i-SPiKE 2023

INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

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Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality . I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH

WELCOME MESSAGE (i-SPiKE 2023 CHAIR)

We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPiKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPiKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail
Chair
3rdInternational Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023)

TREATMENT OF PALM OIL MILL EFFLUENT (POME) USING ELECTROLYSIS

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ABSTRACT

Wastewater treatment is crucial to remove all the solids and contaminants in grey water before being discharged into the environment. This method is significant in safeguarding water quality and environmental ecosystems. It can be denoted that; the palm oil industry has become one of the valuable resources in Malaysia's economic growth. Malaysia is one of the world's largest producersof palm oil. Palm oil brings many benefits in terms of oil production and other products. However, these industry activities can cause environmental pollution. It has generated hazardous waste, namely palm oil mill effluent (POME), threatening human and aquatic life. POME is a brownish liquid, richin organic material and has an unpleasant odour. Over the past decade, wastewater treatment using electrolysis/electrocoagulation has been effective in various water treatment applications in urban and industrial wastewater treatment. Three objectives have been highlighted in this study. Firstly, to characterize POME, which contains high biochemical oxygen demands (BOD), chemical oxygen demands (COD), and suspended solids. Secondly, fabrication of the electrolysis reactor for treating POME. Lastly, to evaluate the quality of treated POME using the Environmental Quality Act 1974. The data obtained has proved the effectiveness of the electrolysis technique. The concentration of contaminants such as BOD, COD, total suspended solids, phosphorus, turbidity, ammonia-nitrogen, nitrite-nitrogen, and nitrate-nitrogen have decreased after the treatment.

Keywords: Electrolysis; palm oil mill effluent; wastewater treatment.

INTRODUCTION

The palm oil industry has played a key role in the development of Malaysia. Malaysia is one of the world's largest producers of palm oil. Palm oil provides many benefits, especially to Malaysia's economy. However, these industry activities can cause environmental pollution. It has generated hazardous waste, namely palm oil mill effluent (POME), threatening human and aquatic life. POME is a brownish liquid, rich in organic material and has an unpleasant odour

(Nasrullah et al., 2017). POME consists of high biochemical oxygen demands (BOD), chemical oxygen demands (COD), and suspended solid approximated at 25,000 mg/L, 53,630 mg/L and 19,020 mg/L, respectively (Bashir et al., 2019). The industry should have an efficient pre-treatment to remove the contaminants in the influent before being discharged into the water bodies. This effluent must achieve the required standards of the Department of Environment, Malaysia. Conventional wastewater treatments, such as aerobic-ponding systems, require a large treatment area and technical workforce (Nasrullah et al., 2020).

Over the past decade, wastewater treatment using electrolysis/electrocoagulation has been effective in various water treatment applications in urban and industrial wastewater treatment (Harif et al., 2012). This process generally has no chemicals addition, low maintenance and requires less attention from the operator (Jovanović et al., 2021), so it is safer and easier to be implemented (Bashir et al., 2019). This study was designated to evaluate the effectiveness of electrolysis in treating POME in terms of contaminant removal in line with the standard and regulations stated by the Department of Environment, Malaysia (refer to Table 1) (ILBS, 2019).

Table 1. Environmental Quality Act 1974 for POME (Schedule 2) (ILBS, 2019).

Parameter	1984 (& consecutive years)
Temperature (°C)	45
pH Value	5.0-9.0
BOD_5 at 20°C (mg/l)	100
COD (mg/l)	-
Total Solids (mg/l)	-
Suspended Solids (mg/l)	400
Oil & Grease (mg/l)	50
Ammonia-nitrogen	150
Total nitrogen	200

LITERATURE REVIEW

The growing industrial use of palm oil causes an increase in palm oil mill effluent (POME). POME is a threat to our environment if it is not treated efficiently. According to previous research (Augustyn, 2021), electrolysis is an electrochemical process where a direct electric current passes through the substance, which will affect the chemical changes. This electrochemical process can be used to remove the contaminants in wastewater called electrocoagulation. Electrocoagulation helps to decrease waste residue. Pairs of metal sheets assembled as electrodes are used in the electrocoagulation processes. They are arranged in two labelled anodes and cathodes and are made of two metal sheets. Following the electrochemistry rules, the cathode will be oxidized (loses electrons), and the water is reduced (gains electrons), which makes the effluent cleaner from the previous condition (Butler et al., 2011). Electromechanically, the metal ions attract the destabilized impurities and tend to create metal oxides. The charge carried by an electrical current running through metal plates aids in optimizing the removal process. The sludge formed by the precipitation process will settle at the bottom, while the flocs formed in the process may float at the top.

RESEARCH METHODOLOGY

This section outlines the research's flow using a particular strategy to accomplish the research's goals. All the methods used are explained in detail, starting from sample collection,method of treatment, and laboratory testing for the sample evaluation. The data collection consists of characteristics of POME before and after the treatment, such as pH, turbidity, total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, and phosphorus.

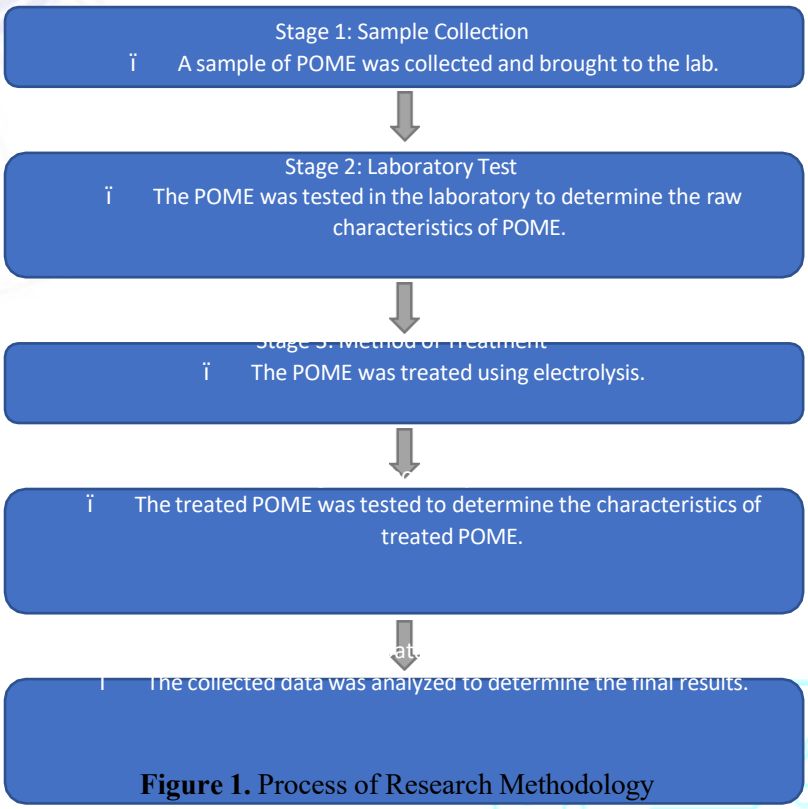

Figure 1. Process of Research Methodology

There are five stages in conducting this research. The first stage was data collection. The raw sample of POME was obtained from Malaysian Palm Oil Board (MPOB) and collected from the palm oil factory in Port Dickson, Negeri Sembilan. An amount of 40 litres of POME sample was brought to the Environmental Laboratory in the School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Selangor, Malaysia.

In the second stage of the laboratory test, the POME was evaluated to determine the characteristics, such as pH, turbidity, total suspended solids (TSS), biochemical oxygendemand (BOD), chemical oxygen demand (COD), ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, and phosphorus.

Then, in the third stage, the POME was treated using electrolysis. A reactor has beenfabricated for this study consisting of power supplies, wires, and electrode plates. For the firstexperiment, 10 L of 100% POME samples without dilution were added to the reactor. The two electrode plates were submerged in the POME samples. Then, each plate was connected to the power supply using wires. Lastly, the power supply was switched on. Aluminiumplates were used in this experiment as anode and cathode. The process used two power supplies with 5 amperes and 18 voltages each. The treated POME sample was collected every30 minutes. The treatment was continued using different concentrations of POME. Here, in the experiment, electrolysis processes were carried out with three different concentrations of POME, consisting of 10% POME in distilled water, 30% POME in distilled water, and 100% POME without dilution.

Later, in the fourth stage, the treated POME was tested to determine its characteristics. The data collected was recorded. Lastly, the fifth stage is comprised of data evaluation. The results on characteristics of POME before and after treatment were analyzed.

RESULTS AND DISCUSSIONS

Tables 2 and 3 show the characteristics of the POME samples obtained from the Malaysian Palm Oil Board (MPOB). The values of contaminants in the untreated POME are very high compared to those allowed in the Environmental Quality Act 1974 (ILBS, 2019) in Table 1. From the data obtained, the contaminants in POME have been reduced after the treatment, which indicated that electrolysis could treat POME effectively. However, from the observation, the low current supplied in this process needs extended time to remove the contaminants from the POME.

Table 2. Characteristics of POME before treatment

Parameter	Concentration	Unit
Biochemical oxygen demand (BOD)	2330	mg/L
Chemical oxygen demand (COD)	23700	mg/L
pH	3.90	
Turbidity	5100	NTU
Ammonium-nitrogen	175	mg/L
Phosphorus	218	mg/L
Total suspended solid (TSS)	14800	mg/L
Nitrite-nitrogen	250	mg/L
Nitrate-nitrogen	310	mg/L

Table 3. Characteristics of POME after treatment

Concentration (mg/L)	Time (min)	TSS (mg/L)	COD (mg/L)	pH	NH_4-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	Phosphorus (mg/L)	Turbidity (NTU)	BOD (mg/L)
100%	0	14800	23700	3.94	175	250	310	218	5100	2330
	30	5500	17300	3.90	80	220	282	176	2700	2280
	60	4200	15800	3.91	51	210	247	118	1822	2150
	90	3100	13600	4.02	39	190	243	113	1664	2090
	120	2600	13600	4.71	35	170	237	98	1602	2010
	180	2200	13200	4.68	32	100	218	94	1460	1890
	240	2000	13100	4.71	24	80	203	86	1398	1740
	300	1700	12200	4.74	17	50	187	74	1307	1680
30%	0	3000	16400	4.19	52	110	110	89	1366	680
	30	2400	15200	4.42	37	100	103	87	1136	620
	60	2000	13600	4.46	20	80	101	86	1102	600
	90	1800	12800	4.72	18	74	94	82	832	560
	120	1400	12000	5.13	14	50	89	80	824	510
	180	800	6000	5.32	10	32	75	72	758	440
	240	600	3200	6.21	8	29	69	66	556	380
10%	0	1600	10000	4.13	20	47	52	17	902	320
	30	1000	7200	4.97	16	43	47	15	792	310
	60	200	5200	5.19	13	40	42	15	664	280
	90	0	4800	5.66	10	39	36	11	598	240
	120	0	2000	6.69	9	34	34	9	364	210
	270	0	2000	7.40	9	19	22	6	196	150
	300	0	1200	7.46	6	17	14	6	158	120
	360	0	1000	7.51	4	13	9	4	90	70

CONCLUSION

It can be deduced that the electrolysis adopted in this study has been effective in treating the contaminants of POME, such as BOD, COD, total suspended solids, phosphorus, turbidity, ammonia-nitrogen, nitrite-nitrogen, and nitrate-nitrogen. More time must be taken into the electrolysis process to achieve a higher quality of POME. Therefore, recommendations for future research have been outlined for this study. High current and voltage in the electrolysis process may improve the treatment rate and less time needed to remove all the contaminants. Different types of electrode plates can be used to evaluate electrolysis performance intreating the POME samples.

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