bed Rice Husk Gasifier will be analysed using analytical and methodical approach. Such LCA can be used to optimise the gasifier as well to proximate the benefit given by the gasifier into manufacturer and rice industry.

Keywords: Rice husk, biomass, optimization, Life Cycle Assessment, Gasifier, Efficiency,

Research Report

Osaka Gas Foundation of International Cultural Exchange

(OGFICE)

Research Title

Solar-Energy-Mediated Conversion of Greenhouse Gases to Methanol

Principal Investigator:

Dr. Wibawa Hendra Saputera

Academic Unit

Research Division	:	Energy and Chemical Engineering Processing System
Faculty/School	:	Faculty of Industrial Technology

INSTITUT TEKNOLOGI BANDUNG

November 2021

1. IDENTITY PAGE

1. Title : Solar-Energy-Mediated Conversion of Greenhouse Gases to Methanol
2. Topic : Technologies concerned with natural gas
3. Research Period : November 2020 – November 2021

4.1. Principal Investigator :

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4.2 Members of the Team:

No	Name and Academic Rank	Field of Expertise	Institution	Allocation of Time	
				Hrs/week	Months
1.	Prof. Dwiwahju Sasongko	Coal and Biomass utilization technology	Institut Teknologi Bandung	10	10
2.	Dr. rer. nat. Rino R. Mukti	Catalysis, zeolite	Institut Teknologi Bandung	10	10

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

No	Name	Departement and NIM	Alocation of Time	
			Hrs/week	Months
1.	Gita Yuniar, S.T.	Chemical Engineering - 23020007	20	10
2.	Adhi Satriyatama	Chemical Engineering - 13018095	15	10
3.	Ignatius Dozy MB.	Chemical Engineering - 13018086	15	10

5. Approved budget : US $ 6,000

Head of Academic Unit
Dean of Faculty of Industrial Technology

Digitally signed by Prof. Brian Yuliarto, ST,M.Eng.,Ph.D.
Location: Bandung

Prof. Brian Yuliarto
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Bandung, 12 November 2021
Principal Investigator

Dr. Wibawa Hendra Saputera
NIP. 119110029

I. EXECUTIVE SUMMARY

1. **TITLE OF RESEARCH** : Solar-Energy-Mediated Conversion of Greenhouse Gases to Methanol
2. **HEAD OF RESEARCH TEAM** : Dr. Wibawa Hendra Saputera
3. **TEAM MEMBERS** : Prof. Dwiwahju Sasongko, Dr. Rino R. Mukti
4. **OFFICIAL ADDRESS** : Labtek X building, Jl. Ganesha No. 10 Bandung 40132

5. **EXTENDED ABSTRACT** :

Large-scale atmospheric removal of greenhouse gases, particularly methane gas, could reduce global warming more rapidly than atmospheric removal of carbon dioxide. Photocatalysis technology, which is defined as the acceleration of chemical reaction under the action of light in the presence of a semiconductor-based catalyst, has been considered one of the most promising technologies for converting carbon dioxide or methane into value-added chemicals such as methanol and ethanol. This technology has several advantages, including being environmentally friendly, operating under ambient conditions (at room temperature and atmospheric pressure), non-toxic, and cost-effective. Thus, the ensuing proposed research will develop a novel hybrid photocatalyst that utilizes visible light/natural sunlight to convert methane or carbon dioxide into methanol to mitigate global warming and climate change concerns. In addition, the proposed project will evaluate the effect of surface modification on ZnO-based catalysts. The photocatalyst shows several interesting properties respective to each modification, such as dopants enable the ZnO to absorb wider wavelength spectra that make it active in far UV and near-visible light. Several factors, including the type of surface modification strategies, including the utilization of zeolite as support of ZnO catalyst, have been evaluated in this study. Additionally, photocatalytic reactor design and activity testing of each synthesized catalyst for converting carbon dioxide have been performed. The results show that ZnO/zeolite exhibited good yield and selectivity towards methanol products. Therefore, photocatalytic technology is expected to be an alternative technology that can be developed on a pilot scale to address environmental and climate change issues, especially in Indonesia.

6. **LIST OF RESEARCH OUTPUT**

As a result of this study, the list of research outputs are as follows:

1. W.H. Saputera, et al. "Recent advances in photocatalytic oxidation of methane to methanol," *Journal Resources Chemicals and Materials*. Status: Under Review.
2. W.H. Saputera, et al. "Technology advances in phenol removals; current progress and future perspectives," *Catalysts* (2021), 11, 998 (Q2, IF = 4.146, Review article, status: Published).

3. W.H. Saputera, et al. “ZnO-incorporated ZSM-5 for photocatalytic CO2 reduction into solar fuels under UV/Visible light,” Chemistry Proceedings, 3. (Status: Accepted)
4. A laboratory-scale prototype of the photocatalytic reactor for evaluating the photocatalytic performance of greenhouse gases conversion to methanol.

II. TECHNICAL REPORT

Abstract: Direct conversion of CO_2 into chemical compounds become a prospective pathway to transform CO_2 into valuable chemical compounds. The introduction of porous materials with high uptake into the photocatalytic system can enrich the CO_2 absorption on the surface of the photocatalyst for catalytic conversion. In this regard, another feasible strategy can be accomplished via combining commercial photocatalyst material into porous supporting materials. The present study investigated a series of ZnO-incorporated ZSM-5 catalysts to produce solar fuels under UV/Visible light irradiation. ZnO/ZSM-5 was synthesized using the wet-impregnation method using Zn(CH3COO)2 as reagent and then calcination. Various characterizations were also conducted to study photocatalyst morphology, structure, absorbance, and physiochemical properties. SEM-EDX images showed that ZnO has successfully been incorporated into ZSM-5 surfaces with particle sizes around 50 nm. The optical properties of the ZnO/ZSM-5 correspond to 3.36 eV, showing the increase of the bandgap value than pure ZnO, which corresponds to 3.18 eV. The solar fuels production, including formic acid (HCOOH), formaldehyde (HCOH), and methanol (CH_3OH) evolution was evaluated under U.V./Visible irradiation. The design composite ZnO/ZSM-5 catalyst achieves methanol and formic acid yields of 39.2 μmol/g.h and 0.72 μmol/g.h μmol/(g.h), respectively, exhibit about 1.5 and 2.5-folds higher than neat ZnO catalyst. The improved yield and selectivity towards methanol products are attributed to the more excellent light absorption, efficient charge transfer, nanostructure morphology, and more active sites available for CO_2 adsorption.

Keywords: ZnO, zeolite, ZSM-5, wet-impregnation, CO_2 utilization, photocatalysis

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1. Introduction

In recent years, CO_2 conversion into valuable chemicals, such as CH_3OH, H2CO, HCOOH, CO, and CH4 via photocatalysis, is presented as an alternative technology in overcoming the current global emission [1,2]. Therefore, the design of photocatalyst materials becomes a significant challenge, mainly to produce a highly active and selective product. Among various photocatalysts, zinc oxide (ZnO) is widely investigated due to its high photoactivity, highly chemical and thermal stability, low cost, and non-toxicity [3,4]. However, the applications of ZnO are heavily limited by the wide range of bandgap (E_g = 3.27 eV), rapid recombination, poor solar light utilization, and photochemical corrosion. Moreover, ZnO particles can easily agglomerate, leading to worse performance in industrial applications [5].

Therefore, many different approaches have been adopted to overcome the disadvantage of pristine ZnO, which mainly focused on improving the specific surface area and more reaction active sites to enhance photocatalytic activity [6]. From this point, another feasible approach can be accomplished via a combination of ZnO with other inorganic porous materials, like graphene oxide [7], single-walled carbon nanotubes [8], fullerenes [9], and Pd [10], which successfully improved its photocatalytic activity. For this purpose, zeolite is considered an excellent candidate to perform as support of photocatalysts. The porous structure of zeolite confined small molecules such as CO_2 to enhance its photocatalytic activity further. Moreover, zeolite has been applied as a supporting material for various hetero-structured photocatalyst, like ZnO/Clinoptilolite [11], Ag–

Research Report

Osaka Gas Foundation of International Cultural Exchange

(OGFICE)

DEVELOPMENT OF PEROVSKITES AND GRAPHENE BASED PHOTOELECTROCHEMICAL CELLS FOR CO2 REDUCTION IN METRO CITIES

Principal Investigator:
Dr. Rahmat Hidayat

Academic Unit

Research Division	:	Physics of Magnetism and Photonics
Faculty/School	:	Fac. of Mathematics and Natural Sciences

INSTITUT TEKNOLOGI BANDUNG

November 2021

I. IDENTITY PAGE

1. Title : DEVELOPMENT OF PEROVSKITES AND GRAPHENE BASED PHOTOELECTROCHEMICAL CELLS FOR CO_2 REDUCTION IN METRO CITIES
2. Topic : Global environmental problems
3. Research Period : November 2020 – November 2021

4.1. Principal Investigator :

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4.2 Members of the Team:

No	Name and Academic Rank	Field of Expertise	Institution	Allocation of Time	
				Hrs/week	Months
1.	Dr. Herman	Photonics	FMIPA ITB	8	10

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

No	Name	Department and NIM	Allocation of Time	
			Hrs/week	Months
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2.	Diyan Unmu Dzujah	Physics, 20218308	10	10
3.				
4.				
5.				

5. Approved budget : Rp. 75.000.000

Approved by,
Dean of Faculty of Mathematics and Natural Sciences

Prof. Ir. Wahyu Srigutomo.,S.Si., M.Si.,Ph.D
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Bandung, 12 November 2021
Principal Investigator

Dr. Rahmat Hidayat
NIP. 196812111994031004

I. EXECUTIVE SUMMARY

1. **TITLE OF RESEARCH** : DEVELOPMENT OF PEROVSKITES AND GRAPHENE BASED PHOTOELECTROCHEMICAL CELLS FOR CO_2 REDUCTION IN METRO CITIES
2. **HEAD OF RESEARCH TEAM** : Dr. Rachmat Hidayat
3. **TEAM MEMBERS** : Dr. Herman
4. **OFFICIAL ADDRESS** : Prodi Fisika, FMIPA ITB, Jl. Ganesha 10, Bandung
5. **EXTENDED ABSTRACT** :

The exploration of the possibilities to develop materials and devices for CO_2 reduction into other harmless gasses or substances has been carried out. The materials under consideration are graphene-based materials with vacancy defects, where transition metals are then likely to be absorbed by those vacancies due to a coordination bonding. Such materials are then applicable for electrodes in CO_2 reduction devices, which may be in the form of electrochemical or photoelectrochemical cells. For investigating the possibility of those metal-doped graphene materials to reduce CO2, we have conducted a computational study on their molecular and electronic structures using Density Functional Theory (DFT) method in the Quantum Espresso computational package. The calculated electronic structures were then analyzed in terms of bandgap and Fermi energies, valence-conduction band energy levels, and distribution of Density of States (DOS). Moreover, in order to investigate the energy barriers of transition states and possible pathways in the CO_2 reduction process, we have also conducted the calculation using Nudged Elastic Band (NEB) method. The result is quite surprising where pure-graphene cannot effectively for CO_2 reduction because high energy barrier of transition states, but metal (such as Co, Cu, Zn, etc.) doped graphene are applicable for CO_2 reduction because of the low energy barrier of the transition state. Nevertheless, the energy barriers vary depending on the metals, which might be related to the different levels of Fermi energy and DOS distribution. The experimental work has not been completed because of some technical problems because of unexpected difficulty due to the occurrence of multi-redox in the system. However, from the computational study, the results have been presented the results in an international conference and written in a manuscript for submission to an international journal (Scopus indexed and Q1 ranked journal). The present research results indicate the possibilities of those metal-doped graphenes as electrodes for CO_2 reduction in electrochemical/photoelectrochemical cells, which commonly can be scaled up for large amounts of CO_2 recycling in metropolitan cities.

6. **LIST OF RESEARCH OUTPUT**

i. D. U. Dzujah, A. M. Pradipto, M. Arifin, K. Nakamura, R. Hidayat, Electronic Structure Calculations of Graphene with Dopant and its Optical Properties in Extreme UV region, The 13th International Symposium on Modern Optics and Its Applications, Tangerang, Indonesia, 2-4 August 2021

ii. D. U. Dzujah, Herman, R. Hidayat, Transition Metal Doped Graphene as Electrode for CO_2 Reduction Studied by Density Functional Theory Calculations, in final preparations

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2020/2021

Final Report

Impact of Covid19 Pandemic on the horticultural Supply Chain in West Java Province

Gilang Munggaran

Danang Pramudita

Sri Malahayati Yusuf

IPB University
Bogor Indonesia

Submitted to:

Environmental Research Center

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2021

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Title : Impact of Covid19 Pandemic on the horticultural supply chain in West Java Province

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Bogor, 30 October 2021

Center for Environmental Research,
Bogor Agricultural University,
Director,

Prof. Dr. Ir. Hefni Effendi, M.Phil

Principal Investigator,

Gilang Munggaran, SP, M.Si

EXECUTIVE SUMMARY

Agriculture is one of the aspects that is affected by Covid-19 pandemic. This is due to the large-scale social restrictions imposed by the government. On the other hand, agricultural activities still plays an important role in fulfill the food needs. Therefore, food supply is crucial during this pandemic, especially with the issue of limiting activities, people's efforts to avoid shopping places, and disruption of production activities that require direct contact.

One of the problems that is faced by the agricultural sector is the disruption of supply chains for agricultural products. The causes are restrictions on market operating hours, as well as restrictions on the transportation sector. Thus, the supply of agricultural products is disrupted, especially horticultural products. This can cause the farmers welfare level to be declined. Therefore, it is necessary to identify supply chain conditions in horticultural products in West Java production centers during the Covid-19 pandemic, measure supply chain performance in horticultural products in West Java production centers during the Covid-19 pandemic, and formulate the strategy to improve the performance of the supply chain for horticultural products in West Java production centers during the Covid-19 pandemic.

The research carried out in 3 main centers for horticultural products in West Java Province. The specific location of research are located at 1) Pangalengan District, Bandung Regenyc, 2) Cikajang District, Garut Regency and 3) Cipanas District, Cianjur Regency. In In the beginning of June 2021, survey have been conducted in Bandung, Garut and Cianjur Regency. At the three locations, data were collected that focused on one horticultural commodity being analyzed. Restrictions on vegetable commodities analyzed in each location aim to facilitate the supply chain analysis process. The basis for selecting vegetable products analyzed is the total annual production which is the largest compared to other locations. Tomato commodity was selected in Bandung Regency, while for Garut Regency, curly chili was selected and Cianjur Regency was carrot commodity. Questionnaire for horticulture farmers and traders is developing based on selected commodities in each location.

Based on the results of research that has been carried out in Bandung Regency, Garut Regency and Cianjur, the identified supply chain members at the research location are 1) farmers, 2) collectors/ dealers, 3) markets and 4) secondary members of agricultural equipment shops. The main target market of the horticultural product is Jakarta, Bogor,

Depok, Bekasi and Tangerang. The main markets namely; a) Kramat Jati Market in Jakarta, 2) Cibitung Market in Bekasi, 3) Tanah Tinggi Market in Tangerang, 4) Kemang and Parung Markets in Bogor and 5) Cikopo Market in Karawang Regency. The sales system to the main market does not use a contract system, but with a buy and sell system and prices follow daily changes. The supply sent by traders to the main market is carried out routinely every day. Merchants usually already have regular buyers in the home market so orders can be placed quickly. In addition to the main market located in the Jabodetabek area, there are also alternative market, namely; markets in Pontianak (Kalimantan) and Palembang and Batam (Sumatra). However, the frequency of delivery to these two markets is not every day. Orders can be placed once a week or every two weeks.

Based on the results of research in Bandung and Garut, basically impact of Covid-19 pandemic to the farmers was not directly from the technical side of production. Farmers can carry out the production process quite well with the good productivity either during the pandemic or before the pandemic. The distribution of vegetable products from the vegetable center to the main market does not experience significant disruption during activity restrictions/lockdown because vegetable commodities are included as a priority staple that will be allowed to enter the city like Jabodetabek.

However, the biggest impact of the Covid-19 experienced by farmers is price fluctuations. Vegetable prices decreased because vegetable supply from farmers was relatively constant, but final consumer demand (demand side) decreased drastically, especially during the early period of the COVID-19 pandemic in 2020. Limited mobility and closure of several businesses caused the activity of purchasing vegetable commodities in the main market declining. Moreover, most of the vegetables from supply the main market in the Greater Jakarta area which is lockdown at that period. Some of the problems faced by farmers and traders in the supply chain of vegetable commodities include delays in the payment process from the market. Late payments occur because the products on the market cannot be sold quickly. However, in general, vegetable farmers are in a safer position compared to traders. Even though there are delays in payments, farmers have the freedom to choose several traders to sell their products. Different things are experienced by traders, many vegetable traders have difficulties with capital due to the limited sales process in the market and prices that tend to fluctuate.

The measurement of supply chain performance in this study is approached primarily from marketing efficiency. Limited information on traditional marketing systems that are not well recorded such as modern systems are the basis for using marketing efficiency analysis as an approach in assessing the performance of the vegetable supply chain. The value for tomato farmers reached 51.94%. The result of farmer share's analysis on carrot commodity value reached 35.71%, while the results of farmer share's analysis obtained by chili farmers is 36.7%. The value of farmer's share of less than 50% indicates that marketing efficiency in chili and carrot commodities does not provide greater profits for farmers or it can be said that the market is not efficient because the largest profits are enjoyed by parties outside the farmers.

One of the strategies to improve supply chain performance based on the results of the study is to focus on improvements in product marketing in the three locations. This is because the three products analyzed in this study are limited to traditional markets. The characteristics of traditional markets which generally do not apply strict standards to product yields are one of the things favored by dealers or farmers because the requirements for the production process are not too strict. The right area to be able to develop digitalization of horticultural product marketing is the carrot commodity in Cianjur because of the readiness of various criteria. Therefore, the involvement of various relevant stakeholders is needed, both farmers, traders and the government to ensure the strategy can run well.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2020/2021

Final Report

Relation of Mobility Index to Land Surface Temperature During COVID-19 Pandemic in Java Island, Indonesia

1. Arif Kurnia Wijayanto

Environmental Research Center, IPB University

2. Irza Arnita Nur

Environmental Research Center, IPB University

3. Luisa Febrina Amalo

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Submitted to:

Environmental Research Center

IPB University

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The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2021

General Information

Title : Relation of Mobility Index to Land Surface Temperature During COVID-19 Pandemic in Java Island, Indonesia

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Bogor, August 10th 2021

Center for Environmental Research,
Bogor Agricultural University,
Director,

Principal Investigator,

Prof. Dr. Ir. Hefni Effendi, M.Phil

Arif Kurnia Wijayanto, M.Sc.

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I. Introduction

1.1. Background

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. In March 2020, WHO declared COVID-19 as a pandemic because it has spread worldwide. Indonesia is one of the countries affected by this disease. Indonesia reported the first case at the beginning of March 2020. Since then, the government has appealed to the public to reduce outdoor activities to reduce the potential spread of the virus. Many companies arranged work from home (WFH) policy to protect their employees.

At the end of April 2020, the provincial government of major Java cities issued large-scale social restrictions (locally called PSBB/Pembatasan Sosial Berskala Besar). It is the same as lockdown, which is applied mainly by other countries. PSBB is one of the government's efforts to break the chain of the spread of COVID-19. Several regions in Indonesia have proposed and implemented PSBB. The implementation of PSBB is regulated in Government Regulation Number 21 of 2020 which was signed by President Jokowi. PSBB issued several restrictions, namely, teaching and learning processes and work are carried out at home, restrictions on religious activities, restrictions on activities in public places or facilities, restrictions on social and cultural activities, restrictions on transportation modes, and restrictions on other activities specifically related to defense and security aspects. By using this policy, the government forced the people strictly to reduce their activities.

This activity limitation has an impact on the dynamics of land surface temperature. With less mobility, the transportation and activity that usually contribute to the increase of temperature will lower. Java Island was mostly affected by COVID 19 because of its high mobility within and outside big cities. And also, the main airports of Indonesia are located in Tangerang, West Java, so, the spread of this virus from other countries will impact Java Islands mostly. Big cities with high cases of COVID 19 recorded in Java, namely, Jakarta, Bandung, Semarang, and Surabaya. Hence, in this study, we tried to analyze the relation of mobility index to Land Surface Temperature during COVID-19 Pandemic in Java Island, Indonesia using Facebook's mobility data.

1.2. Objectives

This study aims to relate the reduction of mobility index to land surface temperature in four big cities in Java Island, Indonesia, namely, Jakarta, Bandung, Semarang, and Surabaya. The hypothesis is that the restriction policy has a relationship for reducing LST due to less human mobility during the enforcement of the policy.

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

Research Grant FY 2020/2021

Final Report

The effect of increasing detergent use on changes in water quality and biota during the Covid-19 pandemic, case study: detergent pollution in Situ Gede, Bogor City

1. Bagus A. Utomo

Environmental Research Center, IPB University

2. Hefni Effendi

Environmental Research Center, IPB University

3. Helmy Akbar

Environmental Research Center, IPB University

IPB University

Bogor Indonesia

Submitted to:

Environmental Research Center

IPB University

for

The Osaka Gas Foundation of International Cultural Exchange (OGFICE)

December 2021

General Information

Title	: The effect of increasing detergent use on changes in water quality and biota during the Covid-19 pandemic, case study: detergent pollution in Situ Gede, Bogor City

Researchers:

1	Name	: Bagus Amalrullah Utomo, S.Pi
	Institution	: Environmental Research Center, IPB University
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2	Name	: Prof. Dr. Ir. Hefni Effendi, M.Phil
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3	Name	: Helmy Akbar, S.Pi, M. Si
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Bogor, 27 October 2021

Environmental Research Center,
IPB University,
Director,

Principal Investigator,

Prof. Dr. Ir. Hefni Effendi, M.Phil

Bagus Amalrullah Utomo, S.Pi

Executive Summary

The COVID-19 pandemic has issued health protocols from WHO such as routinely washing hands with soap and running water and immediately washing clothes after traveling to ensure transmission of the virus attached to clothes can be prevented. The consequence that must be accepted with this condition is the increasing use of chemicals such as detergents. The increased use of detergents will certainly increase the pollutant load on water. Situ Gede is a naturally inundated waters that functions as a tourist area and is a water storage area used to irrigate rice fields around the lake.

This LC_{50} study was conducted on a laboratory scale to examine the effect of pollutants in the form of detergents on Tilapia (*Oreochromis niloticus*) and Sunda Prawn (*Macrobrachium sintangense*). In addition, an analysis of the water quality of Situ Gede was carried out and the formulation of a management strategy for Situ Gede.

The tools and materials used in the laboratory scale test are a set of aquarium installations, fish and shrimp larvae (test biota), toxicants (detergents), and supporting laboratory equipment such as DO and pH meters. This study was conducted following a toxicity test procedure (US EPA 2002). The activity stages consist of the acclimatization stage, the preliminary test, and the main test. Field survey activities included taking water samples at Situ Gede, interviews with local community representatives, and collecting water quality data from routine monitoring at Situ Gede.

The value of LC_{50}-96h in the test of Tilapia was 61 mg/L and Sunda Prawn was 180,702 mg/L. The detergent concentration which is classified as safe based on the value of LC_{50} - 96h for Tilapia is 0.61 mg/L and Sunda Shrimp is 1.81 mg/L. The results of water quality measurements on the LC_{50} test show that the temperature and dissolved oxygen parameters still meet the needs for the survival of the test biota. The relatively high pH value of water during the study was caused by the entry of toxicants (detergents) where one of the compositions of the constituent materials was phosphate.

Based on the results of water quality analysis and routine monitoring data in Situ Gede, it was found that several parameters had increased (BOD, TDS, TSS, and total phosphate). This condition is related to the increasing use of detergents during the Covid-19 pandemic.

The results of interviews and field observations concluded that Situ Gede has an important role in the lives of the surrounding community, both economically, socially, and culturally. In general, the people around Situ Gede do not understand the impact of domestic liquid waste disposal on water quality. The community around Situ Gede supports government programs related to water management, such as the construction of a Communal Wastewater Treatment Plant, monitoring and supervision of Situ Gede.

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

A.	**Tajuk Projek** ***Project Title***	**:**	Study on the effects of microwave radiation conditions and mixture components metal oxide adsorbents' microstructure towards potential H_2S removal applications
	Ketua Penyelidik ***Project Leader***	**:**	Nur Amalina Shairah Abdul Samat
	Fakulti/Institut ***Faculty/Institute***	**:**	Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	Prof Dr. Mohammad Omar Abdullah Dr Dayang Salyani Abang Mahmod Dr Hafizah Abdul Halim Yun Sherena Sar-ee
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	7th December 2020
	Tempoh Projek ***Project Duration***	**:**	12 months (1st January 2021 – 31st December 2021) Extension 31st January 2022 (1 month extension)
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM10,000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM1,227.26 (yet to include ENCON 2022 fee deduction)

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.

With significant economic and environmental impact due to emission of sulfur compounds, the removal of H_2S from industrial gases is essential due to its toxicity and corrosive behaviour that affects steel equipment and catalyst poisoning. Metal oxide adsorbents are some of the common H_2S adsorbents employed in hydrodesulphurization unit to remove H_2S from H_2S-contaminated gas streams. However, pure metal oxides were reported to exhibit limited performance such as low porosity, low surface area, potential metal evaporation, can sinter at high temperatures and mechanically decomposed, thus reducing their lifetime and adsorption capacity. Meanwhile, the

concept of microwave radiation with its effects on the microstructures of metal oxide adsorbents have not been fully understood and analyzed until now. Therefore, this research was attempted and aimed to investigate the potential of microwave radiation in modifying the physical properties and microstructures of some selected metal oxide adsorbents, particularly ZnO, CuO and Fe_2O_3 adsorbents, thus to upgrade their adsorption capacities using various microwave radiation conditions.

The experimental investigations were conducted in the laboratory. Pure samples purchased from Sigma-Aldrich Germany were placed in a microwave facility and irradiated at several microwave conditions (variable parameters); (a) irradiation power i.e. low (130W), medium low (260W) and medium (440W), and (b) irradiation period i.e. 15-minutes intervals for 60-minutes for ZnO and Fe_2O_3 samples and 15 seconds intervals for 1 minute for CuO sample. The research also proceeds to study the effects of microwave irradiation powers on the properties of mixed metal oxide samples i.e. Cu/Zn-O, Cu/Fe-O and Zn/Fe-O at 1:1 weight ratio. All raw and irradiated sample adsorbents were characterized using CILAS 1090 Particle Size Analyzer, Scanning Electron Microscopy and Energy Dispersive X-Ray Spectroscopy (SEM-EDS Hitachi TM4000Plus) and Fourier Transform Infrared Spectroscopy (FTIR) to observe possible/potential modifications in their particle sizes and surface areas, microstructural surface morphologies, molecular components, and bonding structures, among other things. It was initially anticipated that the properties of sample adsorbents could improve by microwave radiation.

Several problems encountered during the research include limited access to laboratory for experimental works in the operation year due to Covid-19 pandemic; previously-proposed microwave facility went on severe maintenance thus project delayed as new facility needed to be purchased; preliminary results showed insignificant results, therefore required repeated and further testing and analysis; results for irradiated mixed metal oxides required further investigation and analysis for publication.

D. Pencapaian Utama
Key Findings

The particle sizes and specific surface areas of both ZnO and CuO adsorbents did not exhibit improvement when exposed to microwave radiation, unlike what was hypothesized. At any radiation conditions, sudden increases in their particle sizes thus decreases in specific surface areas were resulted. Microwave radiation caused ZnO and CuO particles to consolidate/agglomerate and sinter, just as they did during high-temperature conventional heating. This had led to substantial drops in their specific surface areas upon radiation, hence no adsorption improvement could be evident. The maximum specific surface areas of irradiated ZnO and CuO samples were attained at $3.28 m^2/g$ and $20.44 m^2/g$ respectively after 440W radiation. In contrary, Fe_2O_3 adsorbent increased its specific surface area as irradiation power and time increased, making it suitable for a wide range of adsorption applications. Particles were observed to be more dispersed and did not densify upon radiation. The best specific surface area was attained at $18.79 m^2/g$ after 440W radiation. Nonetheless, overall, the work had shown that the specific surface areas of all irradiated adsorbent samples improve as irradiation power and period increases. The higher the irradiation power or the longer the radiation, the smaller the particle mean diameter and greater specific surface area were achieved by all irradiated adsorbents, which thus advantageous for adsorption purposes. Irradiated ZnO sample relatively shows the most minimal increase in its specific surface area as compared to irradiated CuO and Fe_2O_3 samples.

SEM micrographs revealed massive particle surface diffusion in irradiated ZnO and CuO adsorbents. Particles consolidated and densified, generating different masses, thus limiting their adsorption tendencies. Irradiated Fe_2O_3 samples, however, were slightly more distributed and did not densify upon irradiation. As similar peaks were observed before and after radiation, FTIR analysis suggested that microwave radiation does not cause distinctive changes to the functional groups and chemical properties of metal oxide adsorbent samples. Overall, the microstructural adsorption properties of irradiated adsorbents could be enhanced for increasing irradiation conditions, but the performances were still lacking as compared to their raw forms.

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*) : Nil

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) 14th International UNIMAS Engineering Conference 2022 (EnCon2022)
    - Authors: Nur Amalina Shairah Abdul Samat, Dayang Salyani Abang Mahmod, Sherena Sar-ee, Puteri Nur Camelia Kamarulzaman
    - Year: 2022 (In process for publication)
    - Title: Effects of Microwave Radiation in Microstructural Modifications of Zn-O, Cu-O and Fe-O Adsorbents
    - Journal: *Expecting Scopus Indexed*

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*) : Nil

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).

The present work aims to fundamentally investigate microstructural improvements of ZnO, CuO and Fe_2O_3 adsorbents when exposed to several microwave radiation conditions i.e. power and period. Raw and irradiated adsorbents were analysed using Particle Size Analyzer (PSA), Fourier Transmission Infra-Red (FTIR) and Scanning Electron Microscope with Energy Dispersive X-Ray Spectroscopy (SEM-EDS). Results showed that ZnO and CuO particles consolidated, sintered, and experienced substantial drop in specific surface areas upon radiation, hence no microstructural adsorption improvement is evident. In contrary, Fe_2O_3 increases in surface area after radiation, whereby particles were dispersed and did not densify, thus suitable for wide range of adsorption applications. However, it was generally evident that specific surface areas of all irradiated samples improve as irradiation power and time increase. IR spectra of adsorbents demonstrated indistinctive change in chemical properties. Overall, the microstructural adsorption properties of irradiated adsorbents could be enhanced for increasing irradiation conditions, but the performances were still lacking as compared to their raw forms.

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*

27th March 2022

……. …….

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***	:	Investigation of Rainfall-induced Slope Failure Mechanisms along Sarawak Road
	Ketua Penyelidik ***Project Leader***	:	Dayangku Salma binti Awang Ismail
	Fakulti/Institut ***Faculty/Institute***	:	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	:	Prof Ir Dr Siti Noor Linda bt Taib Ir Dr Norazzlina bt M. Sa'don
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	:	1st January 2021
	Tempoh Projek ***Project Duration***	:	1 year (1 Jan 2021 – 31 Dec 2021) *Extension 28 Feb 2022*
	Peruntukan Yg. Diluluskan ***Budget Approved***	:	RM 10000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	:	RM 3,876.70

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.

In this study, a slope failure event in 2015 at KM 6+500 of Jalan Puncak Borneo in Padawan, Kuching was modelled using Seep/w and Slope/w software of commercial geotechnical programme GEOSTUDIO. The slope stability was evaluated based on finite element and limit equilibrium method by considering the transient seepage analysis due to rainfall infiltration. The transient analyses were modelled based on the estimation of advanced hydraulic properties of soil; soil-water characteristic curves (SWCC) and unsaturated hydraulic conductivity. The estimation was performed based on the index properties of the soil which obtained from the ground investigation of the site.

The slope failure was modelled based on ground investigation report and published data to replicate the field condition. A hyetograph was plotted using daily rainfall data and cumulative rainfall depth was determined to obtain the total rainfall during the wet monsoon. As a result of numerical analyses, the factor of safety was observed to fluctuate with time of infiltration. It can be seen that the continuous rainfall contributes to reducing the safety factor over time. The factor of safety obtained was 1.27 after a prolonged rainfall about three days which had recorded more than 100mm per day. Based on JKR Guidelines for slope design, the safety factor for geotechnical design criteria for slope design must be reached 1.3 and it showed that the safety factor has not met the design criteria for the slope design.

Therefore, it illustrates that the water flow in soil slope mass due to rainfall event is governed by the soil-water characteristic curves (SWCC), unsaturated permeability functions and saturated permeability of soil. Thus, the analyses of this current study have illustrated that the transient analysis is essential to model the seepage behaviour and infiltration event that caused slope failure along Sarawak's roads.

D. Pencapaian Utama
Key Findings

The key findings of this project are stated as follows:

i) The concept of transient seepage in the slope stability analysis

Slope failures along Sarawak roads are regularly caused by heavy rain. The outcome of the research study shows the transient seepage is important in slope stability analysis. The safety factor has found to reduce over time with condition of a prolonged rain (i.e. more than three days) with a total of more than 100 mm rainfall depth per day.

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*	4 (Final Year Project)
	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*)

Nil

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)

The paper was presented in the EnCon 2022 conferences and under on-going process of publication. The title of the presented paper is:

1. Numerical modelling of slope stability and transient seepage analysis: Jalan Puncak Borneo Road Case Study

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*)

NIL

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

This study enhances the significance of transient seepage or water flow in soil in the geotechnical risk analysis (i.e slope stability) and enhances the understanding of rainfall-induced slope failure along Sarawak road subjected to local climate condition.

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)

25 /03/2022

……

Tarikh
Date

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

A.	**Tajuk Projek** ***Project Title***	**:**	Estimating Carbon Emissions from Transportation sector: A case study in UNIMAS
	Ketua Penyelidik ***Project Leader***	**:**	Dr Mohamad Raduan bin Kabit
	Fakulti/Institut ***Faculty/Institute***	**:**	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	Dr Zamri Bujang
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	1st January 2021
	Tempoh Projek ***Project Duration***	**:**	1 year (1 Jan 2021 – 31 Dec 2021) *Extension 28February 2022*
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM 10000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 7526.70

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.

Carbon dioxide (CO2) emission from motor vehicles is one of the major contributing factors to global warming. Efforts to reduce CO2 emissions that contribute to greenhouse gases should involve all parties including the universities. In 2017, The Universiti Malaysia Sarawak (UNIMAS) has committed to reducing its campus CO_2 emissions upon joining the Low Carbon Campus initiative. Thus, the current study aims to estimate the baseline of on campus vehicle CO_2 emissions by using mobility analysis of 5294 entry vehicle data from two main gates (West and East) to 15 parking zones in the campus. Parking volume observations and traffic assignment analysis by using Bureau of Public Roads functions were undertaken to determine the links' volumes. Subsequently, vehicle CO_2 emissions were derived from the estimated vehicle fuel consumption. The results reveal that a total of 1333.4 kg of CO_2 emissions was emitted by on campus motorised vehicle movements (which were predominantly petrol cars that comprised 80% of the observed vehicle trips). Additionally, the study discovered that the average on campus vehicle CO_2 emissions was 12.4 kg per kilometre which is far exceeding the European Standard for road traffic CO2 emissions. Thus, to achieve the status of Low Carbon Campus (LCC), it is imperative for the university management to properly address sector 3 CO2 emissions from the transportation segment by employing effective strategy and policy to significantly reduce private vehicle dependency among the university's staff and students.

D. Pencapaian Utama
Key Findings

This research estimates on campus vehicle CO_2 emissions based on mobility analysis of 5294 entry vehicle trips data from two main gates (West and East) to 15 parking zones in the UNIMAS main campus. The key findings are as follows:

1. Based on the study's estimation, a total of 1333.4 kg of CO_2 was emitted by motorised vehicle movements on the campus which were predominantly contributed by petrol cars (80% of the observed vehicle trips).
2. It was also discovered that the average on campus vehicle CO_2 emissions was 12.4 kg per kilometre which is far exceeding the European Standard for road traffic CO_2 emissions. As almost all of the university staff are commuting to campus by private vehicles, it is envisaged that the status of Low Carbon Campus (LCC) could not be achieved without properly addressing CO_2 emissions from sector 3, which is considerably contributed by the vehicle trips (staff and students) by private vehicles.

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*	
✓	Makalah dalam jurnal tempatan *Local journal papers*	1 Journal
✓	Makalah dalam jurnal antarabangsa *International journal papers*	1 Journal
	Monograf atau buku *Book/monograph*	

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

Nil

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)

- ✓ Kabit M.R., Ting, J.L.S. and Yassin A. (2022) Towards campus sustainability: estimating on campus vehicle CO_2 emissions in UNIMAS. Journal of Sustainability Science and Management (accepted for publication)
- ✓ Kabit M.R., Chiew W.Y., Chai A. and Tirau L.S. (2022) Evaluating the effects of signal control applications on roundabout's LOS performance using VISSIM microsimulation model in the 14th International UNIMAS Engineering Conference 2022 (EnCon2022) – accepted for publication

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 study* 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

CO_2 emissions continue to increase since human energy consumption have been intensified for many ages, in which the burning of fossil fuels has been the primary energy source. In 2020, Malaysian CO_2 emissions were estimated at 256 million tonnes which increased by an average of 3.1% per annum since 2009 (BP Plc, 2021). The biggest contributor to CO_2 emissions in the country is the electricity energy sector, followed by transportation and then waste management (handling and disposal). In the 10th Malaysian Plan, the government of Malaysia has committed to reducing its carbon dioxide emission intensity to the gross domestic product (GDP) by 40 % per GDP by 2020 to reduce the carbon footprint in Malaysia. In 2017, Universiti Malaysia Sarawak (UNIMAS) has decided to join Low Carbon Campus (LCC) initiative. As such, a local sustainability plan should be devised and implemented to reduce CO_2 emissions on the campus. This study serves as a baseline study that measure the campus CO_2 emissions from the transportation sector. As the results suggest that the vehicle CO_2 emissions in the campus exceeded the European standard, it is imperative for the university management to properly address sector 3 CO_2 emissions from the transportation segment by employing effective strategy and policy to significantly reduce private vehicle dependency among the university's staff and students.

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:

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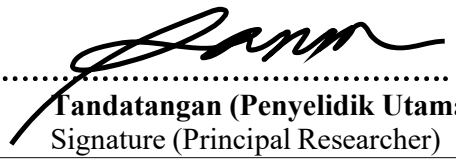

25 /03/2022

…….. ……

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***	:	Investigation of Tribological Properties of Modified Surface Shipping Hull with Reduced Friction for Energy Efficient Shipping Hulls Inspired by Shark and Snake Skins Topography
	Ketua Penyelidik ***Project Leader***	:	Assoc Prof Ir Dr Mohd Danial bin Ibrahim
	Fakulti/Institut ***Faculty/Institute***	:	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	:	Assoc Prof Dr Yuta Sunami Dr Aidil Azli Alias,
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	:	1st January 2021 ~ Feb 2022
	Tempoh Projek ***Project Duration***	:	1 year 2 months (1 Jan 2021 – 28 Feb 2022) *Extension until 28 Feb 2022*
	Peruntukan Yg. Diluluskan ***Budget Approved***	:	RM 10000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	:	RM 9,052.74

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 skin of the Malaysian bull shark or Carcharhinus Leucas was used in this project as it is particularly available in the Sarawak water. In this paper, the biomimicry study of the sharkskin was done by producing a bio-mimicked shark skin sample made of Polydimethylsiloxane (PDMS) silicone through PDMS elastomeric embedded stamping (PEES) method. The observation under the SEM and digital microscope showed that the bio mimicked shark skin sample showed the same topographical features as the real shark skin sample. The inclined plane experiment was conducted by recording the highest maximum slope angle of the different samples when it started to slide over several types of surfaces in different surface conditions. From the experiment, it was observed that the caudal (along the denticles) direction recorded the lowest coefficient of friction (COF), followed by lateral (sideways) direction and rostral (against the denticles) direction for both real and bio mimicked shark skin samples. The COF of each sample was recorded to be the highest when it was sliding over wet laminated plywood while the lowest was over the dry acrylic surface. Meanwhile, experiment using a force transducer was done by sliding an index finger over different type of samples in a different direction and dry condition. This experiment also recorded the same result as the inclined plane experiment for both real and o mimicked shark skin sample where the lowest COF was recorded in caudal direction. Lastly, anti-fouling properties of the sharkskin samples were assessed by investigating the percentage of algae formation over the surface of the flat surface, real and biomimicked shark skin bio mimicked shark skin did not show any algae formation after being soaked for two weeks.

Snake surface microstructure is replicated using PEES method (PDMS elastomeric stamping method) based on snake species Malayophyton Reticulatus. Two replicated samples were produced which were negative and positive imprint. The snake surface microstructure has anisotropic properties. The purpose of this study is to observe microbial growth properties of real snake and replicated snake surface microstructures. The replicated snake surface microstructure is observed under scanning electron microscope (SEM). Based on the observation of snake ventral scale under the scanning electron microscope (SEM) it shows that the surface microstructure is like a V shape structure. In microbial growth experimental analysis, the samples were immersed in a fishpond to observe its algae formation. Results show reductions in algae formation for replicated snake ventral scale compared to a flat surface without replication.

D. Pencapaian Utama
Key Findings

The key findings of this project are stated as follows:

- The friction evaluation experiment using the inclined plane recorded the lowest COF in the caudal direction when it was sliding over the acrylic surface in dry condition while the highest COF was in rostral direction when sliding over wet laminated plywood.
- For force transducer experiment, the lowest COF was also recorded in the caudal direction, followed by lateral and rostral direction.
- Caudal was the direction along the denticles so there was less resistance when sliding along the plane. Meanwhile, rostral was the direction against the denticles so it resisted the sliding motion which resulting in higher COF.
- The biomimicked shark skin sample showed similar frictional behaviour as the real shark skin for both friction evaluation experiment, so the implementation of a biomimetic technique has great potential in reducing drag and friction.
- Meanwhile, algae formation was recorded to be the highest for flat surface (71%) while the real and biomimicked shark skin did not the formation of algae, hence, the shark skin samples showed anti-fouling properties.

The microbial growth of snake surface microstructure successfully analysed. The figure 4.3 that represents the percentage of algae formation on surfaces show that flat surface without replication has the highest percentage which is 16.9%. While for replicated snake ventral scale for negative imprint is only 2.74% and reduction of algae formation by 14.19% compared to flat surface without replication. Furthermore, for replicated snake ventral scale for positive imprint no algae formation visible under observation thus 0% and reduction of algae formation by 16.9% compared to flat surface without replication. This data shows that the surface microstructure of snake ventral scale successfully improved the surface properties by reducing the number of algae formations that attach to the surfaces.

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*	2 (Final Year Project)
	Tesis/disertasi pelajar sarjana *Student's Masters thesis/dissertation*	
	Tesis pelajar PhD *Student's PhD thesis*	
	Kertas persidangan tempatan *Local conference papers*	2 Presentations
	Kertas persidangan antarabangsa *International conference papers*	
✓	Makalah dalam jurnal tempatan *Local journal papers*	2 Journals
✓	Makalah dalam jurnal antarabangsa *International journal papers*	
	Monograf atau buku *Book/monograph*	

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

Nil

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)

- ✓ Accepted to be published in M D Ibrahim, M Micheal Coline, A A Ananthan, D S Abang Mahmod, Y Sunami, "Evaluation of Microbes for Biomimicked and Real Snakeskin," Proc. of the 14th Engineering Conference "Pandemic-Driven Opportunities and Challenges in Engineering and Technology", EnCon 2022, Webex Online, 23-24th Feb 2022, Kuching Sarawak, Malaysia, pp. 1-8.

- ✓ Accepted to be published in M D Ibrahim, A Barragh Sambang, E N Abdull Aziz, D S Abang Mahmod, A A Alias and Y Sunami, "Tribological Evaluation of Friction and Microbes for Bio mimicked and Real Shark Skin," Proc. of the 14th Engineering Conference "Pandemic-Driven Opportunities and Challenges in Engineering and Technology", EnCon 2022, Webex Online, 23-24th Feb 2022, Kuching Sarawak, Malaysia, pp. 1-8.

F. Pengecaman Output
Output Identification

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√	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 study* atau bahan latihan *The finding is suitable for use as a complementary teaching/training material (a case study)*
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	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

This research is a part of investigation on how to control friction using biomimicry, learning from nature. The success of mimicking the snake and shark skin using PDMS and evaluating the surface profile characteristics makes this research brought one step closer to learning how to control hydrodynamic and dry friction at the same time. It is hoped that the findings from this research will be able to be applied to biomedical appliances and flexible electronics, and wearable technology one day.

Catatan Penting/Important Notes

Penyelidik diminta mengemukakan kepada Pusat Penyelidikan:

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Researchers are required to submit to the Research Centre:

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

.....	.....
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***	:	Rotary drying machine for palm oil mill sludge
	Ketua Penyelidik ***Project Leader***	:	Dr Abang Mohammad Nizam Abang Kamaruddin
	Fakulti/Institut ***Faculty/Institute***	:	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	:	Ir. Rudiyanto Philman Jong Assoc. Prof. Dr Abdullah Yassin
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	:	1st January 2021
	Tempoh Projek ***Project Duration***	:	1 year (1 Jan 2021 – 31 Dec 2021) *Extension 28 February 2022*
	Peruntukan Yg. Diluluskan ***Budget Approved***	:	RM 10000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	:	RM 9420.00

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 research has produced a prototype design for small-scale palm oil mill sludge drying machine that has been tested on simulation basis. Machine prototype parts has been fabricated and ready to be assembled for full scale testing. The prototype should be able to process approximately 10kg of wet sludge and produce about 3 – 4 kg of dried sludge.

Figure C1: Fabricated prototype of drying machine chamber

Optimized machine configuration for thermal performance and air movement has been obtained through application of TRIZ principles. Several configurations were tested for air flow and temperature distribution by simulation and being validated with laboratory scale experiment including the drying capability of the tested configurations.

On overall, improved design from the previous design that was set as the baseline for this study on thermal performance and drying capability. The control mechanism, however, will have a potential for continuation of study based on the promising results on the thermal performance and drying capability.

D. Pencapaian Utama
Key Findings

The project key findings are as follows:

i) Prototype design for small-scale palm oil mill sludge drying machine:
Applying TRIZ principles in design selection, this research has proposed a prototype design for optimized palm oil mill sludge drying machine. The prototype has been fabricated but require further testing on full scale basis. Even though the full-scale test has not been conducted, the laboratory scale test and simulation had shown promising results for the success of the prototype.

ii) Optimized thermal performance configuration for the small-scale palm oil mill sludge drying machine:
The small-scale palm oil mill sludge drying machine configurations was evaluated on thermal performance, on both temperature distribution (at a constant of 40°C) and air flow behaviour by computational fluid dynamics simulation, and drying capability test by laboratory scale experiment. It was found that the drying capability was optimized with the configuration of heated air being introduced at the sides of the chambers horizontally, and exhaust air through the top of the chamber vertically. This configurations has been implemented on the fabricated small-scale palm oil mill sludge drying machine chamber.

iii) Improvement of dryer machine from previous design:
Previous machine design was developed with a small capacity of 1kg of wet sludge, hence giving an output of less than 1kg of dried sludge for each time of machine operation. This has a practicality issue even if the production of the dried sludge as fertilizer is for own use. Hence, this research has improved not only the thermal performance and drying capability of the machine, but also on the capacity of the machine to approximately 10kg of wet sludge. Hence, the output is about 3-4 kg of dried sludge per machine run.

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*	2 (Final Year Project)
	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 (Presented in EnCon 2022)
	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*)

Nil

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)

- ✓ Jong, R. P., Shayuri, M. I. A., Yassin, A., & Kamaruddin, A. M. N. A. (2022). Thermal performance evaluation of a small-scale drying machine for palm oil mill sludge. Paper presented at the International UNIMAS Engineering Conference 2022 (EnCon2022), Universiti Malaysia Sarawak. 23-24 February 2022.

- ✓ Shayuri, M. I. A. (2021). Improvement of Drying Effectiveness for Palm Oil Sludge Drying Machine. (Bachelor of Mechanical Engineering Final Year Report). Universiti Malaysia Sarawak.

- ✓ Elin, D. E. P. (2021). Design of Control System for Semi Automated Rotary Palm Oil Mill Sludge Drying Machine. (Bachelor of Mechanical Engineering Final Year Project). Universiti Malaysia Sarawak.

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*
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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)*
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	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

The idea of small-scale drying machine for palm oil mill sludge is to enable small and medium sized farmers or planters to benefit from the production of organic fertilizer from the palm oil mill sludge for own usage or as income generator. Additionally, the effort will allow the community to work towards the environmental conservation efforts in reducing the usage of land for sludge treatment, as an example.

This research has produced a prototype design for small-scale palm oil mill sludge drying machine, with estimated capacity of 10kg of wet sludge to produce about 3-4 kg of dried sludge. Applying the TRIZ principles on design selection, the design is further strengthened through optimization of thermal performance with computational fluid dynamics and drying effectiveness by laboratory scale experiment.

The current design is an improved upscaled design for larger production and better drying performance than the previous design. It is hoped that the output of this research would benefit the society especially those who are within the radius of activities related to the palm oil industry.

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:

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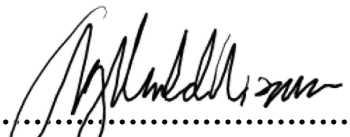

…… 25/3/2022 ……

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***		: Fuel efficiency enhancement of a power-split hybrid electric vehicle using fuzzy logic-based energy management strategy
	Ketua Penyelidik ***Project Leader***	**:**	Ts. Dr. Mohamad Faizrizwan Bin Mohd Sabri
	Fakulti/Institut ***Faculty/Institute***	**:**	Faculty of Engineering
	Ahli Kumpulan Penyelidik ***Research Team Members***	**:**	1. Ts. Maimun Binti Huja Husin 2. Ts. Shamsiah Binti Suhaili 3. Sharifah Masniah Binti Wan Masra
B.	**Tarikh Geran Diluluskan** ***Grant Approval Date***	**:**	4 December 2020
	Tempoh Projek ***Project Duration***	**:**	1 Jan 2021 – 28 Feb 2022 (14 months) *Extension 31 Dec 2021*
	Peruntukan Yg. Diluluskan ***Budget Approved***	**:**	RM 10000.00
	Perbelanjaan Terkini ***Expenditure To-Date***	**:**	RM 9302.50

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.

Based on the objectives of the project:

1.To model a power-split HEV capable of acceptable vehicle performance and fuel consumption through Simulink model modification for simulation purposes.

2 HEV architectures have been used in this project to test and simulate several EMS developed throughout the project duration. These HEV models are modified based on the open-source Simulink HEV model in MATLAB and have been beneficial in helping students to catch up quickly to the HEV topic and thanks to the robustness and freedom presented by the model, it has allowed for different EMS design philosophy and ideas to be carried out and simulated.

2.To embed a smart power flow management strategy based on fuzzy logic to achieve improved fuel efficiency and performance.

The proposed method for the EMS to be deployed ion this project is fuzzy logic but before diving straight into that, it is important to understand the functionality and capability of the HEV model, thus step-by-step approach has been taken to develop the fuzzy logic-based EMS algorithm. Starting from the simplest rule-based controller, the EMS controller of the HEV has been modified further in the attempt to enhance the HEV performance in terms of fuel efficiency. The result is a blended mode fuzzy logic-based EMS which is able to reduce fuel consumption while maintaining good SOC of the battery.

3.To analyse the gain in performance of the energy management controller designed for the power-split HEV through simulations over standard drive cycles.

All EMS controllers are tested on the HEV models using simulations over standard drive cycles and from the simulations, it can be shown that the blended-mode fuzzy lofice-based EMS is able to reduce up to 35.49% fuel consumption over NEDC compared to rule-based EMS.

D. Pencapaian Utama

Key Findings

The key findings of this project are stated as follows:

1. The completion of HEV simulation model on Simulink that can be used to do further modification and simulations in the future which will definitely be a cost saving method for entry into HEV research.
2. From the simulations in can be concluded that the objectives have been achieved. Several online EMS methods have been designed and evaluated. The results have proven that it is possible to deploy low complexity EMS controllers in HEV with varied level of success. It can be observed that the higher the complexity of the EMS design, the better it gets in terms of minimizing the FC and preserving the battery life.

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*	5 (Final Year Project)
	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 conference papers
	Makalah dalam jurnal tempatan *Local journal papers*	
✓	Makalah dalam jurnal antarabangsa *International journal papers*	1 Journal
	Monograf atau buku *Book/monograph*	

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

Nil

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)

All conference papers and journal paper are in the process of publishing.

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*
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	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

The purpose of this research is to explore on methods to improve fuel efficiency of a HEV through a smart and adaptive EMS. The power flow in the proposed model is decided based on its current vehicle speed and the global discharge rate (GDR) value derived from the real-time battery state-of-charge (SOC) and remaining trip distance. From simulations over standard drive cycles, the proposed controller is able to outperform a rule-based EMS by up to 65.4 % improvement in fuel consumption which subsequently reduce the volume of pollutants being released to the atmosphere.

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*

28 /03/2022

…… ……

Tandatangan (Penyelidik Utama)
Signature (Principal Researcher)

Tarikh
Date