Kementerian Perindustrian
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ICSTSI 2020

PROCEEDING

International Conference on Science and Technology for Sustainable Industry

"Emerging Science and Technology as A Solution for Global Challenge on Research and Technology Based on Sustainable Resources"

Banjarbaru, August 6th-7th 2020

BALAI RISET DAN STANDARDISASI INDUSTRI BANJARBARU
Badan Penelitian dan Pengembangan Industri
Kementerian Perindustrian
2020

PROCEEDING

INTERNATIONAL CONFERENCE ON SCIENCE AND TECHNOLOGY FOR SUSTAINABLE INDUSTRY (ICSTSI) 2020

Theme:

"*Emerging Science and Technology as a Solution for Global Challenge on Research and Technology Based on Sustainable Resources*"

Banjarbaru, 6-7 August 2020

Editor in Chief:

Prof. Rodiansono, Ph.D.

BALAI RISET DAN STANDARDISASI INDUSTRI BANJARBARU
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INTERNATIONAL CONFERENCE ON SCIENCE AND TECHNOLOGY FOR SUSTAINABLE INDUSTRY (ICSTSI) 2020

"*Emerging Science and Technology as a Solution for Global Challenge on Research and Technology Based on Sustainable Resources*"

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ISBN 978-602-53575-1-0

Penerbit:
Balai Riset dan Standardisasi Industri Banjarbaru
Badan Penelitian dan Pengembangan Industri
Kementerian Perindustrian

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Cetakan pertama, Desember 2020

PREFACE

The 1st **International Conference on Science and Technology for Sustainable Industry** (ICSTSI) is organized as a collaboration between The Institution of Research and Standardization of Industry Banjarbaru (Balai Riset dan Standardisasi Industri Banjarbaru) and The Chemistry Department of Lambung Mangkurat University. The theme of this conference is *"Emerging Science and Technology as a Solution for Global Challenge on Research and Technology Based on Sustainable Resources"*. Sustainability remains a crucial issue regarding how the industrial sectors use technology to explore and utilize resources in the era of industrial revolution 4.0. This revolution has started with the applications of advanced manufacturing and digital information technologies. The world is undergoing a fundamental transformation, which is changing the way we live, work and think. The fourth industrial revolution presents a future filled with exciting opportunities and new challenges and the potential to meet specific requirements during the COVID-19 crisis. Industry 4.0 technologies have the capability of providing better digital solutions for our daily lives during this crisis.

The main goal of this conference is to bring together scientists, academics, and practitioners who work in various fields to exchange their ideas by presenting their research findings. This two-day of conference are certainly the moment of scientific forum that can be used as a means of knowledge exchange to connect participants (in any discipline) with each other, so they can discuss their work, learning from one another, and achieving improvements in results.

In the initial plan, this conference should have been held in Banjarbaru, a city in the province of South Kalimantan, Indonesia on August 6th-7th 2020. Unfortunately, due to the extraordinary global health issue with the coronavirus disease (Covid-19) that causes the large-scale social restrictions in the framework of the acceleration of Covid-19 handling, ICSTSI was held virtually while maintaining its original schedule. There were about 250 attendees that participated in the conference meeting, and 154 of them were presenting their papers in the plenary sessions. The meeting was done by virtual instead of being postponed because virtual meetings have become the new normal under COVID-19. The virtual meeting *was held by Zoom* meeting video-*conference method*. This virtual conference could be used as a tool to speed up existing discussions and timelines among scientists. Each presenter delivered the paper for approximately 7 minutes presentation and followed by 3 minutes discussions and Q&A sessions. The event was appreciated by the participants because it was well-organized and being one of the pioneers in the new normal video-conference trends. The YouTube channel of the opening ceremony ICSTSI 2020 could be found here https://s.id/u1Kmu.

The plenary session in the first day consisted of the presentation by keynote speakers and poster presentations. The parallel session in the second day contained of invited speakers and oral presentations, divided into 6 different topics: material and applied chemistry; wood and non-wood forest products technology; food, cosmetics, and medicine; analysis and method validation industrial, process optimalization technology; biorefinery, bioenergy, and renewable energy and biotechnology; and waste treatment and environmental management. The keynote and invited speakers who had been presented on this conference are listed below.

Keynote Speakers:
Dr. Ir. Doddy Rahadi, MT (Ministry of Industry, Indonesia)
Prof. Dr. Shinso Yokota (Utsunomiya University, Japan)
Assoc. Prof. Dr. Azlan Kamari (Universiti Pendidikan Sultan Idris, Malaysia)
Prof Dr. Ir. Umar Santoso, M. Sc. (Faculty of Agricultural Technology Gadjah Mada University, Indonesia)
Mukhlis Bahrainy (The CEO of Pachira Group)
Prof. Dr. Is Fatimah (The Islamic University of Indonesia)

Invited Speakers:
Prof. Rodiansono, Ph.D (Lambung Mangkurat University)
Prof. Gustan Pari (Forest Products Research and Development Center)
Dr. Nazarni Rahmi (The Institution of Research and Standardization of Industry Banjarbaru)
Ir. Lies Indriati (Center for Pulp and Paper)
Dr. Lisman Suryanegara (Center for Research of Biomaterial, Indonesian Institute of Science)
Dr. Aris Mukimin (Center for Industrial Pollution Prevention Technology)

The committee has received 154 papers from both oral and poster presentations, with the participants spread from many countries like Indonesia, Japan and Malaysia. The participants of conference came from various research institutions and universities in Indonesia. These papers were reviewed by scientific committee and 85 full papers were accepted to be published in IOP Proceeding Conference Series, 11 papers were published in ISBN Proceeding, 1 paper were published in the accredited national journal and the rest were rejected and unpublished. We would like to thank the participants who have submitted their papers. We also highly appreciate the sponsors who financially supported this event especially to the Industrial Research and Development Council Ministry of Industry, Indonesia.

Banjarbaru, December 2020
ICSTSI Committee

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Study on the influence of production facilities and competence toward job satisfaction on foundry industries in West Java, Indonesia

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Abstract. A study on the influence of production facilities and competence toward job satisfaction on foundry industries in West Java, Indonesia has been done. The target of this research is to analyze the influence of production facilities and to job satisfaction that was not as expected yet. The method of research used descriptive analysis of the three variables studied with approximately 100 respondents of the survey result to six foundry industries in West Java Indonesia. The results of this research in a descriptive study showed that the production facilities, the competency and the job satisfaction were fair to good categories. The production facilities had an average value of 3.2943 and standard deviation 0.5452; the competency had an average value of 3.5647 and standard deviation 0.5796; job satisfaction had an average value of 3.2679 and standard deviation 0.5658. The production facilities and competence have influenced employee job satisfaction, the direct and indirect of 27.72% on foundry industries in West Java, Indonesia.

1. Introduction

A free competition which is full of competition and consumer demand for products/services better with the delivery time, has spurred the company of any organization or institution, both private and government to improve its performance. To be successful, they are required to cost-saving efforts, optimize production capacity, increased efficiency and productivity and also improve services [1]. Foundry industry is an industry relied on by capital asset companies, including the manufacturers of those machinery and factory equipment that are needed enormously in various sectors. It can supply the engineering components from agriculture, mining, power plant, communications, construction, industrial, up to transportation. The users spectrum of casting products is such wide that casting stands at a strategic position in a country's structure of industry [2].

To increase the improving of foundry industry productivity, employee performance should necessarily be optimized, because it would in turn increase the performance of the company as a whole [3]. Therefore, so as to improve organizational effectiveness [4] it needs to evaluate the company through the improvement of production facilities, competence and job satisfaction. Production facilities have an influence on employee job satisfaction. This is in accordance with the results of Sonny's research [5] that said the adequate presence of production facilities can produce optimal productivity of casting products that affect employee job satisfaction.

Employee competencies with job satisfaction influence each other as revealed by Wibowo [6] that competency is the ability of a person to produce at a satisfactory level in the workplace, including one's ability to transfer and apply these skills and knowledge in new situations and increase the agreed of benefits [7].

Furthermore Cascio [8], said that the ability and motivation as interactional factors with performance. Ability is determined by skill and knowledge, while skill is influenced by the capability, personality, and knowledge is formed by education, training experience, and interests that are all summarized in competency theory.

As an effort to the development of foundry industry in West Java, Indonesia. It needs to improve the employee job satisfaction requires complete production facilities and high competence of technicians (operators) [9]. Based on the problem mentioned above, the purpose of this research is to analyze how much influence of the production facilities and competence to job satisfaction that was not yet as expected. One of the causes of not jet optimal job satisfaction is suspected to be due to incomplete and out of dated production facilities and the low job satisfaction of employees.

2. Methods

Viewed from its method aspect, the present research was an analysis of primary and secondary data. The primary data was collected for some time of 2019 by survey in six selected foundry industries in West Java, Indonesia. The primary data obtained through survey by conducting research, interviews to selected companies in addition to the hearings with technicians and experts. The secondary data obtained by a literature study, journals, internet browsing, etc.

The object of this research is to determine and analyze the current condition of production facilities, competence and job satisfaction and how much influence of production facilities and competence to job satisfaction. The location foundry industry in West Java, Indonesia. Six companies were selected, namely: W-1, W-2, W-3, W-4, W-5, and W-6 [2, 9]. For the sake of confidentiality of those foundry industries which were selected to be the research object, then, in conformity with ethic code, written here were only the initials of the companies. The assessment of respondents used five (5) levels with score as follows: very good (4.21 - 5.00), good (3.41 - 4.20), fair (2.61 - 3.40), poor (1.81 - 2.60), bad (1.00 - 1.80) [10].

The method of research is as follows: (a) the sampling technique: cluster proportional random sampling [10], (b) sample size > 100 respondents, (c) the method of research using descriptive analysis, (d) the instrument research test: validity, reliability, normality. The steps of research can be seen in figure 1.

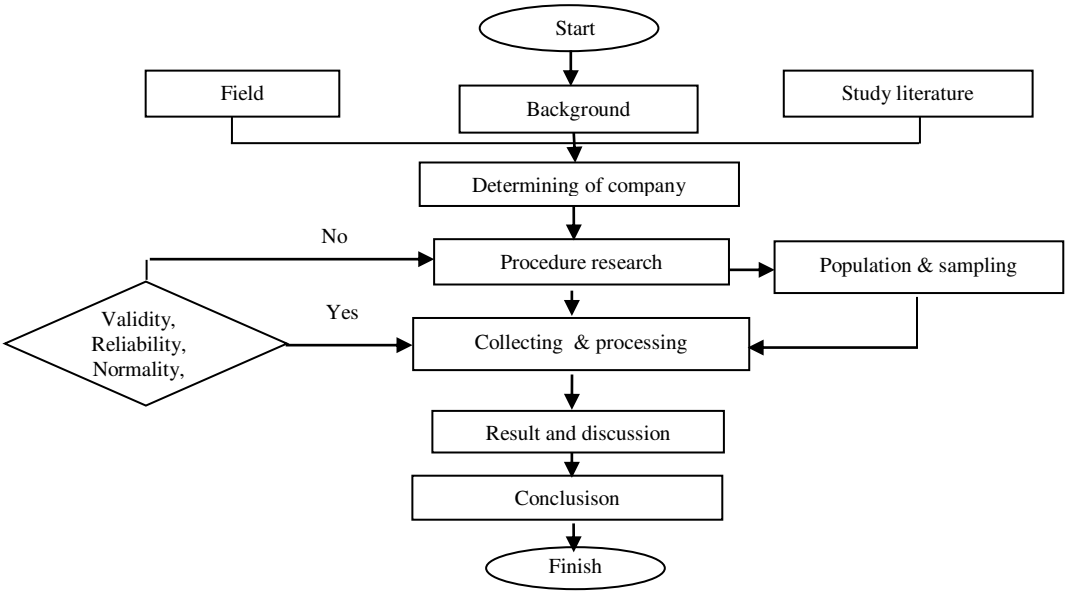


Figure 1. Flow chart of methodologies research.

3. Results and discussion

3.1. Foundry industry condition

The conditions of empirical data of six foundry industries selected in West Java, Indonesia, namely: W-1, W-2, W-3, W-4, W-5, and W-6 are shown in figure2, figure 3, and figure 4.

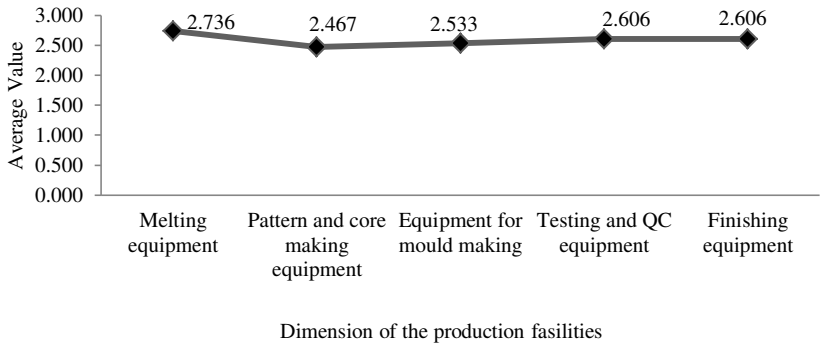


Figure 2. The production facilities of six foundry industries in West Java, Indonesia.

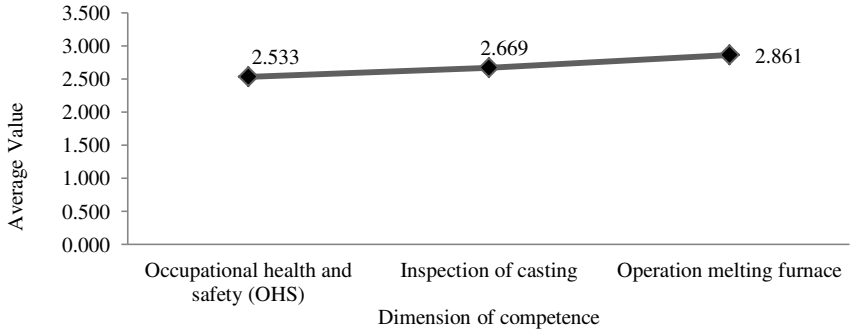


Figure 3. Competence of six foundry industries in West Java, Indonesia.

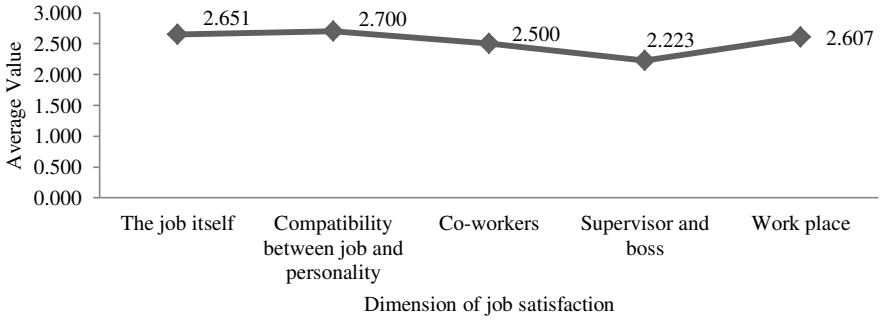
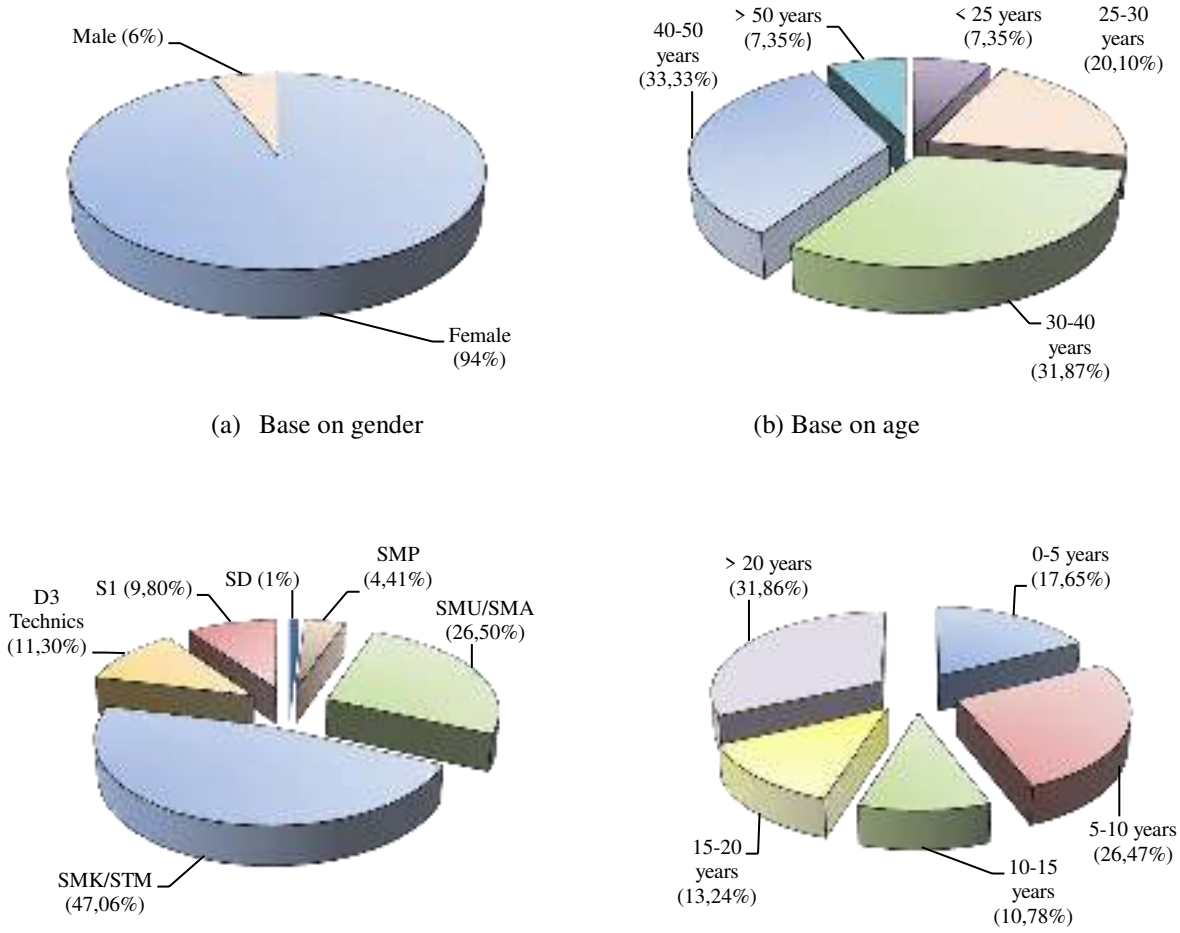


Figure 4. The job satisfaction of six foundry industries in West Java, Indonesia.

The description of respondents' characteristics was seen from gender, age, level of education, and year of service of the employees. More details are shown in figure 5 [2, 7, 9].



(a) Base on gender

(b) Base on age

(c) Base on educational

(d) Base on year of service of the employees

Figure 5. Respondents characteristics.

3.2. The instrument research test

The instrument used in this study was in the form of a questionnaire distributed to respondents with a sample size of approximately 100 employees to six foundry industries in West Java province. The research variables measured:

1. The production facilities, involving five dimensions, namely: melting equipment, pattern and core making equipment, equipment for mould making, testing and quality control equipment, and finishing equipment (5 dimensions).
2. Competence, involving three dimensions, namely: occupational health and safety (OHS), an inspection of casting, and operation melting furnace (3 dimensions).
3. Job satisfaction, involving five dimensions, namely: the job itself, compatibility between job and personality, co-workers, supervisor and boss, and workplace (5 dimensions).

The validity test of the instrument was performed to determine whether or not the data from the result of questionnaire collected was valid for all question, that is [11]:

1. The validity test : all instruments valid (valuer$_{computations} \geq r_{table}$ (0,30)
2. The reliability test : all instruments reliable (value $r_{computations} \geq$ 0,700)
3. Normality test : all instruments normal(value p-value > 0,05).

3.3. Production facilities description variable

The subjects were used to analyze the description of production facilities variable consisted of five dimensions, namely: (1) melting equipment, (2) pattern and core making equipment, (3) equipment for mold making, (4) testing and quality control equipment, (5) finishing equipment. The determination of the dimensions was in conformity with the research characteristics sourced from W-1[12].

The individual assessment of each dimension in production facilities could be categorized from fair up to good. However, if it is integrated into other dimensions, there was a gap between the results shown in the average value of each dimension of the production facilities variable. A quite significant gap occurs in the dimensions of finishing equipment, with the lowest average value of 3.035 and a standard deviation of 0.744. Whereas the highest results were obtained from the dimensions of equipment for mould making, which the highest average value of 3.446 and standard deviation of 0.761.

Based on the analysis result as a whole on the statement of production facilities variable, it could be interpreted that the production facilities variable had an average value of 3.2943 and standard deviation of 0.5452 at an interval scale from 2.749 to 3.839 it's categorized from fair up to good. It indicates that the production facilities in the six foundry industries in West Java has been good.

3.4. Competence description variable

The descriptive analysis of the technician competency variable consisted of 3 dimensions: (1) occupational health and safety (OHS), (2) inspection of casting, (3) operation melting furnace. The determination of the dimensions was in conformity with the research characteristics produced from SKKNI BNSP and TUK-LM BBLM [13].

The individual assessments of each dimension in the casting technicians' or casting operators' competency could be categorized from fair up to good. However, when integrated to other dimensions, it was found a gap between the results shown in the average value of each dimension of competence. A quite significant gap occurred in the dimensions of occupational health and safety (OHS), with the lowest average value was 3.550 and the standard deviation of 0.701. Whereas the highest results were obtained from the dimensions of operating melting furnace, which the highest average value is 3.574 and standard deviation of 0.622. It indicates that the K3 in the foundry workplace is very important for employees by following safe work practices, reporting hazards at workplace, following emergency procedures.

Based on the analysis result as a whole on the statement of the casting technician competency variable, it could be interpreted that the competency variable had an average value of 3.5647 and standard deviation of 0.5796 at an interval scale from 2.985 to 4,144 was in category of fair up to good. It indicates that the casting technician competency in the six foundry industries in West Java has been good.

The dimensions of work safety were generally categorized as poor because awareness and discipline regarding the use of safety equipment were still not optimal. For example, companies have facilitated safety equipment (safety shoes, aprons, face shield, helmets, etc.) according to the demands of their respective workplaces but technicians were less accustomed to using them.

3.5. Job satisfaction description variable

The descriptive analysis of job satisfaction variable consisted of 5 dimensions: (1) the job itself, (2) compatibility between job and personality, (3) co-workers, (4) supervisor and boss, and (5) working environment. The determination of the dimensions was in comformity with the research characteristic produced from George's and Jones [14] theoretical investigation.

By using the same method which is used by above production facilities and competence descriptive analysis. The calculations results of each dimension in employee's job satisfaction could be catagorized from not good to good. However, when integrated to other dimensions, it was found a gap between the results shown in the average value of each dimension of job satisfaction. A Quite significant gap occured in the dimensions of compatibility between job and personality,

the job it self and co-workers, with the lowest average values of 3.045; 3,080; 3.190 by standard deviation values of 0.735; 0.658; 0.706. Whereas the highest results were obtained from the dimension of supervisor and boss with the highest average value and standard deviation of 3.602 and 0.837, respectively.

Based on the analysis result as a whole on the description of job satisfaction variable, it could be interpreted that job satisfaction variable, falling into a category of fair up to good. It indicated that the employee job satisfaction in the six foundry industries in West Java has been good.

3.6. The influence of production facilities and competence toward job satisfaction

After analyzing the research instruments and scaling analysis, the collected data then used to analyze and test the formulation of hypothesis testing based on Structural Equation Modeling (SEM). As a result of SEM for processing data with the Lisrel 8.7, the model as shown in figure 6.

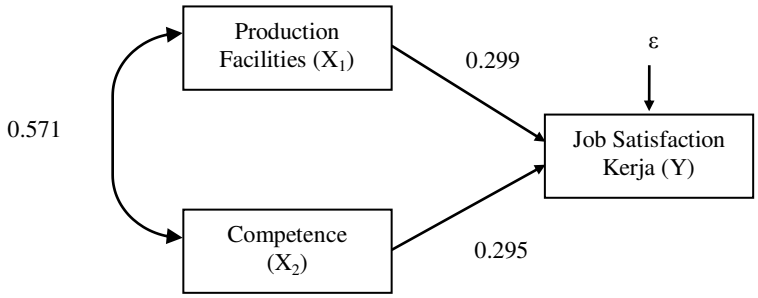


Figure 6. The result of path testing.

where ε is the epsilon.

The calculation results obtained indicate job satisfaction is influenced by the production facilities and competencies, both partially and simultaneously. Based on the correlation value and path coefficient obtained from the results of calculations with Lisrel 8.7, it can be seen the magnitude of the direct and indirect influence of the production facilities and competencies toward job satisfaction, shown in table 1.

Table 1. Direct and indirect influence of production facilities and competence toward job satisfaction.

Variables	Direct influence(1)	Indirect influence through		Indirect influence(2)	Total influence(1 + 2)
		Production Facilities	Competence		
Production Facilities	8.94%		5.04%	5.04%	13.98%
Competence	8.70%	5.04%		5.04%	13.74%
Total	17.64%	5.04%	5.04%	10.08%	27.72

Based on the analysis of the data in table 1, it can be seen that the influence of production facilities and competence toward job satisfaction is influenced by direct and indirect influence. The total influence production facilities, competence and job satisfaction is 27.72%. The direct influence of the production facility variable toward job satisfaction was 8.94% and the indirect influence through the competency variable (5.04%) so that the total contribution was 13.98%. While the direct influence of competence variables toward job satisfaction on job satisfaction was 8.70% and the indirect influence through production facilities (5.04%) so that the total contribution was 13.74%.

In addition to the two variables above, there were still many variables that gave influence toward job satisfaction because it was based on influences outside the model, that was 0.723, meaning that job satisfaction was influenced by variables outside the research model of 72.28%.

4. Conclusion

The production facilities in the foundry industries were perceived as varying from fair up to good. The highest average value was for the equipment for mould making. The lowest average value was for the finishing equipment. Competence in the foundry industries was perceived as varying from fair up to good. The highest average value was for the operating melting furnace. The lowest average value was for the occupational health and safety (OHS) in the workplace. The employees' job satisfaction in foundry industries was perceived as varying from fair up to good. The highest average value was for parameter of the supervisor and boss. The lowest average value for the compatibility of between job and personality. Production facilities and competencies have a direct and indirect effect on employee job satisfaction in the casting industry in West Java, Indonesia. The higher of employee's assessment of production facilities and competence, the greater the influence in increasing job satisfaction. The production facilities must be continuously improved to produce casting products that have high value, namely: vacuum induction furnace for melting and moulding machines with automatic working systems as well as testing and quality control equipment, namely: for moulding sand, chemical composition testing and mechanical tests, spectrometer, Scanning Electron Microscopy (SEM)/Energy Dispersive X-Ray Spectroscopy (EDS). Casting technician competencies need to be guided and developed through professional training that has recognized competency certificates. The job satisfaction of foundry technicians needs to be improved through work placement and rotation in accordance with their fields, providing fair remuneration and a good workplace.

Acknowledgments

The author would like to thank the directors and management in the foundry industries which have given licenses to visit industry and discussion, especially the companies involved in this study: W-1, W-2, W-3, W-4, W-5, and W-6.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 9 – 14
ISBN : 978-602-53575-1-0

UV-Vis and FTIR Spectroscopy: Can early risk of neonatal sepsis be investigated?

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Abstract. Neonatal sepsis (NS) is a clinical syndrome characterized by signs and symptoms of infection with or without accompanying bacteraemia in the first month of life. NS is one of the most common causes of neonatal mortality. It is responsible for 30-50% of neonatal deaths. The manifestation is mostly nonspecific. Blood culture as a gold standard for diagnosis still have many limitations, such as invasive, time-consuming, and highly cost. A strategy to reduce mortality of NS is early detections using biomarkers but most of them are PCR- and "-omic" technology-based and using blood as its sample. The alternative method is a spectroscopy technique using saliva as the sample because the procedure is non-invasive and does not require trained personnel and special equipment. This method is based on the absorption of light by a compound in a certain wavelength to detect biochemical changes in the early phases of disease since the biochemical changes will precede the morphological changes of the disease itself. The utilization of this method to analyze biomarkers in NS has been popular recently. Furthermore, additional research might be needed to study this method for early detection in NS.

1. Introduction

Spectroscopy is a method to analyze the interactions between molecules with light at certain wavelengths. The light that is passed through can be visible (Vis), ultraviolet (UV) and infrared (IR). UV wavelengths cover a range approximately 185-400 nm, Vis 400 - 700 nm and IR 700 - 15,000 nm [1]. In recent years, spectroscopy method has been used to analyze biological samples such as blood plasma, serum, and tissue. Besides, this method can explain the pathomechanism of disease and its molecular interactions, for example interactions between Pb as a cause of osteoporosis and damage to proteins by metals [2,3,4]. Thus, this method is able to detect biochemical changes in the early phases of a disease, including NS [5].

NS is a clinical syndrome of systemic disease caused by bacteraemia that occurs in the first month of life [6]. The clinical manifestations of NS are non-specifics, so the diagnosis is difficult to establish. Blood culture, the gold standard of diagnosis, has many limitations such as using

blood as a sample, time-consuming, and expensive. Blood sampling is not a simple procedure especially in newborns because it is invasive and traumatic [7].

Based on the above reasons, the non-invasive and non-traumatic samples are indispensable, such as saliva. Several studies have proposed using saliva as a sample for early detection of NS. For example, a study conducted by Yunanto *et. al*. [8] recorded that there were changes in the salivary protein structure of neonate at risk of sepsis compared to healthy infants using FTIR spectroscopy. Suhartono *et. al*. [5] also state that saliva can be used to detect hypoxia in neonate at risk of sepsis using UV-Vis spectroscopy. Furthermore, a question arises whether the spectroscopic method can be used for early detection of NS.

2. Neonatal Sepsis

Neonatal sepsis is a clinical syndrome of systemic disease caused by bacteraemia that occurs in the first month of life. This condition can be defined clinically and/or by microbiological examination, in the presence of positive blood cultures and/or cerebrospinal fluid [6]. The pathomechanism of NS is not fully understood. Some literature mention that there is a role of phagocytic cells such as neutrophils in NS. Invasive microorganisms activate the innate immune system as the body's defense mechanism. The immune response to invasive pathogens has an important role in clinical manifestations that arise in NS [9]. Although the inflammatory response is initiated by the presence of invasive pathogens, the inflammatory process that occurs itself is the result of the production of endogenous inflammatory mediators [10].

Previous studies showed that there is an involvement of oxidative stress in the pathomechanism of NS. Activation of neutrophils by invasive pathogens trigger the release of the myeloperoxidase enzyme (MPO) from its azurophilic granules. This activation is known as the respiratory burst. The respiratory burst process that occurs during neutrophil activation not only causes the release of the MPO enzyme from neutrophils but also activates the nicotinamide adenine dinucleotide phosphate oxidase (NADPH oxidase), an enzyme that catalyses the reaction between NAPDH and oxygen to produce superoxide radicals ($\bullet O_2$). Molecules $\bullet O_2$ will undergo further reactions to produce other reactive oxygen species (ROS) such as hydroxyl radicals (•OH) and hydrogen peroxide (H_2O_2). ROS production is important as a defense mechanism against pathogenic bacteria that are present at NS. The ROS is used to destroy invasive pathogens through a series of chemical reactions [11,12].

Besides, ROS produced through oxidative stress processes in NS can cause macromolecular damage, lipid peroxidation, oxidation of amino acid chains, the formation of protein cross-bonds, oxidation of polypeptide chains that form protein fragmentation, and DNA damage. Carbonyl protein derivatives (aldehydes and ketones) are produced by protein side chains oxidized by ROS. Carbonyl protein is a biomarker of protein oxidation markers that commonly used recently [11].

Changes in the internal and external environment of cells through the stress oxidation process can also cause cellular injury. The cellular injury that occurs can cause damage in the phospholipid membrane which is a major component of cell walls [13] It causes the release of arachidonic acid that is metabolized by prostaglandin synthase and cyclooxygenase to produce prostaglandins and thromboxane as inflammatory mediators [14]. The release of inflammatory mediators then promotes leukocytes-endothelial cell adhesion, production of nitric oxide, reactive oxygen, and nitrogen species which cause further reactions and induce endothelial dysfunction, vasodilation, and loss of vascular control [15].

Some inflammatory biomarkers that have been studied for early detection of NS are Advanced Oxidation Protein Products (AOPP), myeloperoxidase (MPO) enzymes, and carbonyl proteins [11]. This is based on the pathomechanism of NS through the oxidative stress pathway as mentioned above [11,12].

3. Saliva as the Biological Sample in Neonatal Sepsis

Saliva plays an important role in a variety of biological processes that occur in the oral cavity, including as a lubricant, chewing, food ingestion, and cleaning action, as well as protecting against

dental caries. Also, the salivary function is known to diagnose various diseases. The use of saliva as a biological sample for diagnostic convenience has several advantages compared to blood and urine. It is non-invasive, does not require skilled personnel and special equipment. Besides, saliva components do not change at room temperature and can avoid the risk of infectious diseases, such as HIV and hepatitis [16,17].

Saliva can determine the physiological and pathological situations of the human body. Saliva contains water, protein, electrolytes, urine, nitrogenous products, and enzymes. Since two thousand years ago, saliva has been used as a medium to help diagnose disease. Ancient Chinese medicine experts claimed that saliva and blood are "close relatives" in the human body. Both come from the same source that causes salivary components are derived from the blood through active transport or passive diffusion so that the biochemical and immunological levels in saliva can reflect conditions in the blood [18]. It has been proven that saliva has many benefits including containing antimicrobial compounds, monitoring the bone marrow function, and their utilization as disease biomarkers such as malignancy [19].

Until now, there is no standardization for saliva sampling methods. Two types of methods currently used for saliva sampling are aspiration and absorption. An aspiration method is using a pipette or suction to aspirate saliva. Meanwhile, an absorption method is using cotton buds or other absorbent devices such as filter paper or sterile cotton rolls to absorb saliva. Each of the methods has advantages and disadvantages. The aspiration method using suction is considered to be able to injure the neonatal mucous membranes which are very fragile and pollute the sample with blood, especially at strong suction pressure, but the sample obtained can be taken in quite a large volume. On the other hand, the absorption method is said to be safer and not injurious, but the volume is less [20].

Over the past few years, saliva is a biological product that has been widely studied for diagnosing disease. Some studies suggest that saliva can be used to diagnose systemic diseases such as diabetes, respiratory system diseases, chronic heart failure, Cushing's syndrome, and disorders related to stress and depression [21]. A study conducted by Yunanto *et. al*. [11] suggests that saliva may be used as an alternative sample examination of inflammatory biomarkers for early detection of NS. The results of the study showed AOPP levels increased in the blood and saliva of the neonate at risk of sepsis. This shows that saliva can reflect conditions in the blood.

4. Nikotinamid Adenin Dinukleotida Fosfat Oksidase (NADPH) Detection Using UV-Vis Spectroscopy

NADPH is an essential electron donor/cofactor produced from $NADP^+$ via the pentose phosphate pathway by glucose-6-phosphate dehydrogenase (G6PD) enzyme. NADPH has an important role in the enzymatic reaction of cell components biosynthetic such as DNA and lipids. Besides, NADPH plays a role in the formation of ROS and as an antioxidant defense mechanism in the oxidative stress process [24]. In NS, neutrophil activation by invasive pathogens triggers the release and activation of the MPO enzyme known as the respiratory burst process. The process will activate NADPH oxidase to catalyse the reaction between NAPDH and oxygen to produce ROS [11,12].

Plenty of work has shown the role of NADPH in sepsis. Exposure to Gram-negative bacterial lipopolysaccharide (LPS) in cardiomyocyte models with sepsis can induce the overexpression of NADPH. In a sepsis condition, an activity of the enzyme NADPH oxidase increases which will tend to consume NADPH as its cofactor, thus a decrease in NADPH in sepsis may be found. However, other studies pointed out that there was an increase in $NADP^+$ levels which might be a compensatory mechanism to increase NADPH after LPS exposure [23,24]. The result of an investigation by Poggi *et. al.* [12] showed that there was an overexpression of NADPH in the model cardiomyocytes with sepsis which caused overexpression of the cyclooxygenase-2 (COX-2) enzyme. The direct activity of NADPH oxidase and the increase in the COX-2 enzyme induced by NADPH also contribute to increasing the production of cytoplasmic O_2 cells. Meanwhile, the involvement of Gram-positive bacterial components in inducing overexpression of NADPH in NS is still unknown.

The measurement of NADPH concentration using the UV-Vis spectroscopy method has been done previously. Research by Karakaya *et. al.* [25] showed an increase in NADPH concentration in bacterial cells *Synechocystis sp.* and *E. coli* using the UV-Vis spectroscopy method by looking at its absorbance at a wavelength of 340 nm. However, the NADPH measurement as another inflammatory biomarker in NS, especially using spectroscopic methods has never been done.

5. Arachidonic Acid Detection Using FTIR Spectroscopy

Arachidonic acid is one of the essential unsaturated fatty acids formed from linoleic acid which is widely available in the body. Arachidonic acid is generally found in phospholipid membrane cells especially skeletal muscles, brain, liver, spleen, and retina which will be released in response to various stimuli such as physical, chemical, and biological stress [26].

In sepsis, invading pathogens causes biological stress that can trigger cellular injury by activating the innate immune system as a body's defense mechanism. Immune cells that play a role in this response are macrophages. Macrophages will be activated and produce cytokines and pro-inflammatory enzymes, activation of the coagulation system cascade, complement system and production of proteases and oxidant compounds which ultimately cause damage to phospholipid membrane in the cell wall and release of arachidonic acid by enzyme phospholipase A_2 [6]. Moreover, ROS produced by oxidative stress in sepsis can cause damage to macromolecules and cell phospholipid membranes [11].

The first step in the arachidonic pathway is the release of arachidonic acid from the phospholipid membrane by the enzyme phospholipase A_2. Arachidonic acid is produced then converted to eicosanoids through three pathways: cyclooxygenase (COX), lipoxygenase (LOX), and cytochrome P-450 (cyt P450). In the COX pathway, arachidonic acid is converted by COX to prostaglandin H_2 (PGH_2). PGH_2 will be reprocessed by various terminal synthase enzymes into active prostanoids. Prostanoids produce many biological effects and play an important role in the physiology and pathology of the body. The types of prostanoids synthesised through the cyclooxygenase pathway include prostaglandin D_2, prostaglandin E_2, prostacyclin, and thromboxane A_2 as inflammatory mediators. Also, ROS can convert arachidonic acid into isoprostane [26].

Regarding this matter, researchers also have conducted some investigations. Bruegel *et. al.* [27] showed an increase of arachidonic acid concentration in adult patients with sepsis compared with the healthy ones. The increase was statistically significant with a p-value <0.01. Arachidonic acid concentration can be measured using FTIR spectroscopy. Kiefer *et. al.* [28] in their study used FTIR spectroscopy to measure the concentration of arachidonic acid in *Porphyridium purpureum* microalgae by looking at the absorbance at a wavelength of 3200-2700 (2857, 2872, 2928, and 2958) nm.

6. Conclusions

Spectroscopy is a potential alternative method for early detection of NS because it has several advantages. This method can detect biochemical changes in the early phases of a disease it is fast and inexpensive and can be used with saliva as the sample (the sampling procedures are non-invasive, do not require skilled personnel and special equipment). Therefore, further research is necessary to study this method for early detection in NS.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 15 – 20
ISBN : 978-602-53575-1-0

Carved palm oil waste for crafts

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Abstract. Oil palm plant that is no longer productive must be cut down and regenerated. Research on the utilization of palm oil stem waste has been carried out. However, this utilization uses complex techniques and methods that require large costs. Among them is the method of impregnation by adding additional substances into the waste stem with a certain pressure. In this research, palm oil waste is not used as a building material, but rather as a room divider so it does not receive too much weight. The burden is received only from the mass of the material itself. In this research, palm oil wood waste will be split and cut into blocks and boards. Then the palm stems are carved using computer numerical control (CNC) carving. Furthermore, the results of the carvings are finished using a water-based wood finishing system. The machining parameters used for the manufacture of this carving product with a speed of 22,000 RPM and a feeding speed of 10 mm/s. The carved products produced are quite good in terms of shape and reduplication. This product has also been tested in an open space for 1 year with satisfactory results and found no parts eaten by termites and wood powder.

1. Introduction

A huge amount of oil palm trunks were made available during replanting activities to replace the unproductive oil palm trees in Indonesia. The area of oil palm plantations is currently spread in almost all provinces in Indonesia. Riau Province in 2018 with an area of 2.49 million hectares is a province that has the largest oil palm plantations. Followed by successive provinces of West Kalimantan covering an area of 1.49 million ha, North Sumatra covering an area of 1.47 million ha, Central Kalimantan Province covering an area of 1.22 million ha, South Sumatra with an area of 1.02 million ha, and other provinces. In total there are 12.3 million hectares of oil palm plantations in [1]. Oil palm plants have an age limit of productivity for up to 25 years. However, this age number can be drastically reduced if the plant is exposed to harmful pests and diseases, especially if attacked by *Ganoderma fungus*, then at around 5 years of age, when productivity is quite high, palm oil will certainly experience a decline in production until finally, the oil palm tree will die for a short time [3]. In 2018, there were 270,168 hectares of damaged oil palm plantations. If the population of oil palm plants is 136 palm trees/ha, it can be estimated that 36,742,868 trees must be cut down annually. From the aforementioned set of issues, the purpose of this activity is to increase the added value and competitiveness of palm oil waste products through preservation techniques and diversified innovation in the development of product design for interiors by utilizing local wisdom motifs as outlined in carving products and environmentally friendly finishing techniques to improve product performance. There are some methods to increase hardness, such as filling with epoxy [7]. Another method which is more popular called impregnation [9]. This impregnation

process has been developed by using its shell as the filler [10]. But all those techniques need a lot of money and technology.

In this study, the authors will make carvings on palm oil stems without a hardening process. We use CNC which allows the manufacture of wood carvings that have poor quality. In this research, we will also look for a more optimal CNC feeding speed with good quality carving results. CNC was originally intended only for working on metal media. However nowadays with the needs of the community, it is also designed to work on other materials such as wood. In general, CNC designed for working on wood media has 3 main axes The spindle on a CNC can move in the x, y, and z axis direction. CNC is proven to be able to make more consistent engraving [11] and can cut processing time [5]. CNC has also been used in non-commercial wood and plantation waste wood [8]. In fact, using CNC for wood materials is not as easy as imagined. Many parameters must be count for this work. These parameters can affect the quality of the wood surface [4]. From all of those parameters, feeding speed has a very strong effect on the quality of the engraving results [2].

2. Materials and methods

2.1 Materials and equipment

The main raw material used in this study is oil palm stems from research plantations in Piyungan, Yogyakarta (figure 1). The main equipment used is planner machine and CNC router machine in the wood, rattan, and bamboo laboratories, Center for Crafts and Batik, Ministry of Industry at Sidobali road, Yogyakarta.

Figure 1. Logging of oil palm trees.

2.2 Fabricating process

Palm trees that have been cut down will be split and cut into sheet boards and beams. The board will be cut to 80 cm long, 20 cm wide, and 3 cm thick. For blocks will be cut with a size of 5x5 cm and 1 meter long. The next process is drying. All wood material will be put into the drying oven. The wood is heated in the oven at 70°C for 1 week until the desired dryness level is between 12-14%. After the drying process, the wood is put back in the warehouse until it becomes stable at room temperature (figure 2). The next step is the design and manufacture of engraving products using CNC (figure 3).

Figure 2. Oil palm wood after drying process.

Figure 3. CNC in the wood laboratory, Yogyakarta.

3. Result and discussion

3.1 Carving result

The carving design which has been made is the kawung batik motif. Carving on palm oil wood uses CNC with a V-shaped chisel with a diameter of 6 mm. Initially, the design was made in a 2-dimensional form (figure 4). Then the selected design will be made in 3 dimensions (figure 5) and converted into G-code so that it can be read by a CNC machine. The software used is V-carve. While the software to drive CNC is MACH-3.
MACH-3.

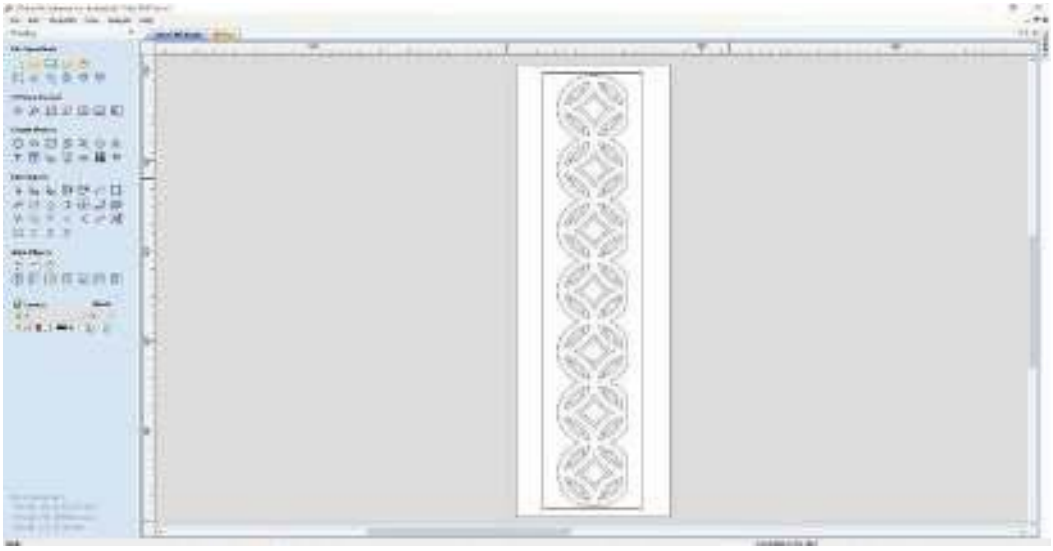

Figure 4. Design 2D.

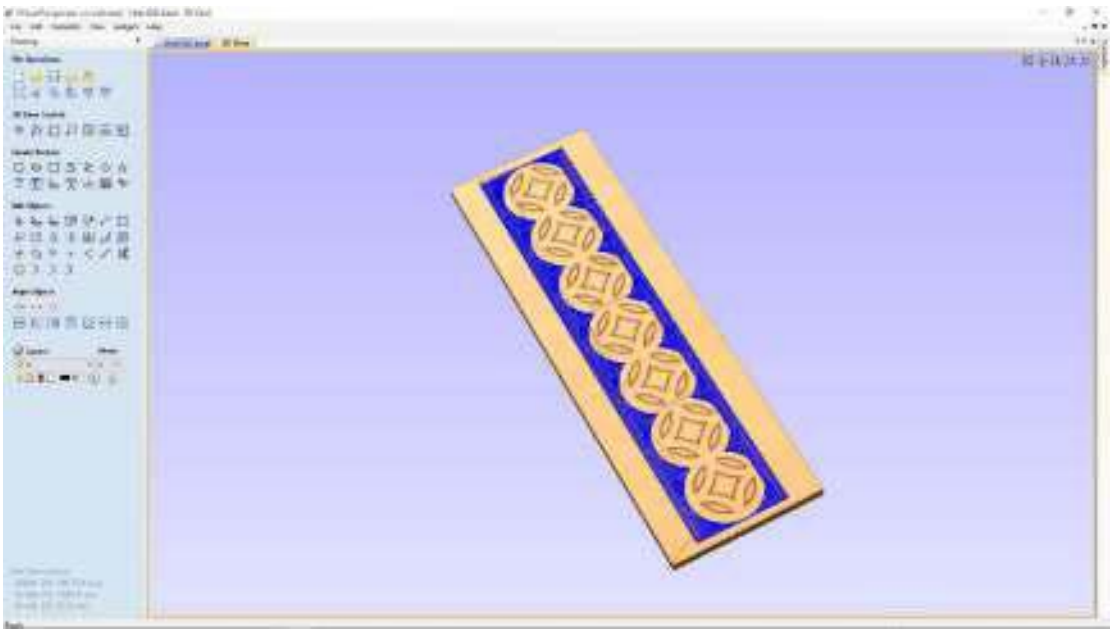

Figure 5. Design 3D.

3.2 Finishing result

The results of carving on palm oil (figure 6) then finished using a water-based system, which means that we use water as a solvent. Initially, palm oil is given a basic color so that it has the same color. Furthermore, we put bioduco top coat to protect the product from the weather (figure 7).

Figure 6. Carved palm oil.

Figure 7. Finished palm oil.

3.3 Durability

The carved oil palm has been put in a showroom since October 2018 until now. The product had been checked regularly to see if there was any defect. As the result, there was no defect happened to this product. This product is not eaten by termites at all. This product is also not moldy. This shows that the oil palm stem is quite durable and can be used as an interior product for more than 2 years.

4. Conclusion

This research proves that oil palm stem can be processed using a CNC machine. The shape of the carving can be made diversely and even complicated shapes. The palm oil stem can be used as a substitute for interior products, especially products that do not receive heavy loads such as room dividers and others. The durability of this product is more than 2 years.

Acknowledgments
The author says thanks to Mrs.Titik Purwati Widowati as the head of the Center for Crafts and Batik which allows this research. Also all of my friends in the wood laboratory and Mr.Sutarman and Mrs.Farida as the leader in this division. And last but not least for the committee of ICSTSI 2020.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 21 – 32
ISBN : 978-602-53575-1-0

Development of IoT web box on net metering bidirectional renewable energy for real-time and mobile monitoring

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Abstract. Net Metering is a way to trade electricity from new and renewable energy sources, but until now the owner has not been able to monitor production results in real-time, especially the export and import of electrical energy from and to the State Electricity Company. The purpose of this research is to develop a Web Box that can read and send two-way data from the existing KWh Meter to the server via the Internet of Things technology so that it can be monitored on a mobile basis. First, the installation of 2 KWh 1 phase Solar Panel with the AC Coupling method was carried out. The second is to collect data from the KwH meter that is readily available in the market. Third, developing the Web Box communication with Web API. Fourth, the Web box tested using the CISPR32 standard. The results were Web Box used RS485 and python communication to retrieve data from the existing KWH Meter to the Raspi B + microprocessor. The IoT function used wifi to send data to the server via the Web API developed using Code Igniter. Web Box data transmission was performed every 3 seconds. The Web Box has been proven to meet the requirements of the CISPR32 standard. So it can be concluded that Web Box can read bidirectional data from existing KWh Meters and send it to the server through Web API every three seconds so that it can be monitored on mobile basis and meet the requirements of the CISPR32 standard.

1. Introduction

Figure 1 shows how the net measurement works. The customer's renewable power plant generates DC energy then converts it to AC energy with an inverter. On the other hand, the provincial power grid also produces and delivers energy. The excess energy is sent back to the provincial grid and recorded by Bidirectional Meter.

Figure 1. How Net Metering Works.

Net Metering uses a counter meter that can rotate back and forth (bi-directional). The State Electricity Company uses the EXIM (export-import) meter as a term for net metering. The usage surplus is calculated as credit for electricity usage in the following month, with a tariff structure of 65% of the normal price in accordance with the following net metering regulations:

a) Regulation of the Board of Directors of the State Electricity Company number 0733.K / DIR / 2013 concerning Utilization of Electric Energy from Photovoltaics by State Electricity Enterprise Customers.
b) Circular Letter of the Board of Directors of the State Electricity Company number 0009.E / DIR / 2014 concerning Operational Provisions for the Integration of Customer-Owned Photovoltaics into the Electric Power System Area of the State Electric Company.

Systems for controlling, diagnosing and monitoring power consumption using the Raspberry Pi, Arduino Uno, non-invasive AC current sensor and Relay Board 4 channel as an integrated system to control, diagnose and monitor equipment to check its efficiency in power consumption proposed by [1]. An enterprise energy monitoring system application which is based on IoT (Internet of Things) architecture and combines several technologies proposed by [2]. Automated systems that allow monitoring and control of electrical devices connected to the Internet via Wi-Fi are denominated by iPlug [3]. Application of energy monitoring based on IoT stands for a supervising system for solar photovoltaic power generation that can greatly enhance the performance, monitoring, and maintenance of the plant that is presented by [4]. A real-time energy consumption monitoring system was presented for large public buildings, which is beneficial for energy saving and helps to establish the building energy consumption performance evaluation is presented by [5]. Several studies have been conducted that can prove the system can reduce energy consumption by 1030% [6-7]. Tsuyoshi Ueno et al developed a monitoring system that was installed in 10 residences and its effects on energy consumption have been analyzed. Energy consumption is reduced by 12% after system installation and 60% from homes reduces the consumption of power that is used continuously [6].

The results of interviews with the East Java State Electricity Company, currently monitoring of electricity usage is only on the internal side of the State Electricity Company and not on the customer side. Problems will arise when the surplus balance has accumulated enough but cannot be cashed or sold. Especially if the minimum tariff or interconnection fee is still charged. Previous studies have not yet taken KWh meter data from measuring instruments that are already on the market and are plug play and utilize IoT technology.

The purpose of this research is to design net metering that can measure the production and use of electricity bidirectionally that can be monitored mobile. This paper describes the Web Box System, developed by authors, which aims to ensure, autonomously, accurately, and simultaneously, the energy consumption monitoring of energy consumption. The system consists of a low-cost energy monitoring system based on IoT, developed using microprocessor Raspi B+ and use a Wi-Fi connection to the Internet, for storage and availability of monitoring data on a Web portal in real-time. This system is capable to monitor the energy consumption of the KWh Meter Provincial Power Grid, KwH Meter Load, KwH Meter Solar Power Plant connected to it considering the current consumed by the equipment and the mains voltage. Real-time energy monitoring system provides feedback to the consumers, thus the consumer will be able to identify the opportunities to adjust and identify how to conserve energy. This paper presents a real time energy monitoring system that is cost-effective and reliable, it can be used to analyze and evaluate the output voltage or generated energy from a household appliance.

2. Methodology

In figure 2 the methodology is: first, the installation of 2 KWh 1 phase Solar Panel with the AC Coupling method is carried out. The second is to collect data from the KwH meter that is readily available in the market, third, the development of Web Box communication with Web API. Fourth, the Web box tested using the CISPR32 standard.

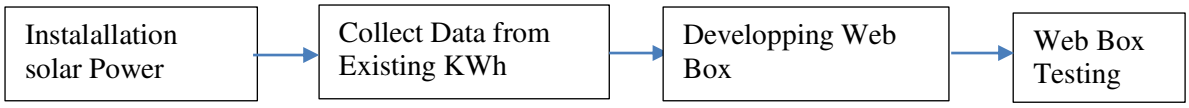

Figure 2. Methodology.

2.1 Installation of solar power plant

The installation of 2 KWh 1 phase Solar Panel Photovoltaic modules are set up with a minimum angle of 10° to obtain a self-cleaning mechanism, especially on rainy days [shown in figure 3]. In the southern hemisphere or below the equator, the photovoltaic module 8 X 280 Wp must face north or 0° [figure 4]. The electricity production from the solar panel will be combined with electricity from the State Electricity Company in the same phase.

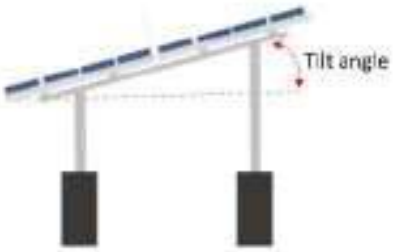

Figure 3. Azimuth Angle.

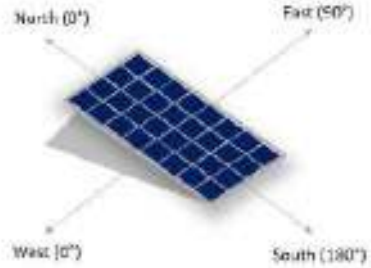

Figure 4. Inclination Angle of Solar Panels.

The way of combining the two power sources is an AC-coupling system that connects the solar module circuit and the State Electricity Company to the AC side via a network inverter [shown in figure 5]. Solar Power Plant will be On-Grid Solar Power Plant.

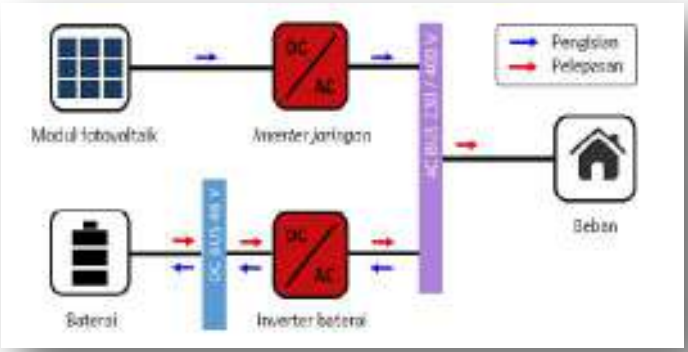

Figure 5. AC Coupling

2.2 *Collect data from existing kWh meter*

A local monitoring system is needed to provide basic information such as instantaneous voltage, current, frequency, power, and total energy flowed to the load. The local monitoring system consists of an energy meter, voltage measurement and current transformer (CT) as input for the meter. Manual inspection is the most reliable way to monitor the system because the operator will check the system directly and report it in the form of a logbook. However, the detailed data that can be obtained from this manual inspection method is limited, making it less profitable for further analysis.

Local monitoring uses KWh meters that are already on the market, most of which are imported products. As shown in figure 6, the renewable energy from power solar plant goes to DC Meter. Then it goes to the inverter to change DC to AC. After that goes to panel AC. In Panel AC we have 3 kinds of KWh Meter: KWh Meter Provincial Power Grid, KwH Meter Load, and KwH Meter Solar Power Plant. On the other hand, electricity from the provincial power grid is imported, the energy goes to the AC Panel as well along with the output from the inverter and makes the AC Coupling. If there is excess energy sent back to the Provincial Electricity Network, it will be recorded in the KWh Provincial Electricity Network as export energy. This KWh Meter has communication using RS485 so that the Web Box gets data from the KWh Meter via a communication cable.

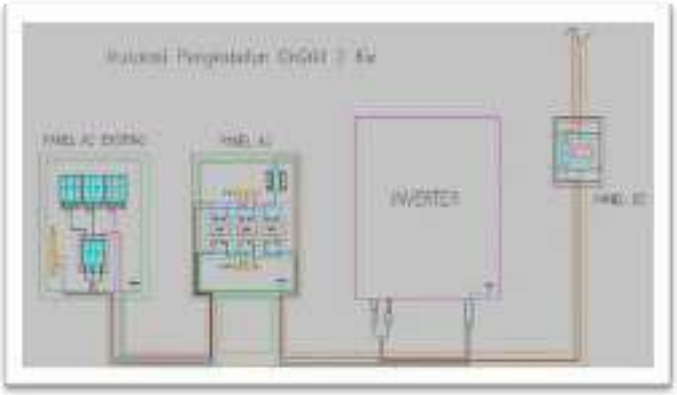

Figure 6. KWh Meter

2.3 Developing web box communication

Web Box Development Methods [shown in figure 7] include: After the Web Box gets data and manages data using Raspi B +, it will be sent to the server using Wi-Fi with an interval of 3 seconds. Data will be forwarded IoT technology into Server. The parameters planned to be monitored are described in table 1.

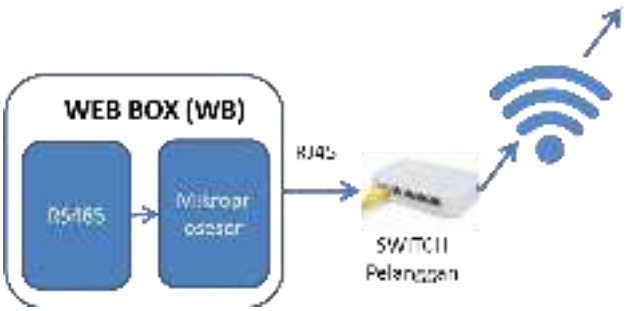

Figure 7. Plan of Web Box Development.

Table 1. Monitoring Parameter.

No	Parameter	Unit	Information
1	Output Voltage of Photovoltaic Modul Circuit	V	DC Production
2	Output Current of Photovoltaic Modul Circuit	A	DC Production
3	Output Voltage Network Inverter	V	AC Production
4	Output Current Network Inverter	A	AC Production
5	Active Energy at Load	KWh	Load
6	Remaining Active Energy / exported to the State	KWh	Export

	Electricity Company		
7	Remaining Reactive Energy / exported to the State Electricity Company	KWh	Export
8	Active energy entering/imports from the State Electricity Company	KWh	Import
9	Reactive energy entering / importing from the State Electricity Company	KWh	Import

Web Box is used to gather energy data passed and stored to a database through cloud-based RESTful API resources. These resources are then used by the mobile web application for displaying real-time and historical energy readings. Remote Monitoring System is the process of monitoring carried out by taking data, Furthermore, the data can be directly visualized and can be accessed from a computer through a browser (Web browser) or through a mobile phone [5].

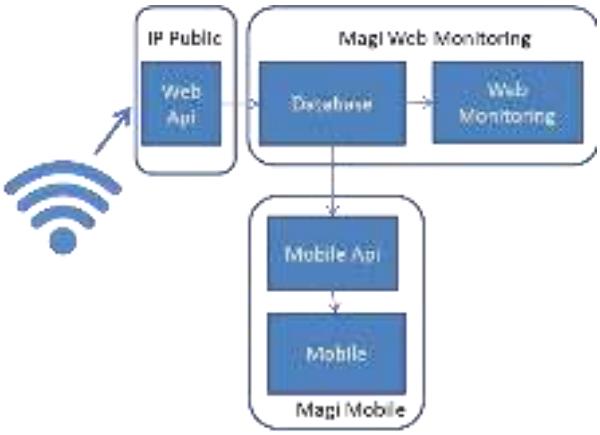

Figure 8. Plan of Monitoring Software Development.

Figure 8 explains the method of developing remote monitoring. Development of web monitoring uses Code Igniter. Monitoring Software itself uses Web API technology so that it can be accessed by customers through many devices. Data from the Web Box is sent via the Rest API which will be saved to the database. Web API can be accessed from various types of media. Web-based monitoring will be developed using Code Igniter. REST (Representational State Transfer) is a standard model of web-based communication architecture.

2.4 Web box testing

After the development process, Web Box will be tested with the CISPR32 standard in the EMC Laboratory Baristand Industri Surabaya. This test is a fulfillment of the regulation of the Ministry of Communication and Information, namely Perdirjen SDPPI Number 3 of 2019 - Technical Requirements for Telecommunications Equipment and or Equipment for Low Power Wide Area. Figure 14 shows the results of radiation testing at a frequency of 30 MHz - 1 GHz.

3. Results and discussion

3.1 Installation of solar power plant

Before installing the solar panels, the selection of load paths is borne by the building panels. With a capacity of 2000 Wp, the burden borne by Solar Power Plants is 2 (two) room air conditioners. Measurements were made using the Ampere Meter tool in accordance with figure 9. As we can see in Figure 13, A x 220 V = 2860 Watt, with 2000 Wp it can be shown that the energy exports and imports are bidirectional.

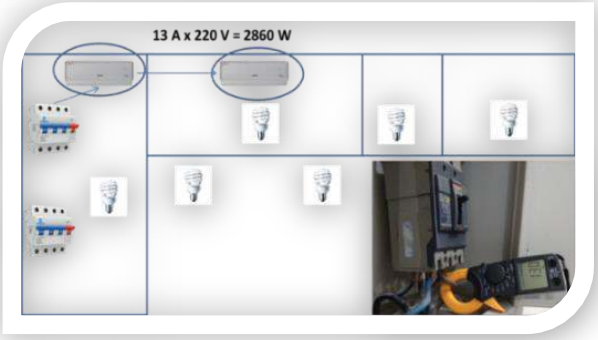

Figure 9. Selection of Load Paths.

Electricity is supplied by two electricity sources such as the State Electricity Company and Solar Power Plants, but this case takes preferably in Solar Power Plants. This load will use the energy source from the Solar Power Plant first, but if there is residual energy that is not used, it will be the energy released and recorded by the KWh meter. During the export process, electricity will be flowed back to another panel above it, which will then be transferred to another panel or other load. The choice of place, building and panel installation process can be seen in Figure 10. The specifications of the panels used are described in table 2.

Figure 10. Panel Installation.

Table 2. Specifications of Solar Panel.

No	Item	Specification
1	Solar Panel	Seraphim 280 Wp – 8pcs
2	Solar Panel Supports	
3	Distribution Board	MCB, PVC white cable, PVC Flexible House
4	Cabling and Accessories	Solar panel cable, inverter cable, grounding cable, MC4
5	Grounding	Copper Rod, Copper ring, Cable clamp

Production solar power plant was shown in table 3. Even though the solar power plant has a capacity of 2000 Wp, what is obtained is not optimal because it can take advantage of many factors such as weather, cloud conditions, etc. and in Surabaya's rating the temperature is above 30°C, while at 25°C.

Table 3. Production Solar Power Plant.

No	Time	DC Meter
1	12.06.2019 13:59	1264 Watt Hour
2	12.06.2019 14.31	1105 watt Hour

From the normalized values of current, voltage and power at 25°C, with an increase in temperature, cell current increases slightly, but the voltage drops at a larger rate, leading to the larger drop in the power output. If the cell temperature drops below 25□C, the current drops slightly but the voltage and power increase. In general, up to about 0.5% loss in efficiency per degree Celsius of temperature increase is typical in silicon cells [8]. Figure 11 shows the ideal temperature for silicon cells.

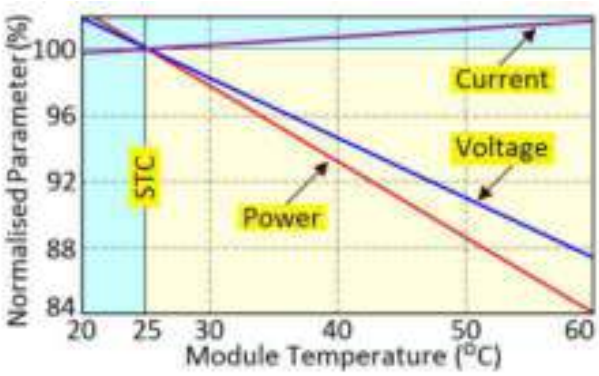

Figure 11. Ideal Temperature for Silicon Cell.

3.2 Collect data from existing kWh meter

Figure 12. Local Monitoring.

Local monitoring has been installed using available equipment existing at the market. 1 is dc meter, 2 is inverter, 3-panel ac, 4-panel ac existing. [shown in figure 12]. The brands and specifications installed are described in table 5.

Table 5. Brand and Specification of Local Monitoring Devices.

No	Item	Specification	Quantity
1	DC Meter		1 pcs
2	Inverter	Solis Mini 2000 4G	1 pcs
3	KwH Meter	Eastron SDM220	2 pcs
4	KwH Meter	Eastron SDM230	1 pcs

After local monitoring has been installed, monitoring of energy production and energy use by this device has been carried out as described in table 6.

Table 6. Local Monitoring Analysis.

No	Time	DC Meter	Inverter	KWh Meter Solar Power Plant
1	12.06.2019 13:59	1264 Watt	1235 Watt	1194 watt
2	12.06.2019 14.31	1105 watt	1076 watt	1037 watt

Based on table 6, it can be seen that the energy produced by solar panel never reach 2000 W. This is because the city of Surabaya is not in optimal conditions for the energy achievement of the Peak Watt Solar Panel and many other factors that affect such as clouds. The energy consumption factor by the sensor must also be considered in the sensor selection. The local monitoring product (Table 6) shows a 1264 Watt DC Meter, when entering the 1235 Watt Inverter, after entering the 1194 Watt Solar Power Plant. It is estimated that the energy consumed is between 3-10 watts per unit meter or inverter.

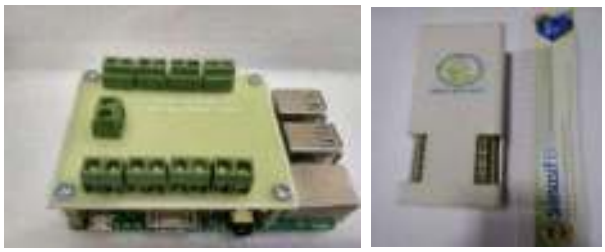

Figure 12. Web Box Design.

Figure 12 shows the designed Web Box has the following specifications: there are 8 RS485 slots, of which the first 4 slots for Solar Power Plant, monitoring 3 AC sensor values and 1 DC sensor. In addition, there are 4 other slots that are used to monitor the results of the sensor box. Tools for developing webboxe are explained in table 7.

Table 7. Tools for Developing Webbox.

No	Item	Quantity
1	USB to RS485 Serial Converter	1
2	Raspberry Pi 3 B+ New Edition	1
3	MICRO SD CARD V-GeN 8GB Class 10	1

Figure 13. Communication RS485 to Get Data.

Figure 13 use cable to connect KWh meter and Web Box. Every KWh meter has an id to take data. The connection and the data in process inside of Web Box.

3.3 Developing web box communication

The firmware of the Web Box was developed in Raspi 3b + with the algorithm described in the flowchart in Figure 14. Firmware development is processing using python. After Data are taken from the existing KWh Meter, these data are compiled in Json and sent to the server through API.

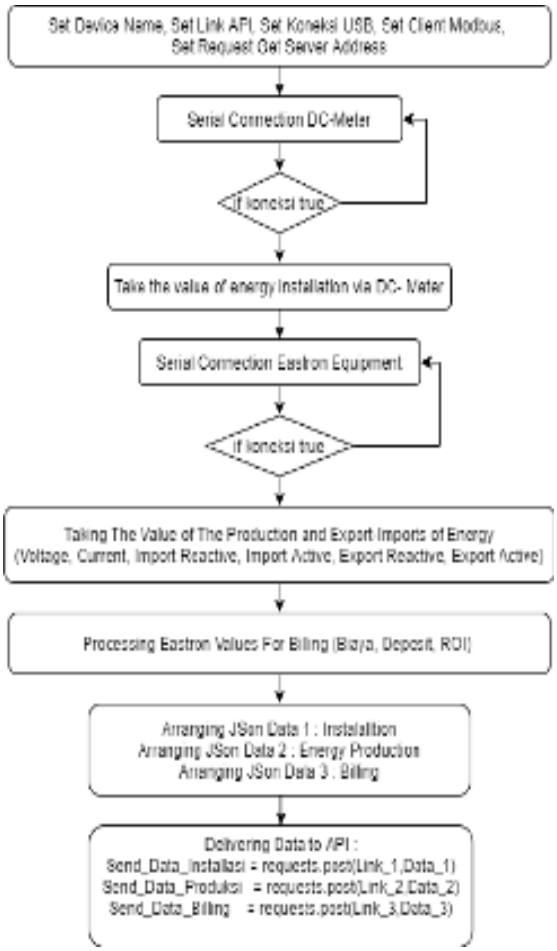

Figure 14. Flowchart Firmware.

In figure 14 also can be seen that data are delivered via the IoT function and RS485 data communication. Data managed using the Rest API is expected to reach many devices and with internet technology can reach all parts of the world. WiFi has a distance range of 22-60 m, whereas internet technology can reach anytime, anywhere and in real time. Remote monitoring can be observed using a website and also by a mobile phone.

The access right of the Customer can monitor the Result of the Installation of Solar Power Plants, Energy Production, and Billing. The menu in the mobile phone application is the same as the web-based application figure 15.

Figure 15. Web Aplication and Mobile Application for Customer.

In the administrator permission level figure 16, it contains : webbox settings, sensor box and customer data.

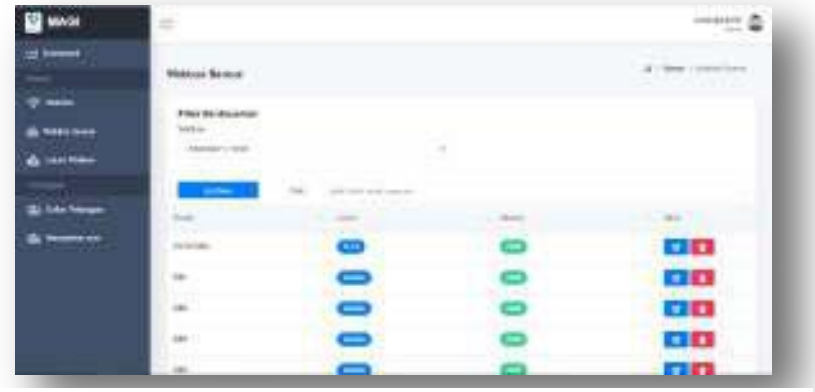

Figure 16. Administrator Permission Level Web Application.

3.4 Web Box Testing

Electromagnetic Compatibility testing has been carried out on the IoT Web Box device. In figure 17 can be seen on the graph that the Quasi Peak value of Radiated Emissions generated by the device is below the red limit line. From the results of these tests, it can be concluded that the product meets the requirements of the CISPR32 standard. Figure 18 shows the conducted test.

The main purpose of this test is to measure how much potential the device has to interfere with the function of other electronic devices in the immediate environment.

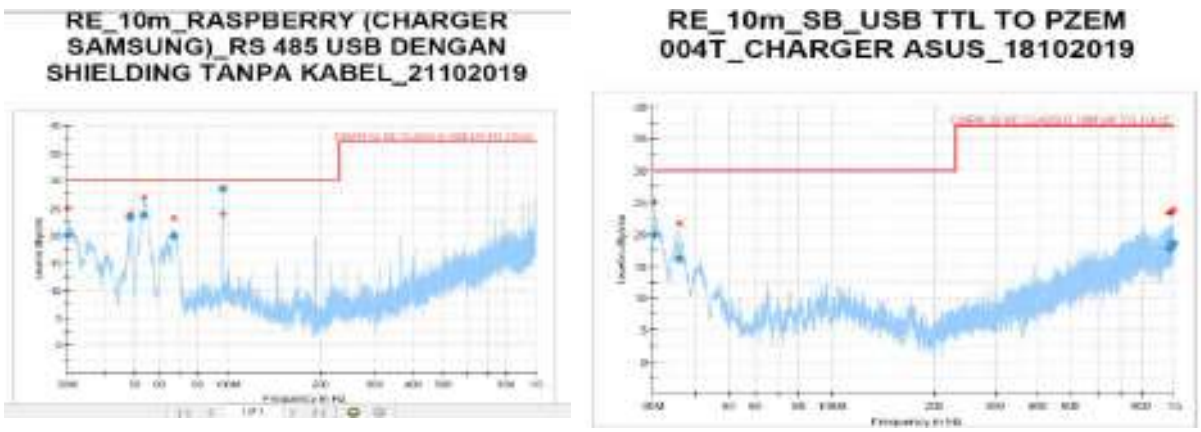

Figure 17. EMC Test Result for Radiated Emission Parameter [freq. 30 MHz – 1 GHz] in 10 m distance of measurement.

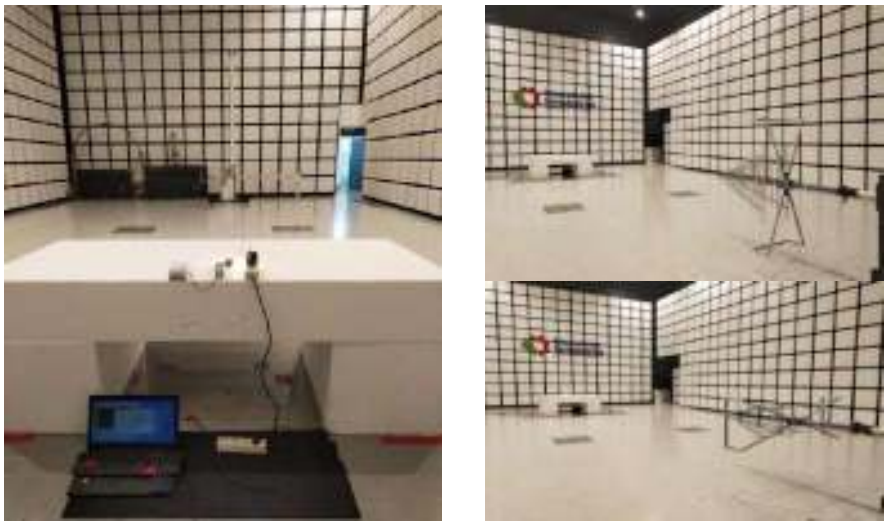

Figure 18. Conducted EMC Test.

4. Conclusion

Solar Power Plant which is carried out using 8 (eight) of 280 Wp solar panels can not produce 2240 Wp but only reach 1600 W maximal because optimal energy produce by the solar cell is 25 Celcius degree. Local monitoring is installed using any tools that are already on the market and they are important things that consist of DC sensors, 3 KWh Meter and inverters. Local monitoring consumes 3-10 watts of energy so that in selecting local monitoring energy consumption needs to be considered. Webbox was developed using Raspi B+ and RS485 communication to get data from the existing KWh Meter. Web Box delivers data every 3 seconds to the server through Rest API to reach many devices and with internet technology can reach all parts of the world. Web Box is tested using Electromagnetic Compatibility testing and results Quasi Peak value of Radiated Emissions graph generated by the device is below the red limit line. From the results of these tests, it can be concluded that the product meets the requirements of the CISPR32 standard.

Acknowledgments

The researchers would like to thank Baristand Industri Surabaya EMC laboratory for the Lab equipment and for letting us operate their laboratory for the conduct of this research.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 33 –42
ISBN : 978-602-53575-1-0

Identification of chemical compound from cocoa waste and cocoa vinegar resulting from the pyrolysis process

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Abstract. Cocoa and derivative products consist of compound of polyphenols and different potential levels of antioxidants. The greater content of polyphenols provides benefits to human health, cosmetics, and food functional. Cocoa waste can be reused by pyrolysis to overcome the accumulation of plantation waste. This research aims to identify the fraction of the chemical compound and determine the yield of cocoa vinegar. Cocoa shell and leaves were determined by the lignin, cellulose, and hemicellulose content and further processed by pyrolysis at range 115-515°C. The chemical compound was determined using GC-MS. The result showed that cocoa shells contained lignin about 50.68%, cellulose 49.06%, and hemicellulose 19.06%, whereas analysis of cocoa leaves contain lignin 48.21%, cellulose: 61.98%, and hemicellulose 25.44%. The yield for liquid smoke of cocoa shell produced the largest liquid smoke product at a pyrolysis temperature of 215 ° C, about 16.16 %. Analysis GC MS from cocoa vinegar shell and leaves waste showed that acetic acid was the highest compound with 33.67% and 47.87% respectively. The next compound was 1, 6-anhydro-beta-d-glucopyranose (7.76%), 1-Hexyn-3-ol (6.60%), and Phenol, 2-methoxy (4.69%). The results of the identification of chemical compounds that have the potential for fiber and food ingredients are acetic acid, benzenesulfonic acid, and caffeine.

1. Introduction

Biomass waste used as liquid smoke has gained attention in recent years, produced by the pyrolysis process. Pyrolysis compounds undergo decomposition into hemicellulose, lignin, and cellulose. Biomass waste produces cocoa vinegar, tar, charcoal, and others. Differences in the composition of the raw material components are expected to affect the composition and type of compound pyrolysis results. Biomass waste content such as cellulose, hemicellulose, and lignin as well as the pyrolysis conditions are the main factors in the occurrence of pyrolysis reactions and resulting products. Several typical wood biomass contains 25%–35% hemicelluloses, 40%–50% cellulose, and 10%–40% lignin [1].

Pyrolysis of *Humulus inpulus* bio-oil produces phenolic compound straight-chain and cyclic alkanes and alkenes, ketones, and acids. That 25, 81% of all peaks are due to aromatics, 21, 55% for alkanes, 18, 03% for alkenes, and rest is for ketones anodic acids [2]. Pyrolysis conditions including temperature, pressure, vapor-phase residence time and heating rate affect the chemical reactions responsible for producing various chemical compounds present in bio-oils. In other research, liquid smoke from bamboo could be used as cosmetics, supplements, and healthy drinks [3]. Woody biomass waste (*Pinus radiata*) coming from forestry activities has been pyrolyzed to obtain charcoal and, at the same time, a hydrogen-rich gas fraction. The pyrolysis has been carried out in a laboratory-scale continuous screw reactor, where carbonization takes place, connected to a vapor treatment reactor, at which the carbonization vapors are thermo-catalytically treated. Different peak temperatures have been studied in the carbonization process (500–900°C), [4].

The utilization of biomass waste is an environmentally friendly renewable energy source. Many concerns point out to the need to use renewable feedstock, compost, and replace as much as possible the fossil fuels; among them could be mentioned the depletion of fossil oil reserves, constant uncertainties as far as price is concerned, unsecured supplies, and environmental pollution [5]. This research will use types of pyrolysis of cocoa waste derived from cocoa shells and cocoa leaves in the district of Bantaeng. Testing of physical and chemical properties of cocoa waste determines compression test and dependability and long burning. The main objectives of this research were (1) to get the yield and pH of cocoa vinegar on pyrolysis process, (2) to identify the fractions of potential chemical components of liquid smoke cocoa shell district Bantaeng.

2. Materials and methods

2.1. Raw material

Cocoa shells and leaves from Bantaeng district were used as the material. Previously, the cocoa shell and leaves were tested for Klason lignin content (SNI 0492:2008), then cellulose and hemicellulose content determined using the modified hydrochloric acid method . Samples put into the kiln was made of stainless steel which is equipped. Burning was carried out at temperature pyrolysis of 115-515°C for 5 hours for each sample. Increase in temperature after no smoke was issued again. Cocoa vinegar or ter separated from the condensate by precipitation for 24 hours. The analysis was conducted on the cocoa vinegar yield (% w/ w), pH. Analysis TGA/DTG (DSC Q series) of raw material for thermal decomposition

2.2. Identification of chemical compounds

Chemical compounds of each fraction cocoa vinegar were identified by GC-MS (QP 5050 A Shimadzu) with a length of 30 m and a diameter of 0.255 mm. Operation condition at a temperature of 125°C, gas flow rate of 0.6 mL/min and injection volume of 0.2 mL.

3. Result and discussion

3.1. Identification of compound chemical

The analysis of cocoa shell lignin content from Bantaeng was 50,68%, cellulose : 49.06%, hemicellulose : 19.06%, whereas analysis of cocoa leaves lignin content from Bantaeng : 48.21%, cellulose : 61.98%, hemicellulose : 25.44%,: 6.40%, and others 10.38%.%.(table 1).

Table 1. Different Analysis of Content Lignin, Cellulose and Hemicellulose.

No	Type sample	Lignin (%)	Cellulose (%)	Hemicellulose(%)
1	Cocoa leaves waste	48,21	61,98	25,44
2	Cocoa shell waste	50,68	49,06	19,06

Acids are a group of volatile compounds that were dominant in number. Identification of the phenolic compounds, acids, esters, ketones, alcohols, and furans then the separation process is carried out to determine the furfural compounds, phenol, and toluene potential as renewable bioenergy. The results of this study are supported by [6]. Compounds resulting from the pyrolysis of 2 types of coffee waste (TR_1 and TR_2) at 300, 400, 500, and 600°C contained several groups of compounds such as phenols, alkanes, alkenes, steroids, acids, esters, ketones, benzene derivatives, and alcohol [7]. From these two liquid smokes resulting from the pyrolysis of raw materials, the highest yield of liquid smoke was liquid smoke of pine wood sawdust by 49.60% and teak wood sawdust 43.78% [8].

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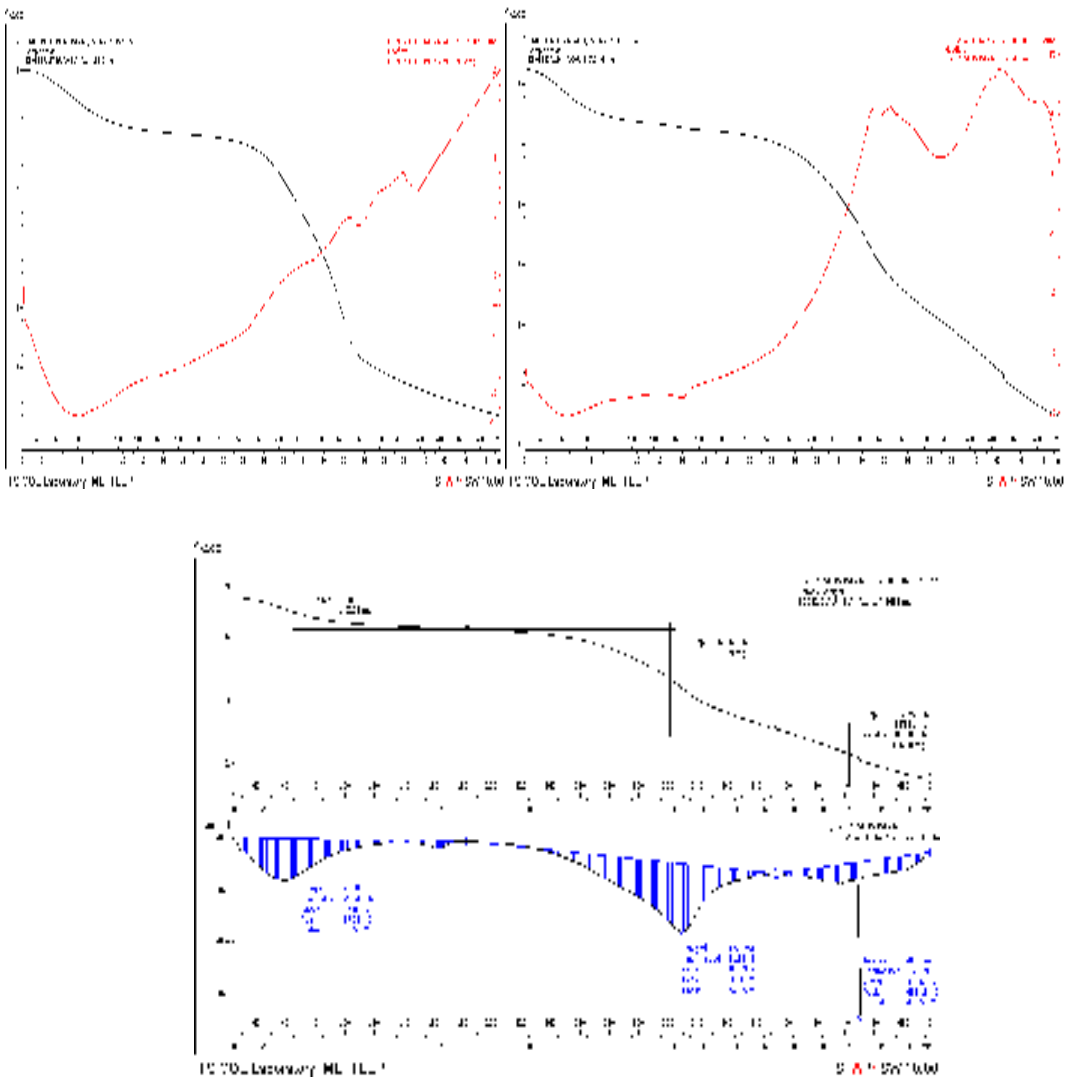

Figure 1. Analysis TGA and DTG from Cocoa waste Bantaeng District.

From the analysis of TGA and DTG from Cocoa waste Bantaeng District (figure 1), the pyrolysis process had been divided into seven stages. The first stage was a slow reduction of 1.6% of mass observed from 40 to 113.1°C. This event was most likely a result of evaporation of free water enclosed in the resin. Starting at 113.1°C and ending at 556.6°C, a significant drop in mass was observed. This stage could be divided into three sub-stages. The first one occurred between 113°C and 331°C and was connected with a small release of heat observed on the DSC curve – we hypothesize it to be a result of dehydration which is an exothermic reaction and can result in cross-linking of the resin [9]. The second and third stage corresponded to two maxima of the complex exothermic peak observed on a DSC curve at approximately 355.0°C and 480.1°C, indicating an ongoing chemical reaction resulting in a release of heat (such as crystallization, oxidation or combustion) [10].

Figure 2. Liquid Smoke for Cocoa Shell (left) and Leaves (right).

The yield for liquid smoke of cocoa shell (table 2), produced the largest liquid smoke product at a pyrolysis temperature of 215 ° C, obtained 16.16 followed by a temperature of 315 ° C of 11.97%, then the pyrolysis temperature was 415 °C of 11.09%. The appearance of liquid smoke can be seen on figure 2. The yield for liquid smoke of cocoa leaves shown in table 3.

The gases obtained at very high temperatures (700–900°C) in the presence of Ni-containing catalysts are rich in H_2 and CO, which makes them valuable for energy production, as hydrogen source, producer gas or reducing agent. Aiming to make the process of obtaining charcoal from biomass more sustainable and profitable, an essential aspect to investigate is the use of the derivate co-products, gas and liquids [11]. If charcoal production is carried out at very high temperatures (700–1000 °C) and slow heating rates (carbonization), the process yields more gas than liquid fraction, and the properties of the gas are more promising than those of the liquid fraction, which is mainly composed of tars and water [12]. The objective of the optimization of charcoal production must focus on maximizing the production of gas together with the reduction of the generated tars and water.

Table 2. Yield cocoa shell vinegar for time and temperature of pyrolysis.

No.	Time (min)	Temperature (°C)	CocoaVinegar	
			Weight(gr)	Yield(%)
1.	07.25-08.58	115	45	3,43
2.	08.58-10.07	215	212	16,16
3.	10.07-10.43	315	157	11,97
4.	10.43-11.11	415	145	11,09
5.	11.11-13.10	515	42	3,20

Table 3. Yield cocoa leaves vinegar for time and temperature of pyrolysis.

No.	Time (min)	Temperature (°C)	Cocoa Vinegar	
			Weight((gr)	Yield(%)
1.	07.12–08.94	115	52	10,83
2.	08.94 -10.00	215	63	13,13
3.	10.00-10.35	315	31	6,45
4.	10.35-11.06	415	7	1,46
5.	11.06-13.03	515	5	1,04

The pH analysis for the liquid smoke of cocoa shells in Bantaeng Regency (table 4) for a temperature of 115 ° C was 2.60 for a temperature of 215 ° C of 3.18, for a temperature of 315 ° C of 3.46, for a temperature of 415 C of 4.95 and finally 515 C of 6.98. The pH analysis for liquid smoke of cocoa leaves in Bantaeng Regency was for a temperature of 115 ° C was 2.66. for a temperature of 215 ° C of 3.56, for a temperature of 315 ° C of 3.67, for a temperature of 415 C of 4.27 and finally 515 C of 5.18.

Table 4. The pH analysis.

No	Temperature °C	pH	
		Cocoa shell	Cocoa leaves
1	115	2.60	2.66
2	215	3.18	3.56
3	315	3.46	3.67
4	415	4.95	4.27
5	515	6.98	5.18

Analysis GC MS cocoa vinegar leaves (table 5) as acetic acid, 2-Cyclopenten-1-one. Methyl ButyricAcid, 2-Cyclopenten-1-one,2-methyl-, 1-Propanamine,N,2-dimethyl-N-nitroso, 2-

Butanone,1-(acetyloxy)--butanone, Tetrahydrofurfurylalcohol, 2-Cyclopenten-1-one,2-hydroxy-3-methyl, Phenol,2-methoxy-, 1-Hexyn-3-ol, 2-Pyrrolidinone, 2-Methoxy-4-methylphenol, n-Heptanal, cyclopenten-3,4,5-triol, 2(3H)-Benzofuranone,3a,4,7,7a-tetrahydro-3a-methyl, Phenol,2,6-dimethoxy, 2,5-Cyclohexadiene-1,4-dione,compd.with1,4-benzenediol(1:1), 2-isopropenyl-2,5-dimethylcyclohexanone-6,6-D2 n-Amylacetate, 2,4-Dioxa-6,8-, dithiaadamantane,1,3,5,7-tetramethyl, 1,6-anhydro-beta-d-glucopyranose, 4-Pyridinecarboxaldehyde, 3-hydroxy-5-(hydroxymethyl)-2-methyl-, 1H-Azepin-1-amine, hexahydro-, 2-Decene, 3-methyl-, (Z)-5,10-diethoxy-2,3,7,8-tetrahydro-1h, 6h-dipyrrolo[1,2-A;1',2'-D], 2-Cyclopenten-1-one, Methyl from the identification of liquid smoke from cocoa pod husks, chemical compounds that have the potential as food ingredients (fiber) are acetic acid, n Amyl acetate and others.

While bioactive chemical compounds derived from liquid smoke from cocoa waste are n-Amyl acetate, Resorcin, Levoglucosan functioned as biofuel. This is supported by other studies, that pyrolysis of corn cobs with a hot carrier at a temperature of 430-620 °C, gives a maximum bio-oil yield of 14.24% at a temperature of 510 ° C [13]. The results showed that the pyrolysis of camphorwood in the conversion rate range from 0 to 0.85 might be considered as a one-step process. The study can provide guidance for the design and optimization of industrial reactors and the selection of target biofuels or chemical raw materials [14].

Table 5. GC-MS Analysis for Cocoa Vinegar Leaves from Bantaeng District.

Peak#	Retention Time	Area	Concentration (%)	Chemical Composition
1	8.230	884179155	47.87	Acetic acid
2	10.074	17599904	0.95	2-Cyclopenten-1-one
3	10.921	26354214	1.43	MethylButyricAcid
4	11.292	21312667	1.15	2-Cyclopenten-1-one,2-methyl-
5	11.913	27253494	1.48	1-Propanamine,N,2-dimethyl-N-nitroso-
6	12.267	21470934	1.16	2-Butanone,1-(acetyloxy)--butanone
7	12.699	49399835	2.67	Tetrahydrofurfurylalcohol
8	13.649	44374649	2.40	2-Cyclopenten-1-one,2-hydroxy-3-methyl
9	14.066	86550942	4.69	Phenol,2-methoxy-
10	14.611	63494383	3.44	1-Hexyn-3-ol
11	14.943	29979997	1.62	2-Pyrrolidinone
12	15.248	19133464	1.04	2-Methoxy-4-methylphenol
13	15.434	50048984	2.71	n-Heptanal
14	15.820	40893768	2.21	cyclopenten-3,4,5-triol
15	16.092	19315733	1.05	2(3H)-Benzofuranone,3a,4,7,7a-tetrahydro-3a-methyl-
16	16.930	17402180	0.94	Phenol,2,6-dimethoxy-
17	17.267	33629350	1.82	2,5-Cyclohexadiene-1,4-dione,compd.with1,4-benzenediol(1:1)(CAS)Quin

18	17.693	83828813	4.54	2-isopropenyl-2,5-dimethylcyclohexanone-6,6-D2
19	17.967	43711701	2.37	n-Amylacetate
20	18.292	41085399	2.22	2,4-Dioxa-6,8-dithiaadamantane,1,3,5,7-tetramethyl
21	18.944	143388434	7.76	1,6-anhydro-beta-d-glucopyranose
22	20.342	18361999	0.99	4-Pyridinecarboxaldehyde,3-hydroxy-5-(hydroxymethyl)-2-methyl-
23	20.520	16983496	0.92	1H-Azepin-1-amine,hexahydro-
24	21.267	20465078	1.11	2-Decene,3-methyl-,(Z)-
25	21.968	26671080	1.44	5,10-diethoxy-2,3,7,8-tetrahydro-1h,6h-dipyrrolo[1,2-A;1',2'-D]P
26	10.074	17599904	0.95	2-Cyclopenten-1-one
27	10.921	26354214	1.43	MethylButyricAcid
		85489635	100.00	

Table 6. GC-MS Analysis for Cocoa Vinegar Shell Waste from Bantaeng District.

Peak#	Retention Time	Area	Concentration (%)	Chemical Composition
1	8.728	1003472153	33.67	Aceticacid
2	9.374	129834441	4.36	aceticacid,anhydride with formicacid
3	11.242	42912258	1.44	2-Furanmethanol
4	11.743	153775917	5.16	1-deuterobutane
5	12.780	52529828	1.76	3-Hepten-2-ol,(Z)-
6	13.431	37282270	1.25	Benzenesulfonicacid,4-hydroxy-
7	14.108	118964393	3.99	Phenol,2-methoxy-
8	14.585	178816977	6.00	1-Hexyn-3-ol
9	15.122	45303886	1.52	Butanoicacid,2-propenylester(CAS)allyln-butanoate
10	15.475	57250716	1.92	1-Pentanol
11	15.831	125490864	4.21	1,4-butandial
12	16.624	97351527	3.27	3-Nonyne
13	17.282	63003277	2.11	n-(1-cyano-propenyl)-formamide
14	17.608	50077263	1.68	6-methyl-2-pyrazinylmethanol
15	17.700	138126510	4.63	Phenol,3,5-dimethyl-4-(methylthio)-,methylcarbamate
16	18.353	120591598	4.05	4,4,6-Trimethyl-2-phenylamino(imino)-5,6-dihydro-4H-1,3-thiazine
17	18.987	171024573	5.74	1,6-anhydro-beta-d-glucopyranose(levoglucosan)
18	19.375	62946207	2.11	5H-1,4-Dioxepin,2,3-dihydro-
19	19.742	15708512	0.53	-
20	19.863	28133731	0.94	2,5-dioxo-3-isopropyl-6-methylpiperazine

21	20.202	115993499	3.89	Spiro[5.5]undecane,1-methylene-
22	20.842	10942859	0.37	
23	20.975	17247780	0.58	1,4-diaza-2,5-dioxo-3-isobutylbicyclo[4.3.0]nonane
24	21.295	71599586	2.40	Caffeine
25	21.947	72226000	2.42	5,10-diethoxy-2,3,7,8-tetrahydro-1h,6h-dipyrrolo[1,2-A;1',2'-D]P
			100	

GC-MS analysis cocoa vinegar shell waste from Bantaeng District (table 6) were Acetic acid, anhydride with formicacid, 2, uran methanol, 1-deuterobutane, 3-Hepten-2-ol,(Z)-Benzenesulfonicacid,4-hydroxy-, Phenol,2-methoxy-, 1-Hexyn-3-ol, Butanoicacid,2-propenylester1-Pentanol, 1,4-butandial, 3-Nonyne, n-(1-cyano-propenyl)-formamide, 6-methyl-2, pyrazinylmethanol, Phenol,3,5-dimethyl-4-(methylthio)-,methylcarbamate, 4,4,6-Trimethyl-2-phenylamino(imino)-5,6-dihydro-4H-1,3-thiazine,1,6-anhydro-beta-D-glucopyrano (selevoglucosan), 5H-1,4-Dioxepin,2,3-dihydro-, , 2,5-dioxo-3-isopropyl-6-methylpiperazine, Spiro[5.5]undecane,1-methylene-, 1,4-diaza-2,5-dioxo-3-isobutylbicyclo[4.3.0]nonane, Caffeine, 5,10-diethoxy-2,3,7,8-tetrahydro-1H,6H, ipyrrolo[1,2-A;1',2'-D]. The results of the identification of chemical compounds that have the potential for fiber and food ingredients are acetic acid, benzenesulfonic acid, and caffeine.

Some components of the hardener/catalyst can either undergo degradation into acetone [15] or into acetic acid. Laino [16] conducted pyrolysis of pure triacetin and found that after 30 s at 526.85 °C it constitutes in 79% of the pyrolysis products. However, some components of hardener/catalyst either do not undergo any thermal decomposition (e.g adipic acid, dimethyl ester) at all or do so to a very small degree, and thus, their concentration in the pyrolysis product is high (e.g. glycerol 1,2-diacetate). Cocoa beans originating from Bantaeng Regency with the following composition; Water content of 30.76%, crude protein content of 17.93%, fat content of 33.98%, crude fiber of 21.11%, BETN content of 20.495, and ash content of 6.46%.

4. Conclusions

Cocoa shells from Bantaeng contained lignin about 50, 68%, cellulose 49.06% and hemicellulose 19.06%, whereas analysis of cocoa leaves was lignin content 48.21%, cellulose 61.98%, hemicellulose 25.44%,: 6.40%, and others 10.38%. The results of the identification of chemical compounds that have the potential for fiber and food ingredients are acetic acid, benzenesulfonic acid, and caffeine.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 43 – 50
ISBN : 978-602-53575-1-0

Determination of Fe, Cu, Pb and Cd in seaweed (*Eucheuma cottonii*) and the seawater in Pico Village-Bantaeng District using inductively coupled plasma optical emission spectroscopy (ICP-OES)

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Abstract. Bantaeng is located in a coastal area which is quite potential for the development of fisheries and seaweed. The type of seaweed which is widely cultivated is Eucheuma Cottonii. This study aims to determine the existing heavy metals contamination of seaweed and seawater in the Pico Village, Bantaeng, as well as a preliminary study of the potential of seaweed as a metal binder. The sample in this study was seawater as a medium for seaweed growth and seaweed itself. The research method was an experimental method by destructing the sample and were analyzed using ICP-OES. The results showed that the quality of waters for the metal content of Fe, Cu, Pb, and Cd in Location I and location II were still below the permitted threshold according to Ministry of Environment and Forestry No. 51 2004. As for seaweed itself, it had much higher levels of metals than the seawater. Fe, Pb, Cu, and Cd of seaweed in the location I and location II were still in below BPOM regulations, except the Cd metal content obtained has exceeded the allowable threshold (0.05 ppm). Differences in metal content in seaweed and its seawater could be an indication that seaweed absorbs metals in the seawaters.

1. Introduction

One of the districts in South Sulawesi Province that manages seaweed (*Eucheuma Cottonii*) and has a fairly wide and potential coastal area is Bantaeng which covering the west and east coasts. Bantaeng has marine and non-biological potentials that are quite promising to manage. Bantaeng is one of the central locations of seaweed production *Eucheuma Cottonii (E. Cottonii)* in South Sulawesi and one of the main export commodities that plays an important role in improving the welfare of people who cultivate seaweed on a large scale. However, lately, the condition of coastal waters has become increasingly worrisome with the number of industrial discharges through rivers into sea waters suspected of containing heavy metals

The industrial sector is the second choice to be developed in Bantaeng, which has increased year to year. The development of the industrial sector is very likely in the future, but requires very strong investors. With the development of the industrial sector, the impact is very positive because in addition to increasing people's income it also absorbs a lot of labor. But on the other hand, the presence of the industry can have an impact on pollution if the Environmental Impact Analysis (EIA) application is not carried out.

Most of the pollutants found in the ocean come from human activities on land. In general, these pollutants come from industrial, agricultural, and household activities. According to the source, this pollution can be divided into 7 groups, namely: (1) industry, (2) surface liquid waste (sewage), (3) urban waste water (storm water), (4) mining, (5), shipping, (6) agriculture and (7) aquaculture. While the types of pollutants mainly consist of sediment, nutrients, toxic metals, pesticides, exotic organisms, pathogenic organisms, and oxygen depleting substances (substances that cause oxygen to dissolve oxygen in water) [1]. Heavy metals can enter the waters naturally with natural events such as weathering, rock, and soil erosion. The presence of heavy metals in waters can also come from urban runoff, rainwater, household waste, industrial waste, mining operations, atmospheric deposition, and agricultural activities (Haynes and Johnson, 2000) in [2]. This study aims to determine the existing heavy metals contamination of seaweed and seawater in the Pico Village, Bantaeng, as well as to see the potential of seaweed as a metal binder by looking at the relation of metals contained both in seaweed and seawater.

In this research, the heavy metals that measured were Fe, Cu, Pb, and Cd by using ICP-OES because of its ability to identify and measure all elements simultaneously. ICP is suitable for measuring all concentration of elements from ultra-trace to the level of the main component, detection limits are generally low for most of the typical elements until µg / L scale. ICP can complete various readings of elements in a short period of 30 seconds and only use ± 5 ml of the sample.

2. Materials and methods

This research was conducted in October 2019 located in location 2. Samples were taken directly in Pico Village, Bantaeng. The study was conducted at the Bantaeng AK-Manufacturing Chemical Analysis Laboratory Laboratory.

2.1. Tools

Multiparameter, hot plate, beaker glass, beaker flask, stir bar, bulb, funnel, analytical balance, furnace, Buchner.

2.2. Materials

Seaweed (*E. Cottonii*), sea water, multi-element standard solution 1000 ppm, aquabides, HCl 10%, HNO_3 pro analysis, aluminum foil, filter paper.

2.3. Methods

2.3.1. Sampling and preparation of samples One kg of wet seaweed and 500 mL of sea water were taken from Desa Pico. Sea water that was taken was sea water where the sample was taken. A sample of 10 mL of sea water was put into a beaker and added by 0.5 mL of concentrated nitric acid (HNO_3). The mixture was stirred until homogeneous, then heated using a hot plate until the solution almost used up. Then put into a 100 ml measuring flask and was added with distilled water until meniscus mark.

Seaweed samples were cleaned from impurities using aqua dest and dried at 120^oC until it turns blackish brown. Then dried seaweed, crushed and homogenized into powder with a mortar and then stored in aluminum foil until analysis was carried out. The sample was weighed as much as 5 grams in a clean porcelain cup, then ashed in a furnace at 400^oC for 20 hours (until it turns to ash). Add 20 mL of a concentrated solution of nitric acid (HNO_3) in a beaker glass and heated using a hot plate. The filtrate was cooled at room temperature and placed in a 50 ml volumetric flask and dissolved with 1 N hydrochloric acids (HCl) solution to the meniscus mark. Filter the solution by used Whatman paper 42 so that a clear yellowish solution was obtained and ready to be analyzed.

2.3.2. Made standard solution

Multi-element standard solution series with a concentration of 0.05; 0.10; 0.20; 0.50 and 1.00 ppm

made into a 50 mL measuring flask and with 5% nitric acid (HNO_3) to each flask until miniscus mark. Subsequently tested with ICP to analyze metals (Fe/ Cu / Pb /Cd) in seawater.

2.3.3. Measured parameters

Field Parameters is measured by multiparameter (temperature) with a different location. The heavy metal of Seaweed and sea water is analyzed by ICP-OES with the condition operation are in table 1.

Table 1. ICP-OES working condition.

Parameters	Working condition
Exposure time	UV : 15s; Visible : 5s
RF power (W)	UV : 1150 W; Visible : 1150W
Nebulizer gas flow	UV : 0.5 L/min;Visible :0.5 L/min
Coolant gas flow	12 L/min
Auxilary gas flow	0.5 L/min
Pump speed	50 rpm
Flush pump speed	50 rpm
Maximum delays	Uptake: 300 ; Rinse : 300
Miniumum delays	Uptake: 30 ; Rinse : 30
Measure mode	Axial

3. Results and discussion

3.1. Concentration of heavy metal in seaweed and seawater

Pollutants are materials that are foreign to nature or materials originating from nature itself that enter an ecosystem structure so that it disrupts the designation of the ecosystem. The source of pollution that enters the body of water is divided into pollution caused by natural pollutants (natural) and pollution due to human activities or commonly called anthropogenic pollutants. Heavy metals can enter the marine environment naturally through; weathering, rock and soil erosion, or through urban and city runoff, rainwater, sewage, industrial waste, mining operations, atmospheric deposition, and agricultural activities (Batley, 1996; Irvine and Brich, 1998; Haynes and Johnson, 2000) in Govindasamy [2]. This pollutant needs to be analyzed considering the impact caused can be fatal both for the environment and humans.

One of the seaweed commodity-producing regions in South Sulawesi is Bantaeng Regency, which is one of the centers of the seaweed processing industry in South Sulawesi. Sea waters stretching between the Flores Sea of Mount Lompobattang, with an altitude of 0 (zero) to an altitude of more than 1,000 meters above sea level, with a coastline length of 21.5 Km. Seaweed is widely cultivated in waters making it vulnerable to heavy metal pollution.

Based on the results of research in the Pico Village, Bantaeng Regency at different sampling times had different concentrations of metal content as well. This can be seen in table 2 and 3. In general, the results of the study showed the levels (Fe / Cu / Cd / Pb) in location II had lower concentrations than in location I both in sea water samples and seaweed samples. Based on government regulation No. 51 of 2004 [3] concerning Sea Water Quality Standards in Appendix III obtained limits for the content of heavy metals for each (Cu / Cd / Pb) according to the table 4.

The metal content of seaweed both in samples taken in the location I or in location II has the same tendency where the content of heavy metals in seaweed is higher than in waters. Based on the regulation of the Food and Drug Supervisory Agency (BPOM) No 5 2018 [4] concerning the maximum limit of heavy metal contamination in food can be seen in table 4.

Based on the table, the metal content in Pb either in seaweed or in sea water are still below the limit allowed by BPOM. However, the Cd metal content in seaweed taken in location I and II have

a that exceeds the content of Cd those are 0.121±0.000363 ppm and 0.160 ± 0.001000 ppm, respectively. Among others, cadmium (Cd) toxicity is caused by its ability to bind to S (sulfur) and COOH groups of protein molecules (amino acids and amides). This heavy metal also has the ability to replace the presence of other metals contained in metalloproteins such as Cu and Zn [5]. In a weak acid condition, cadmium is easily absorbed into the body and is a carcinogen as well as cumulative toxins that can damage organs such as the kidneys, liver, lungs, cardiovascular system, immune system and reproductive system [6,7].

Table 2. Concentration of seaweed in location I and II.

Heavy metals	Concentration Heavy Metals of Seaweed (ppm)	
	Location I	Location II
	$\bar{x}$ ± SD	$\bar{x}$ ± SD
Fe	3.434 ±0.033262	2.302 ± 0.010786
Cu	0.107±0.000577	0.100 ± 0.000577
Pb	0.013±0.000577	0.104 ± 0.000577
Cd	0.121±0.000363	0.160 ± 0.001000

Table 3. Concentration of seawater in location I and II.

Heavy metals	Concentration heavy metals of seaweed (ppm)	
	Location I	Location II
	$\bar{x}$ ± SD	$\bar{x}$ ± SD
Fe	0.088 ± 0.001000	0.019 ± 0.000577
Cu	0.009 ± 0.000577	0.003 ± 0.000000
Pb	0.003 ± 0.000577	0.003 ± 0.000577
Cd	0.000 ± 0.00000	0.000 ± 0.000000

Table 4. Quality standards of sea water for marine biota.

Heavy metal	Max concentration (mg/L) [a]	Max concentration (mg/L) [b]
Cu	0.008	-
Cd	0.001	0.05
Pb	0.008	0.2

[a] Quality standards of sea water for marine biota regulation no. 51 of 2004
[b] Maximum limits of heavy metal contamination in processed food for seaweed based on the regulation of the food and drug supervisory agency (BPOM) no. 5 of 2018

Cadmium is a type of heavy metal that when exposed to the human body will bind to albumin and also blood cells and metallothionein in liver and kidney tissue. If oral exposure, it can cause injury to the proximal tubule of the kidney. Symptoms of acute cadmium poisoning include vomiting and diarrhea. While the symptoms of chronic poisoning are the occurrence of nephrotoxicity. The results of cadmium measurements on 3 replications using ICP-OES showed that the three replications had very small absorption values so that it showed that the Cd metal content in the sample was not detected or below the instrument measurement limit. The results of this study are similar to those of Teheni [8] which showed high levels of Cd up to 0.2920 ppm in samples of *E. Cottonii* originating from Takalar seawaters. Cadmium was not detected in seawaters could be an indication that the metal content in the waters were absorbed by seaweed as well as

other heavy metals (Fe, Cu, and Pb) were detected smaller in the waters compared to the in seaweed.

In seaweed and other biota, heavy metals content such as cadmium and lead are often found. Lead is everywhere in the environment because it is found in nature and is used in the industry. Lead absorption is mainly through the gastrointestinal tract and the respiratory tract. Direct consumption of large amounts of lead can cause tissue damage especially liver and kidney tissue [9]. This is quite alarming considering that heavy metals have high toxicity [10,11]. Aquatic plants such as algae or Bryophyta have the ability to absorb heavy metals from water so that the levels in plants are higher than those in their environment [12].

Temperature plays an important role in seaweed growth. Seaweed lives and grows in waters with a water temperature range between 20-28^{0}C. Based on the research results the temperature of waters around 25-27^{0}C. The temperature will affect the process of photosynthesis because it will affect the oxygen content dissolved in the waters. Besides sea water sampling had been done in different seasons. This will also affect the solubility of metals in waters. According to Hutagalung [13] in [14], rising temperatures will cause higher levels of bioaccumulation. Strengthened by the opinion of Darmono [15] that the higher the water temperature in water, the power of toxicity increases, so that the content of heavy metals (Fe/Cu/Cd/Pb) is more easily absorbed by seaweed. Rising temperatures in the waters will accelerate the reaction in the formation of heavy metal ions.

The degree of acidity or pH is one of the factors that affect the life of seaweed. The maximum pH range for the life of marine organisms is 6.5 - 8.5 [16]. The composition of dissolved elements and compounds causes sea water to have a pH (acidity) in general between 7.5 - 8.4 with an average pH of 7.8. The degree of acidity will affect the biological activity and chemical reactions that occur. As pH increases, the toxicity of heavy metals decreases. Marine biota that lives in water will experience bioaccumulation if the pH gets lower [17].

Low levels of heavy metals in the waters are estimated because the metal has entered the seaweed. This is consistent with the results of research in which the levels of metals in seaweed are much higher than those in the waters. As explained above the pH of water that tends to be normal influences the stability of the metal solubility [18]. The results showed the levels of metals (Fe / Cu / Cd / Pb) seaweed taken in the location I and II almost the same.

Pb in the air is mainly sourced from motor vehicle exhaust (smoke) which partially forms particulates in the free air and partially attaches and is absorbed by plant leaves [18]. The presence of lead-heavy metal contamination (Pb) found in the waters in Pico Village is most likely derived from the air due to the exhaust gas used by fishermen or boats around the Port. In addition, lead naturally enters water bodies through the crystallization of lead in the air with the help of rainwater [19].

The results of the study of the heavy metal content found in biota from Ling-Ding in Guangdong province are very high examples of pollution that occurs due to economic development [20]. Pollution that occurs in Marine Biota will directly affect human health. The presence of pollutants such as iron for example can come from rust on ships or iron poles in the water. Although it is not regulated in the Ministry of Environment and Forestry Regulation for waters the presence of iron if it is too high it will be dangerous.

High population, port activities and industrialization are real sources of pollution. This activity will produce ecologically damaging pollution which results in the death of marine life and a decline in its economic value [21]. Damage and decline in natural values and the most dangerous is that it can cause poisoning and even death in humans themselves. Water bodies that are contaminated with heavy metals from estuary environments are likely to cause bioaccumulation in the food chain. Usually, this contamination is transported from the source through the river system and deposited downstream. Most pollutants can be mixed through sedimentation and are suspended into solids. The presence of heavy metals in sediments causes greater environmental problems when contamination of aquatic organisms occurs (Morrisey, 2003) in [22].

Some damage caused by toxicity of Pb to health had been identified such as disturbed heme biosynthesis, disorders of the nervous system, reproductive disorders, and even inhibition of growth [13,15]. Lead (Pb) is one of the heavy metals that most pollute the sea waters. It is because

lead is one of the decomposition products of fuel used by ships. When the human body is exposed to lead, lead is carried by red blood cells and distributed to the soft tissues (kidneys and liver); redistributed to bones, teeth, and hair usually in the form of phosphate salts. The mechanism of toxicity is because lead can inhibit heme biosynthesis, and can also bind to Sulfhydryl groups in proteins.

4. Conclusion

Seaweed and seawater samples at two sampling locations indicate that the levels of heavy metals other than Cd are still below the standard quality standards set by the Ministry of Environment and Forestry No. 51 of 2004 and regulation of the Food and Drug Supervisory Agency (BPOM) No 5 2018. The metal content in seaweed samples is higher than that in seawater, this indicates that seaweed has the potential as a heavy metal biosorbent.

Acknowledgments
Many thanks to the Director of AK-Manufacturing Bantaeng who have provided financial support and facilities for this research, to the lecturers team of Chemistry Study Program for sharing their knowledge and experience as well as laboratory staff for their willingness to help during research in the laboratory.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 51 – 58
ISBN : 978-602-53575-1-0

The downstream potential of pineapple derivative products

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Abstract. Pineapple (*Anenas comosus* L. Merr.) is a fruit plant that has long been widely recognized by the public. This plant is quite easy to cultivate, and Indonesia's climate is very suitable for growing it. Given that pineapple is a commodity that has a high economic value, it is necessary to look for strategies for developing pineapple in the hope of increasing farmers' incomes so that it can ultimately improve the economy of the community. This research is a type of descriptive research that uses external data. The results of the analysis of this study indicate that the downstream pineapple processing industry has enormous potential. With so many types of pineapple derivative products, the community or farmers have many choices to do pineapple-based production activities and have the opportunity to get a global market share. Pineapple production increased from 2016 to 2018. This increase is proportional to the increase in exports of pineapple commodities to all export destination countries. In increasing downstream pineapple derivative products, seriousness from the government and entrepreneur is needed in solving problems that often occur such as farm management, land ownership, capital, farmers' culture, unbalanced fertilization, and limited market access.

1. Introduction

Pineapple (*Anenas comosus* L. Merr) is a fruit plant that has long been widely recognized by the public. This plant is quite easy to cultivate, and Indonesia's climate is very suitable for growing it. Pineapple plant growing on Indonesia is very diverse, diverse this is a source of germplasm which is very beneficial to the development program pineapple plant breeding [16]. Pineapple export volume is so large that Indonesia became the largest pineapple exporting country in the world until early 2012 [1]. The increase in canned pineapple exports also continues to increase along with the increase in demand, especially by the United States, Japan, the Netherlands, and European countries. While nationally in 1992 there were 18,597 ha of pineapple planted areas spread throughout Indonesia which meant an increase in demand, but the main production centers were North Sumatra, South Sumatra, Lampung, West Java, East Java, North Sulawesi, and Central Kalimantan. The area of smallholder pineapple plantations reaches 47% of 3.74 million ha and involves more than three million farm households. Pineapple development also opens additional job opportunities from the processing of derivative products and by-products which are very diverse in types [1].

Indonesia has agricultural commodities that are in demand by export markets, one of which is pineapple. According to Worldatlas.com, Indonesia is the 9th largest pineapple producer in the world with a production of 1.39 million tons per year. The world's largest pineapple producer is

Costa Rica. Its production reaches 2.93 million tons per year. In second place is Brazil, with pineapple production of 2.69 million tons per year. The Philippines is the third-largest producer of pineapple in the world, with production reaching 2.61 million tons per year. Other studies have shown that Western demands lead to innovation at the producer end of international supply chains and changes in governance structures towards chain coordination and vertical integration in developing countries [7].

Pineapple (*Anenas comosus* L. Merr) is one of the tropical fruits that are in great demand both domestically and abroad. Pineapple is generally consumed in the form of fresh or table fruit, but can also be enjoyed in the form of juice as a fresh drink or in the form of processed product such as *dodol*, pineapple chips and jam. In pineapple, bromelain acid enzymes that are beneficial to health include reducing blood pressure, cleaning blood, improving digestion, inhibiting the growth of cancer cells, and increasing the body's defense system. Pineapple consumption could reduce plaque index in children aged 10-12 years old [15]. Consumption of pineapple during pregnancy maternal morbidity and fetal health problems can be prevented through appropriate processing of foodstuffs [17]. In the food sector, pineapple can also be used for biscotti with local flavors [18]. In the field of animal husbandry, a solution of pineapple at a concentration of 0.5% can increase the degree of fertilization and hatching of *baung* fish eggs [20]. The more preferred products were fresh pineapple, pineapple pie, jelly, sweets, jam, chips, juice, nata de pina, candy, syrup, and stick [23].

Pineapple is a commodity that is proven to have sufficient market opportunities both at home and abroad. At present marketing of pineapple is not only in the fresh form but also in the form of processed food, for example, fresh pineapple but also in the form of processed food, such as canned pineapple, nata de pina, *dodol* and others. Indonesia's fresh pineapple exports from 1987 to 1990 continued to increase with an average growth rate of 287.83%. Pineapple export volume is so large that Indonesia became the largest pineapple exporting country in the world until early 2012 [1]. The increase in canned pineapple exports also continues to increase along with the increase in demand, especially by the United States, Japan, the Netherlands, and European countries.

The exact time of harvest needs to be known so that it can be marketed in good condition. In addition to maintaining fruit quality, proper mastery of post-harvest technology is needed so that fruit prices do not fall. The agribusiness system is the biggest contributor in the formation of Gross Domestic Product (GDP), opportunities for employment opportunities and participation in increasing exports. The results of the Ministry of Agriculture's analysis (2001) stated that the contribution of the agribusiness system in GDP reached around 48%, in the employment of up to 77%, and in total exports accounted for 50 - 80% of the value of non-oil exports. The agribusiness system also has an important role in environmental preservation because it is able to smooth the population distribution and all its activities so that it can prevent excessive population pressure in certain areas, population pressure and excessive activity only in certain areas can cause an imbalance of the ecosystem due to excessive exploitation so that it can damage the environment of the area.

One of the commodities identified as having great business potential to achieve these goals is pineapple. Harvested area in Indonesia ± 165,690 ha or 25.24% of the national fruit harvest target (657,000 ha). In the last few years, the area of pineapple plant ranks first in 13 types of commercial fruits that are cultivated in Indonesia [4]. Pineapple in addition to fresh consumption can also be processed into a variety of food and beverage products, such as canned pineapple, jam, dried food, juice, spirit/solvent, jam variety, juice, chips, syrup, *dodol*, concentrate, cocktail, etc. The use of pineapples in industrial products that have added value is only a small part realized in the form of industry. In addition, waste or by-products of pineapple fruit and leaf skins have not been widely used for the food, paper and textile industries [2]. One type of potential natural fibers are pineapple leaf fiber. result of a study showed that fabric with the proportion of 50% pineapple leaf yarn: 50% cotton had a higher value of tensile strength [21]. Besides being used as an adsorbent, high cellulose content in pineapple leaves can be used as pulp mix material in papermaking [22].

Considering that pineapple is a commodity that has high economic value, it is necessary to look for strategies for developing pineapple in the hope that it can increase farmers' incomes so that they

can ultimately realize the welfare of farmers. Therefore, this research was conducted with the aim of knowing the potential downstream of pineapple derivative products.

2. Methods

This research is a type of descriptive research which aims to illustrate the potential downstream of pineapple derivative products. The data used in this study are external data, that is, the data from the Central Statistics Agency are processed to illustrate information related to pineapple potential. Descriptive analysis of the studies using the curriculum as a descriptive and published at the Curriculum Inquiry journal [6].

3. Results and discussion

3.1. Pineapple commodity production

If a country exports more than imports, the country's national income will increase so that it will have a positive effect on economic growth [19]. In Indonesia, people have long been planting horticultural crops such as pineapple because it is very supportive of the climate and geography in Indonesia. Pineapple cultivation is considered an opportunity to develop processed pineapple production and can also improve the regional economy. In general, farmers or the community still many are cultivating pineapples independently. However, in addition, there were also those who received assistance in the form of funds and guidance from private companies through the Corporate Social Responsibility (CSR) program or related institutions. Based on statistics Indonesia data pineapple production in Indonesia has increased in 2018 compared to the previous year as shown in figure 1.

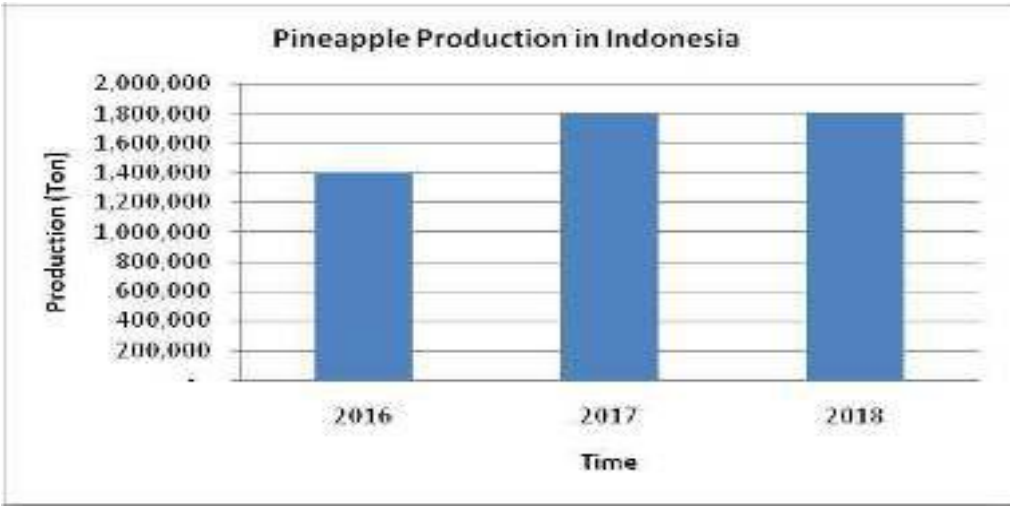
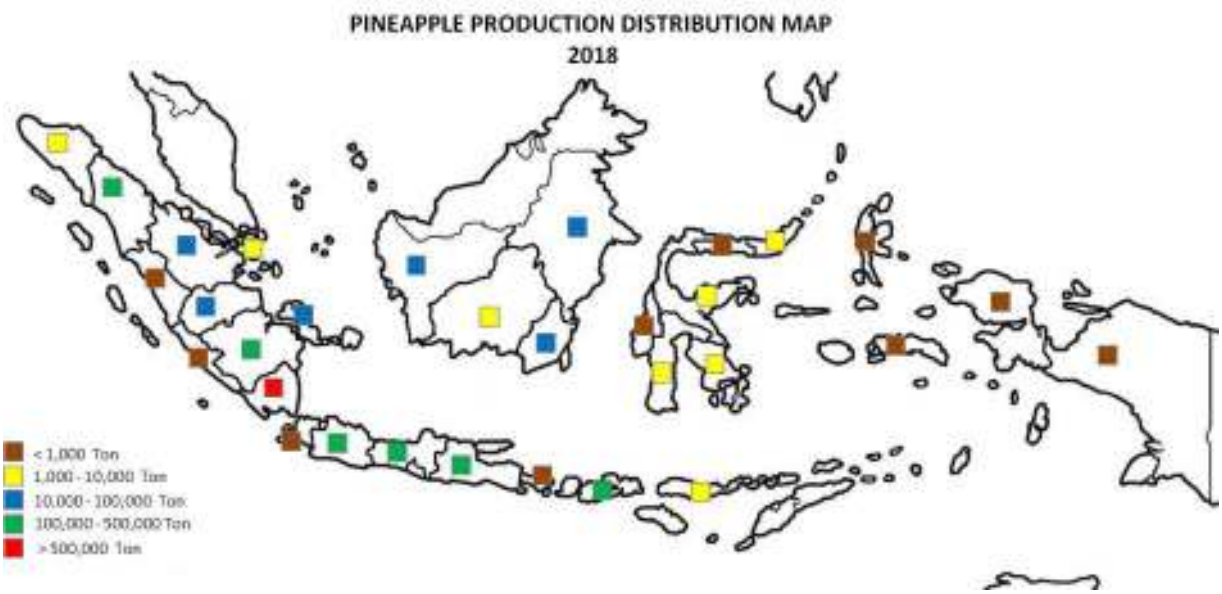


Figure 1. Pineapple production in Indonesia.

Based on data from pineapple production in 2016 - 2018, pineapple production in 2016 amounted to 1.39 million tons to increase to 1.80 million tons in 2018 with an average growth of 14.58% per year. The spread of pineapple plants in Indonesia is almost evenly found in the whole area, because of the region Indonesia has a diversity of agro-climates that allows the development of various types of plants, both plants tropical horticulture and horticulture subtropical. There are several areas that are become a pineapple production center, including South Sumatra, Lampung, West Java, North Sumatera and Java East. The area is an area compatible with the agro-climate pineapple cultivation. The data is a contribution from all regions in Indonesia whose distribution is shown in figure 2.



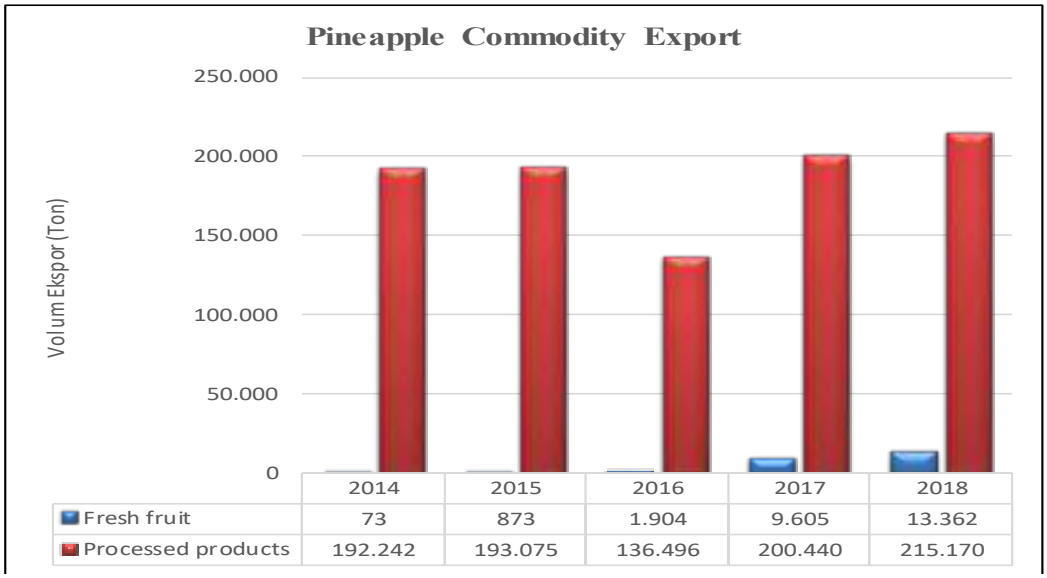
Source: Statistics Indonesia

Figure 2. Pineapple production distribution map in 2018.

Based on the distribution of pineapple production in figure 2, it shows that Indonesia has great potential to undertake pineapple processing industry activities. Almost all provinces in Indonesia produce pineapple according to the type or character in their respective regions. each region does not always have the same type of pineapple. For example, Pemalang regency is one district that has good potential for planting honey pineapple, due to the geographical location on the slopes of Mount Slamet with its sandy soil able to absorb more water and good for the growth of honey pineapple [24]. in another area, Kediri district, pineapple cultivation has produced two varieties superior pineapples are queen and cayenne types [26].

3.2. Pineapple commodity export opportunities

Indonesia is one of the potential natural resource-producing countries, including agricultural sector resources. Although Indonesian fresh pineapple export competitiveness is based its market share is still relatively small compared to others producers and exporters of fresh pineapple [25]. The agricultural sector is expected to be able to provide fields work, provide raw materials for industrial agricultural products and increase foreign exchange earnings in countries by increasing the volume and value of agricultural exports [14]. Indonesian pineapple export conditions based on statistics Indonesia data are shown in figure 3. The export value of pineapple commodities in the form of fresh and processed products has increased by 8.8% in 2018 compared to 2017. In general, the exported products are processed pineapple products, namely as much as 94% of total exports in 2018. This shows that the need for pineapple-based products in importing countries has increased. Countries importing pineapples and their processed products with a significant amount of imports include the United States, Spain, the Netherlands, Germany, Japan, Hong Kong, Singapore, Saudi Arabia, Australia, Mexico, and Argentina.



Source: Statistics Indonesia

Figure 3. Pineapple commodity export data.

The RCA index shows that Indonesia is superior to the Philippines in several countries such as the Netherlands, Germany, Singapore, Spain and Argentina for pineapple commodities. The ISP and IIT indices show that Indonesia has a tendency as an exporting country [11].

3.3. Development of pineapple-based products

Based on the pineapple industry tree shown in figure 4, it explains that there has been very much pineapple-based product development. Thus, the pineapple producers will have many choices in producing products that are in accordance with the planned capacity and targets. The Pineapple industrial tree in figure 4 describes derivative products from pineapple [12].

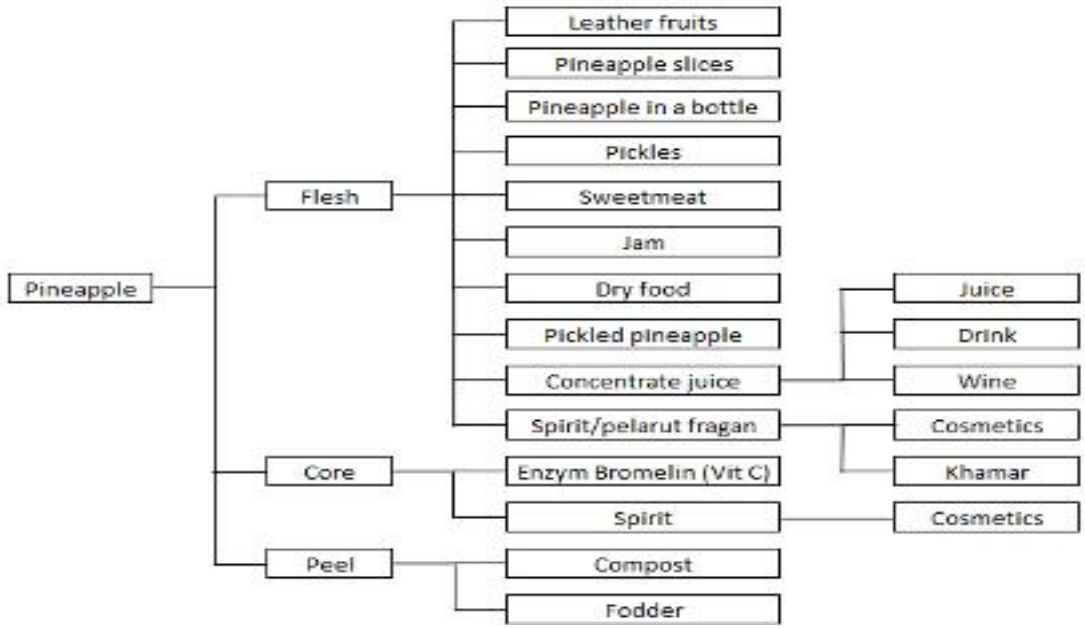


Figure 4. Pineapple industrial tree.

In the implementation of the development of pineapple-based products, it needs to be supported in terms of guidance and loan funds to pineapple farmers. Guidance by government agencies or the private sector that is carried out on an ongoing basis will greatly affect the progress of small and medium industries that process pineapple-based products such as the dissemination and technical guidance of appropriate technology for efficient and effective production activities. The quality of pineapple is one of the most concerning things in industry. The proposed system is promising to be applied to predict the internal quality of pineapples non-invasively [8]. Other studies have also concluded that pineapple bark waste can be used as liquid fertilizer. Liquid Organic Fertilizer from pineapple bark waste contains nutrients such as Phosphate, Potassium, Nitrogen, Calcium, Magnesium, Sodium, Iron, Manganese, Cu, Zn and Carbon [9]. Pineapple weevil can be used as a natural disinfectant because it has antibacterial compounds [13].

3.4. Pineapple processing industry in Indonesia

In Indonesia, there are several industries that produce various kinds of processed pineapple products. Some industries that produce processed pineapple products are shown in table 1.

Table 1. Companies producing processed pineapple.

Company name	Product	Location
PT. Great Giant Pineapple	Pineapple slices	Lampung
PT. Riau Sakti United Plantations	Pineapple slices	Riau
Pina Pineapple	Juice	Jawa Barat

One of the companies is PT. Great Giant Pineapple which is an agro-industrial company engaged in plantation and canning pineapple. Products produced by PT. GGP include canned pineapple, juice, and pineapple concentrates and other fresh fruits that have been marketed to more than 60 export destination countries. From this information, it can be explained that the potential of the pineapple commodity downstream industry is very promising and can improve the economy of the community, especially pineapple farmers.

3.5. Downstream industry challenges

The results of a study explain that there are several problems in developing the pineapple processing industry including [5]:

1) Farm Business Management
2) Land Ownership
3) Capital / Capital Money
4) Farmer Culture
5) Unbalanced Fertilization
6) Limited Market Access

The needs to be solved by all relevant parties so that efforts in increasing downstream pineapple derivative products can run more optimally. The pineapple marketing system is also a challenge for farmers. the results of research [10] showed that there are eight channels formed. In general, all of the marketing channels of Bogorinarian Pineapples had not been efficient. The major marketing channel is farmers-rural collectors-retailers-consumers which has low farmer's share and the price at the farm level [10]. One of the problems in pineapple cultivation in Indonesia is there are no seed producers that can provide quality seeds large quantities, in a short time [27]. This problem needs special attention from the government.

4. Conclusion

Based on the analysis, it can be concluded that the downstream pineapple processing industry has enormous potential. With so many types of pineapple derivative products, the community or farmers have many choices to carry out pineapple-based production activities and have the opportunity to gain global market share. Pineapple production experiences a positive trend, namely

an increase from 2016 to 2018. This increase is proportional to the increase in exports of pineapple commodities to all export destination countries. The increase in pineapple exports shows that the demand for pineapple-based products in importing countries has increased. In increasing downstream pineapple derivative products, seriousness from the government and business entrepreneurs is needed in solving problems that often occur such as farm management, land ownership, capital / money capital, farmers' culture, unbalanced fertilization, and limited market access.

Acknowledgments
The author would like to thank Pekanbaru Product Development and Industrial Standardization Center (BPPSI) for the facilities provided and the authors also thank all the teams for their support and cooperation. For the next stage, it is necessary to research and develop products to grow the Small and Medium Industries in areas that have good pineapple commodity potential.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 59 – 68
ISBN : 978-602-53575-1-0

Bioassessment of river water pollution using benthic macroinvertebrates as bioindicators

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Abstract. Benthic macroinvertebrates are indicators that provide an integrated assessment of the health of water bodies and potentially identify water quality deterioration prior to detection by physicochemistry. The research was caried out using a survey method by sampling the macroinvertebrates that lived around the watershed. The sampling was performed by kicking and jabbing techniques. The obtained macroinvertebrate samples were sorted and stored for identification and evaluation of the types of macroinvertebrate, habitats, and the quality and pollution level of water using the Family Biotic Index. The results showed that the types of macroinvertebrates that were found consisted of 21 species including Sericosmatidae, Lepidasmatidae, Glossosomatidae, Psychomydiidae, Perlidae, Perladidae, Gomphidae, Lepthoblebiidae, Caenidae, Heptageniidae, Elmidae, Simuliidae, Tipulidae, Chironomous thummiplusmosus, Baetidae, Sphaeriidae, Planariidae, Glossiphoniidae, Nereidae, Physidae, and Lymnaeidae. The Family Biotic Index (FBI) and the Biological Monitoring Working Party (BMWP) scores were 4.75 and 88, respectively. To conclude, the watershed contained slight organic pollution with a medium level of pollution.

1. Introduction

Rivers are open ecosystems that can receive streams or water catchments to affect water quality and those living in the river. The river water quality is influenced by the water supply quality from the catchment area, while the water supply quality from the catchment area is related to its human activities [1]. Various types of river utilization activities, such as agriculture, household needs, and industries can make river water has a very strategic role in the lives of humans and other living things. The river water environment consists of abiotic and biotic components that interact through the nutrient cycle and energy flow [2]. If the interaction between the two is disrupted, a change will occur that causes the aquatic ecosystem to become unbalanced [3].

The river has dynamic properties, but the utilization can potentially reduce the value of the benefits of the river itself and create other impacts that can endanger the environment widely. This change can reduce the important materials in the water so that it disturbs the aquatic ecosystem. Disposal of garbage into river bodies can cause changes and damage, both directly and indirectly, to these resources. The direct consequences include the death of fish in rivers, damage to

agriculture and fisheries around landfills, or change in the color of river water handled that cannot be used for human needs. The indirect result is damage to river ecosystems, such as the decline in productivity and diversity of aquatic indicator species. For the large species richness or health of the ecosystem, the indicator species can be used as an indirect measurement [4]. In tropical countries, benthic macroinvertebrates are closely related to the water quality degradation in which their community diversity is in line with the polluted aquatic environment [5]. The benthic can identify the cause of water quality deterioration in streams [6].

Globally, the abundance and diversity of aquatic macroinvertebrates have been used to determine the ecological condition of river bodies [7]. Benthic macroinvertebrate is one of the best biological water quality indicators [8] because of its resistance to the ecological variability [9]. Benthic could monitor the problem in the ecosystem through behavioral or physiological processes. It could also recognize pollutants in an ecosystem and the extent to which the problem may exist [10]. Hence, Some kinds of benthic macroinvertebrates can be used as organic pollution indicators. The advantage of using benthic macroinvertebrates as pollution indicators is due to their long-lives, which are settled in a particular area and have limited mobility [5] so that their presence is very sensitive to exposure to pollutants [11]. In this study, water quality testing was carried out in Coban Sewu watershed, Batu City, to analyze the diversity of benthic macroinvertebrate species and water quality in the watershed. The purpose of this study was to study the macroinvertebrate species lived in Coban Sewu watershed and to analyze the quality of its watershed.

2. Materials and methods

2.1. Study site

Coban Sewu watershed is in Bendosari Village, Pujon District, Malang Regency, with the coordinates of 7^{o} 51' 59.01" S; 112^{o} 25' 24.04"E and an altitude of 874 m above sea level. The watershed is in a rural area. Based on the structural geology, the location was a fracture that becomes a waterfall. The fracture was indicated by the presence of upright cliffs and scratches on the wall allegedly that the fracture occurred was a normal fracture.

2.2. Macroinvertebrate sampling

The bioassessment was conducted in Coban Sewu watershed in January 2017. This research was implemented based on a study methodology for the results of monitoring of Coban Sewu watershed. The sampling of macroinvertebrates was done using a purposive random sampling method. This sampling was performed using the kicking and jabbing method (Figure 1a).

The sampling tools included D-net (500 µm mesh), a sample bottle, tweezers, a white tray, a sieve bucket (0.5 mm mesh), a label sheet, and a waterproof marker pen. Meanwhile, the laboratory analysis tools included a petri dish, a microscope, and 96% alcohol. The data collection procedures were divided into two stages. The first was the macroinvertebrates sampling at the field, and the second was the macroinvertebrates identification in the laboratory.

The macroinvertebrates sampling was conducted based on Stark *et al*. [12]. The sampling procedure began at the downstream end and continued to the upstream. The natural flow area of the substrate was selected because it would point organisms into the D-net. When sampling, the D-net was held in the direction against the water current and placed on the streambed. After stepping into the sampling area, the substrate under the feet was disturbed by kicking to release the organism from the bottom of the water, the gravel, and the cobbles. Afterward, the D-net was jabbed into the bottom of the watershed to collect organisms near the bottom and to further disturb the macroinvertebrates. The disturbed area should extend no further than 0.5 meters upstream from the net. The material from the D-net should be removed into the white tray if the D-net had begun to be clogged (Figure 1b). This treatment was repeated at several different locations within a 50 m stream reach and covered a total area of riffle habitat. The D-net was turned outward to move the sample into the sample container. Any unwanted leaves, sticks, and stones were removed that might not fit into the sample container or would reduce the effectiveness of the preservative (Figure 1c). The organisms were transferred to a half full of water in a white tray as the sample container

(Figure 1d). The side of the sample bottle was stuck by a sticker that recorded the replicate number, date, and code/name. The macroinvertebrates were preserved using 96% alcohol.

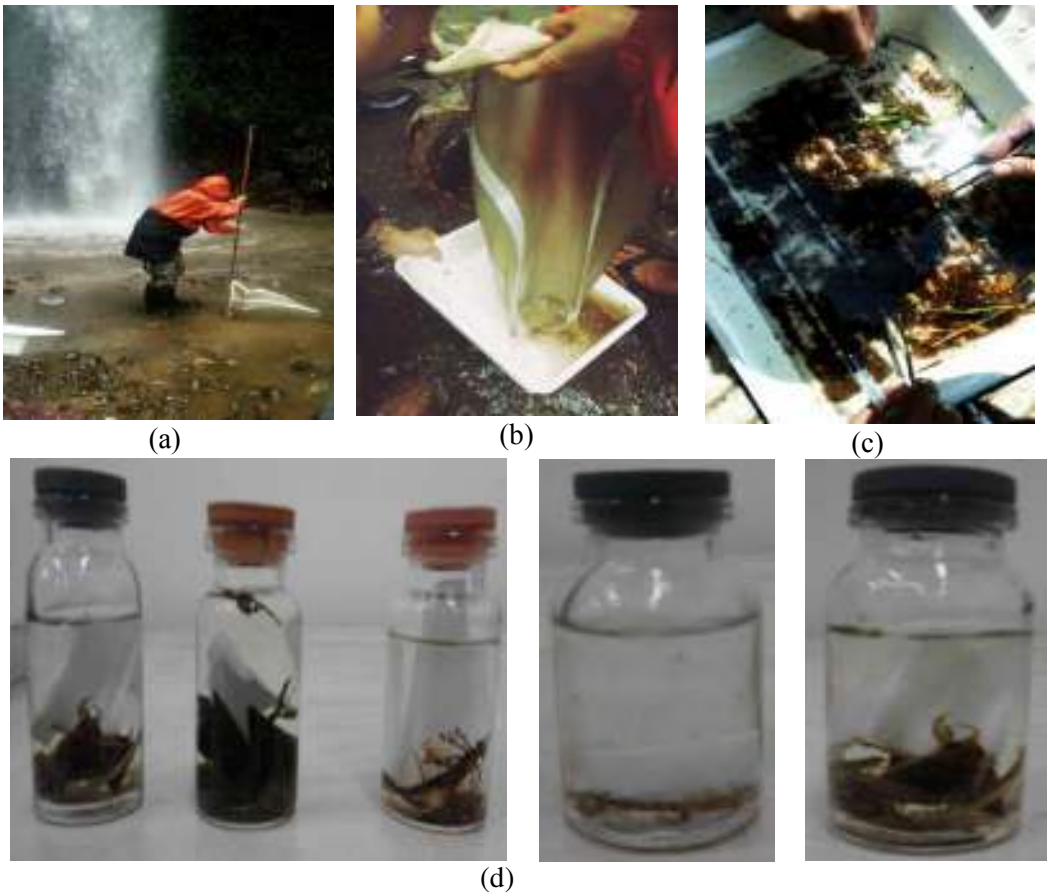

Figure 1. (a) Kicking and jabbing method; (b) transferring the material from the D-net into the white tray; (c) removal of unwanted material; (d) macroinvertebrates.

2.3. Water quality assessment

Measurement of the water quality assessment was carried out by Family Biotic Index determination, Biological Monitoring Working Party-Scoring System, and water acidity measurement.

2.3.1. Family Biotic Index determination. The assessment of the water was done by using Family Biotic Index (FBI). Biotic indices are based on the idea of pollution tolerance for various benthic. Firstly, the FBI was calculated to determine the score of organisms' pollution tolerance in a sample. The score of family degree pollution tolerance was taken from Hilsenhoff [13]. Secondly, in a given family, the number of organisms were multiplied by the tolerance score for that family. The sum of the product in a sample was then added and divided by the number of organisms within the sample, resulting in THEFBI. The FBI resulted in numerical scores to a specific indicator organisms at a particular taxonomic level. The formula of FBI is shown below:

$$FBI = \frac{\sum x_i . t_i}{n} \quad (1)$$

where:

xi = number of individual within a species

ti = tolerance value of species

n = total number of organisms in the sample

Besides, the degree of the water quality is presented in Table 1.

Table 1. Degree of water quality.

Family biotic index	Water quality	Degree of organic pollution
0.00 – 3.75	Excellent	Organic pollution is unlikely
3.76 – 4.25	Very good	Possible for slight organic pollution
4.26 – 5.00	Good	Possible for some organic pollution
5.01 – 5.75	Fair	Substantial pollution is fairly likely
5.76 – 6.50	Fairly poor	Substantial pollution is likely
6.50 – 7.25	Poor	Substantial pollution is very likely
7.26 – 10.00	Very poor	Severe substantial pollution is likely

Source: Hilsenhoff [11]

2.3.2. The scoring system of macroinvertebrates. The macroinvertebrate assessment system for evaluating water quality in Coban Sewu watershed used the Biological Monitoring Working Party-Score System (BMWP) [14]. The BMWP is an index that requires a limited taxonomic precision, effective, and efficient because it was simple and easy to use. It is a procedure used to measure water quality by using a macroinvertebrate as a biological indicator. This method is based on the principle that aquatic invertebrates are different, and they have different tolerance for pollutants. Because of the huge number of taxa, Alba-Tercedor [15] modified Hellawell's BMWP and preserved the original scores. The total score of BMWP was the sum of all scores of each taxon in the study site based on order or family (Table 2). Moreover, taxa that were not included in the Alba-Tercedor [15] would be put a score of 1 [16], and the taxa which were included in Alba-Tercedor [15] table would be put a score based on Table 3.

Table 2. Interpretation of BMWP.

Class	Score of BMWP	Category	Interpretation
	>150	Very good	Very clean water
I	101 – 149	Good	Clean or not significantly altered
II	61 – 100	Questionable	Clean but slightly impacted
III	36 – 60	Moderate	Moderately impacted
IV	16 – 35	Poor	Polluted
V	0 – 15	Very poor	Heavily polluted

Source: Alba-Tercedor [13]

Table 3. Taxa scores of BMWP.

Taxa	Score
Trichoptera: Sericostomatidae, Odontoceridae, Leptoceridae, Brachycentridae **Plecoptera:** Perlidae **Ephemeroptera:** Leptohyphidae, Leptophlebiidae	10
Trichoptera: Psychomyiidae, Philopotamidae, Glossomatidae, Calamoceratidae **Odonata:** Libellulidae, Gomphidae, Cordulegastridae, Calopterygidae, Coenagrionidae	8
Trichoptera: Polycentropodidae **Plecoptera:** Nemouridae	7
Trichoptera: Hydroptilidae, Hydrobiosidae Crustacea	6
Trichoptera: Hydropsychidae, Helichopsychidae, **Ephemeroptera:** Polymitarcidae Platelminthes, Euthyplociidae	5

Diptera: Tipulidae, Simuliidae **Coleoptera:** Dryopidae, Elmidae	
Megaloptera: Sialidae, Corydalidae **Ephemeroptera:** Caenidae, Baetidae **Diptera:** Tabanidae, Stratiomyidae, Psychodidae, Limoniidae, Empididae, Dolichopodidae, Dixidae, Chaoboridae, Ceratopogonidae, Anthomyidae **Coleoptera:** Haliplidae, Curculionidae, Chrysomelidae **Arachnida:** Hidracarina	4
Mollusca **Hemiptera:** Vellidae, Pleidae, Notocectidae, Nepidae, Mesovellidae, Naucoridae, Limnocoridae, Hydrometridae, Gerridae, Corixidae, Belostomatidae **Coleoptera:** Notoridae, Hydrophilidae, Helodidae, Gyrinidae, Dytiscidae **Annelida:** Hirudínea	3
Diptera: Thaumaleidae, Muscidae, Ephydridae, Culicidae, Chironomidae	2
Lepidoptera **Diptera:** Sciomyzidae, Syrphidae, Thagionidae **Blattaria:** Blattidae **Annelida:** Oligochaeta	1

Source: Alba-Tercedor [13]

In Indonesia the use of the biotic index to assess water quality was still very limited. Trihadiningrum and Tjondronegoro [17] have succeeded in compiling a classification of macroinvertebrates based on the pollution loads. Biota grouping was based on the highest species abundance found at certain water quality levels. On that basis river, water quality could be divided into 6 pollution levels as shown in Table 4.

Table 4. Indicator of macroinvertebrate pollution level.

Pollution level	Macroinvertebrate indicator
I. Healthy (not polluted)	Planaria, Trichoptera (Glossosomatidae, Lepidosmatidae Sericosmatidae)
II. Fair (polluted)	Coleoptera (Elminthidae), Odonanta (Aeshnidae, Agriidae, Olarycbenatidae, Gomphidae), Trichoptera (Psychomydae, Hydropschydae), Ephemeroptera (Caebidae, Ecdyonuridae, Pseudocloeon, Leptophlebiidae), Plecoptera (Peleididae, Perlidae)
III. Fairly poor (polluted)	Odonanta (Cordulidae, Libellulidae), Crustacea (Gammaridae), Mollusca (Bivalvia, Pulmonata)
IV. Polluted	Hemiptera, Hirudinea (Hirudidae, Glossiphonidae)
V. Poor (polluted)	Syrphidae, Diptera (Chiromonus thummiplumosus), Oligochaeta (ubificidae)
VI. Very poor (polluted)	There were no macroinvertebrates, very tolerant of organic waste which were found on the water surface

Source: Trihadiningrum and Tjondronegoro [17]

3. Results and discussion

The water quality assessment used macroinvertebrates indicators, mainly based on macrobenthic animals, like larvae, insects, worms, and some other types of soft animals that live at the bottom of the waters. From the study result, the macroinvertebrates in Coban Sewu watershed could be identified for 6 classes (Insecta, Mollusca, Rhabditophora, Hirudinea, Polychaeta, and Gastropoda), 12 orders (Trichoptera, Plecoptera, Odonata, Ephemeroptera, Coleoptera, Diptera, Ephemeroptera, Veneroida, Planaria, Rhincobdelae, Phyllodocidae, and Bassomatophora), and 21 families as shown in Table 5. Of the 21 families, the insects had the highest abundance. Sericosmatidae, Lepidasmatidae, and Glossosomatidae are insects that live in a healthy watershed, while Chironomous thummiplusmosus and Baetidae are insects that cause pollution [17].

Based on the macroinvertebrate families, the FBI calculation resulted in a value of 4.75 which means that Coban Sewu watershed was in a quite good category that contained slight organic pollution with a medium level of pollution. The dominance order of Trichoptera and Diptera in the watershed was an early signal of an increase in waste input of anthropogenic to the waters [18]. It reflected that the form of domestic and agricultural waste [19] and the human activities along the watershed caused disturbance [20]. The BMWP macroinvertebrate scoring at Coban Sewu watershed is shown in Table 6, whereas the water quality assessment based on Trihadiningrum & Tjondronegoro [17] is shown in Table 7.

Table 5. The macroinvertebrate community in Coban Sewu watershed.

Class	Order	Family
Insecta	Trichoptera	Sericosmatidae, Lepidasmatidae, Glossosomatidae, Psychomydiidae
	Plecoptera	Perlidae, Perladidae
	Odonata	Gomphidae
	Ephemeroptera	Lepthoblebiidae, Caenidae, Heptageniidae
	Coleoptera	Elmidae
	Diptera	Simuliidae, Tipulidae, Chironomous thummiplusmosus
	Ephemeroptera	Baetidae
Mollusca	Veneroida	Sphaeriidae
Rhabditophora	Planaria	Planariidae
Hirudinea	Rhincobdelae	Glossiphoniidae
Polychaeta	Phyllodocidae	Nereidae
Gastropoda	Bassomatophora	Physidae, Lymnaeidae

Table 6. The macroinvertebrate scoring at Coban Sewu watershed.

Macroinvertebrate (order:family)	Score
Trichoptera: Sericosmatidae	10
Trichoptera: Lepidasmatidae	1
Trichoptera: Glossosomatidae	8
Trichoptera: Psychomydiidae	8
Plecoptera: Perlidae	10
Plecoptera: Perladidae	1
Odonata: Gomphidae	8
Ephemeroptera: Lepthoblebiidae	10
Ephemeroptera: Caenidae	4
Ephemeroptera: Heptageniidae	1
Coleoptera: Elmidae	5
Diptera: Simuliidae	5
Diptera: Tipulidae	5

Diptera: Chironomous thummiplusmosus	2
Ephemeroptera: Baetidae	4
Veneroida: Sphaeriidae	1
Planaria: Planariidae	1
Rhincobdelae: Glossiphoniidae	1
Phyllodocidae: Nereidae	1
Bassomatophora: Physidae	1
Bassomatophora: Lymnaeidae	1
Total	88

The determination of organic content in the ecosystem was calculated by the BMWP score. Based on Table 6, the BMWP score in this study was 88. In line with the FBI, it showed that the watershed was clean but slightly impacted (questionable category). Pollution in this level was organic content pollution, which was possible caused by the side by side location with agricultural activities and forest [21] and the disposal of household waste. The existence of agricultural practices has a very strong influence on macroinvertebrate diversity. Water from the agricultural land that flew through this river allowed organic pollution to occur. But this still requires further research on how agricultural land contributes to this organic pollution. The lower the BMPW score, the lower is the level of sensitivity of macroinvertebrate to adapt to the environment, and vice versa [22]. In this case, the macroinvertebrate families that caused the most organic pollution were Chironomous thummiplusmosus, Lymnaeidae, Physidae, Nereidae, and Baetidae (Table 7). Chironomidae were very tolerant of organic pollution, settled in tender bottom sediment [23], and had individual resistance to disturbed water conditions [24]. The presence of Chironomidae in the waters indicates human influence on the habitat of the river [25]. Besides, the more Chironomidae populations that are found in the water indicates that there has been organic waste that is released in the river. If the watershed continues to be used by the public without any environmental monitoring, the water quality will have a serious level of pollution.

Table 7. Classification of macroinvertebrates in Coban Sewu watershed.

not polluted	fair	fairly poor	polluted	very poor
Sericosmatidae, Lepidasmatidae, Glossosomatidae, Planariidae	Perlidae, Perladidae, Gomphidae, Psychomydiidae, Lepthoblebiidae, Heptageniidae, Elmidae	Sphaeriidae, Caenidae, Simuliidae, Tipulidae	Glossiphonidae	Chironomous thummiplusmosus, Lymnaeidae, Physidae, Nereidae, Baetidae

In addition, the results of measuring water quality biologically make it possible to monitor all changes in variables related to aquatic life and ecological conditions. It does not require a lot of chemicals so that its application is practical and inexpensive. Wang [26] stated that pH values of <5 and> 9 are unfavorable conditions for most macrobenthos organisms. For macroinvertebrate, the effect of pH is concerned to stress decreasing. Macroinvertebrate diversity decreases slightly when the pH is above six [27]. Based on the measurement, the watershed had an average pH of 7.1. In conclusion, it showed that the watershed was quite normal.

4. Conclusion

The macroinvertebrates lived around Coban Sewu watershed consisted of 6 classes (Insecta, Mollusca, Rhabditophora, Hirudinea, Polychaeta, Gastropoda), 12 orders (Trichoptera, Plecoptera, Odonata, Ephemeroptera, Coleoptera, Diptera, Ephemeroptera, Veneroida, Planaria, Rhincobdelae, Phyllodocidae, and Bassomatophora), and 21 families (Sericosmatidae, Lepidasmatidae, Glossosomatidae, Psychomydiidae, Perlidae, Perladidae, Gomphidae, Lepthoblebiidae, Caenidae, Heptageniidae, Elmidae, Simuliidae, Tipulidae, Chironomous thummiplusmosus, Baetidae, Sphaeriidae, Planariidae, Glossiphoniidae, Nereidae, Physidae, and Lymnaeidae). The Family

Biotic Index (FBI) was 4.75, meaning that Coban Sewu watershed contained slight organic pollution with a medium level of pollution. The Biological Monitoring Working Party (BMWP) score was 88, meaning that it was clean but slightly impacted (questionable category). Last, the macroinvertebrate families that caused the most organic pollution were Chironomous thummiplusmosus, Lymnaeidae, Physidae, Nereidae, and Baetidae.

Acknowledgments
The authors would like to thank all parties (especially for the Faculty of Fisheries and Marine Sciences and the Faculty of Agriculture, Brawijaya University) that have given the facilities/laboratories and support in this research.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 69 – 76
ISBN : 978-602-53575-1-0

The development of paving block composite using high-density polyethylene plastic waste and palm kernel shell ash

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Abstract. Palm kernel ash (PSA) waste by boiler heating in crumb rubber industry contents high silica, so it will influence the compressive strength of paving block. In addition to palm kernel ash waste, high density polyethylene (HDPE) plastic waste from human activities is very high so that it will affect environmental damage. The influence of various mixture composition of PSA and HDPE, by products from boiler heating in crumb rubber industry, on physical and mechanical properties of paving block have been studied. The Experimental model used variety of HDPE waste plastic concentration and palm shells ash waste that consisted of A0(100 : 0), A1(97,5 : 2,5), A2(95 : 5), A3(92,5 : 7,5), A4(90:10), and A5(87,5 : 12,5)%. Palm kernel ash and HDPE waste plastic were mixed and pressed at 180^{o}C, 200 kg.cm^{2} use metal molding about 10x20x6 cm dimension. Plastic paving block result tested for physical, thickness, compressive strength, water absorption, and microscopic morphology using SEM. The result shows that palm kernel ash waste significantly influenced the compressive strength, water absorption, and microscopic morphology but no significant effect to physical property and thickness.

1. Introduction

Palm kernel ash can be used as a construction material, it is produced from palm shells that burned as boiler fuel in a crumb rubber factory. Generally, after the burning process, about 5% of palm kernel ash (based on the weight of solid waste) produced and palm shells contain ash 1,53%, Nitrogen (as N) 0,41% [1,2,3].

In general, palm kernel ash waste has varied in color, depending on the operating system in the factory. The utilization of palm kernel ash waste is not yet optimal, the amount is increasing and most of it is disposed of as waste, so it effects environmental problems. Research has been conducted to feasibility test of using ash as a substitute for cement [4]. In this study, palm kernel ash was obtained from burning palm shells. It was obtained from PT. Hevea MK. I Palembang, South Sumatra, it was sieved using a 150 mesh filter to separate the larger ash particles. Palm kernel ash contains Silicon dioxide (SiO_2) 43.60%, Aluminum oxide (Al_20_3) 11.40%, Ferric oxide (Fe_2O_3) 4.70%, Calcium oxide (CaO) 8.40%, Magnesium oxide (MgO) 4.80%, and Sulfur trioxide (SO_3) 2.80% [5].

Besides palm kernel ash, HDPE plastic waste is a potential waste that can pollute the environment. Human activities always produce waste, so dispose of it in a certain way so that

waste management does not become a new problem. The use of plastic and composite materials is increasing, resulting in low costs and ease of use in manufacture. Therefore, the amount of accumulated plastic waste is high and it has potency as a big challenge to utilize the waste [6,7].

Disposal of plastic waste in the environment consider as a big problem because biodegradability is very low and its presence is in a large quantities [8,9]. The biggest components of plastic waste are polypropylene, polyethylene terephthalate, and polystyrene [8]. Types of HDPE plastic waste consist of milk bottles, shampoo bottles, detergent bottles, jerry cans of oil, and toys [10].

The chemical composition of HDPE such as (-CH2-CH2-) about 97%, carbon black about 2.25% and additive about 0.75%. (Source: Material Safety Data Sheet Polyethylene). HDPE can be recycled and it is good for products that require high flexibility but it must solid. The physical properties of HDPE such as Specific gravity about 0.941 - 0.965, Cristallinity (%) about 80-95, Melting temperature (^{o}C) about 127-135, Tensile strength (MPa) about 17.9-33.1, Tensile modulus (MPa) about 413-1034, Elongation at break (%) about 20-130, Impact strength (ft-lb/in) about 0.8-14 and Heat deflection temperature (C at 66 psi) about 60-88. HDPE is produced by free radical polymerization. HDPE is usually used for food and soft bottles such as honey, mustard, trash bags, agriculture and building construction. One of HDPE utilization waste is paving block material. Today, many consumers are interested in paving block rather than using other sidewalks such as concrete or asphalt because it is environmentally friendly materials, it helps with groundwater, it has a faster and easier installation and maintenance, and it has various forms and low budget [11].

Similar research on the utilization of waste plastics in production of paver blocks has been conducted[12]. The process of paving block using 1.14 kg cement, 1.60 kg of dust/ mine dust, 2.08 kg of coarse/gravel aggregate, and 600 g of plastic waste, with melting process, the averages of compressive strengh is about 16.05 N / mm2. Another research about investigation of the Strength Properties of palm kernel shell ash concrete observed the mechanical properties of various percentages of cement, gravel oil palm kernel ash, shell aggregates and water, with 0% ash addition, 10 and 30% of palm kernel ash, and 0.5 water: cement ratio. The results of the product of compressive strength in 28 days for the addition of 10% ash from palm kernel ash (PSA) about 22.8 N/mm2 [3] .

In this research, HDPE plastic waste and palm kernel ash were melted in the reactor furnace, then pressed with hydraulic press to produce paving blocks. This research would contribute to road and pavement contruction. The result would contribute towards the solution for a safe disposal of waste plastic. The use of palm shell plastic waste intended to reduce environmental problems because of excessive waste plastic, production cost, and increase the quality of pavements.

2. Experimental method

Palm kernel shell ash (PSA) used in the study obtained from the boiler burning of a crumb rubber factory PT. Hevea MK 1 Palembang, South Sumatra. Other materials that used such as HDPE plastic, obtained from waste water disposal and water. The plastic waste was selected only for HDPE plastic, then it was washed with water to remove dirt, then it was dried. Furthermore, palm kernel shell ash waste was burned using a temperature of 180^{o}C, then sieved using a size of 150 mesh. Then HDPE plastic and palm kernel ash mixed following the research composition, then put the mixed into an injection machine with compressive strength in rate about 200 kg.cm^{2} [13,14].

As a filter, a mixture of HDPE plastic waste and palm kernel shell ash (PSA) was prepared about 2000 g of total weight using reactor furnace and temperature at 180^{o}C for 15 minutes. After mixing, a hydraulis press was used about 210 kg.cm2 of compressive value and metal molding (length x width x thickness) about 10 x 20 x 6 cm for pressing at 5 minutes. Before testing, the mixture soaked in the water for 8 minutes. The research composition of HDPE and PSA was designed by varying the percentage weight/weight of (HDPE:PSA) such as A0(100: 0); A1(97.5: 2.5); A2(95: 5); A3 (92.5: 7.5); A4(90:10); and A5(87.5: 12.5)%. In addition, observations were made for the physical properties of the mixture such as visible properties, compressive strength, water absorption, and product thickness. A magnifying glass was used to observe the physical appearance on the surface of the composites, while a digital calliper was used to measure the

thickness. Based on ASTM C 936, compressive strength was tested and utilizing ASTM D570-95 for the water absorption test. Those properties were conducted in three repetitions to obtain high accuracy data.

3.Results and discussion

3.1 Physical appearance

Physical appearance of paving blocks shown in table 1, physical appearance of the apparent nature of paving blocks for floors/roads was observed with a perfect shape criteria, no cracks and defects, part of the corners were not easily broken with the strength of the fingers.

Table 1. Physical-surface appearance of composites of HDPE/PSA.

HDPE/PSA (w/w) %	RESULTS
100/0	No cracks, smooth surface
97.5/2.5	No cracks, smooth surface
95/5	No cracks, smooth surface
92.5/7.5	No cracks, smooth surface
90/10	No cracks, smooth surface
87.5/12.5	No cracks, smooth surface

This situation was due to HDPE that had high elasticity so that the products produced with some addition of palm kernel shell ash had a good physical shape. The observation was made at the age of 0 days so that it had not been degraded by the presence of bacteria/ microorganisms and air/ozone attacks during the degradation process [15,16]. This condition was supported by the results of the research, if the plastic paving block was oxidized on the surface causing cracks and brittle due to the lack of antioxidants in the composite [17,18]. Physical-surface appearance paving block is in figure 1.

Figure 1. Physical-surface appearance paving block.

3.2 Water absorption

Testing of water absorption in specimens was done by the soaking process at room temperature for ±24 hours, removing and drying the remaining water for ±1 minute. Then, the surface of the product dried with a cloth in order to reduce the remaining water. Then, paving block weighing, drying in oven at 105^{o}C, cooling at room temperature.

Figure 2 illustrates that the greater percentage in addition of palm kernel shell ash, the higher the value of water absorption, the lowest average water absorption test results shown in treatment A0/100/0 (0.13%) and the highest average shown in treatment A5/87.5/12,5 (2,82%). Palm kernel shell ash (PSA) contained silica, the result of testing SiO_2 contained about 34.7%. It would increase

the porosity and absorptive capacity [16], supported by another research that HDPE plastic had a small absorption (0.1%), the results of water absorption in plastic paving blocks were lower than cement paving blocks [19,16]. The increasing of water absorption with the addition of PSA suspected that the silica and hydroxyl groups of PSA allow water absorption through hydrogen bonds. The density of the test specimens greatly affected the water absorption value. The density of water absorption is inversely proportional [20]. The lower the density, the water absorption would be greater, and the higher the density of paving blocks, the bond between particles was more dense, so that the water cavity in the paving block decreased, and water was difficult to fill the cavity.

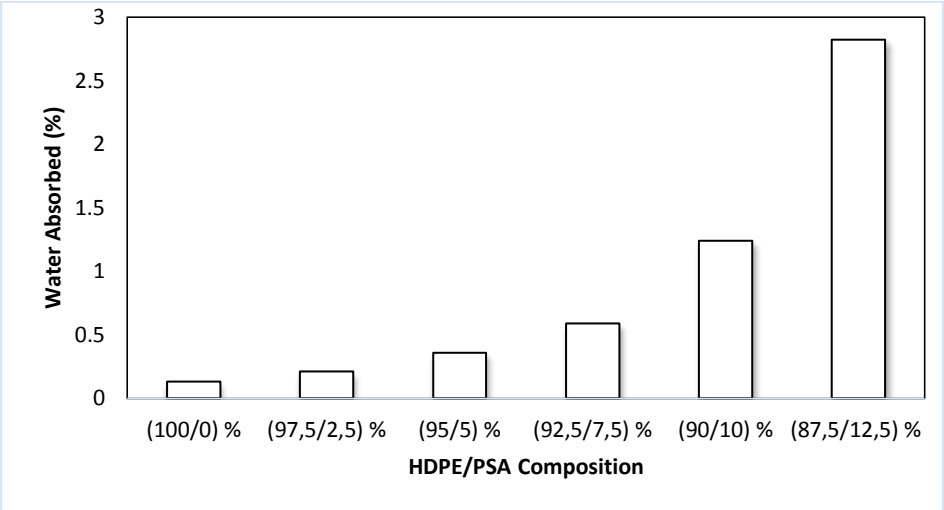

Figure 2. Water absorption of paving block with HDPE/PSA composites.

3.3 Compressive strength

The composite of paving block was made by mixing the HDPE and palm kernel shell ash, with melting in an injector with a temperature of around 180^{o}C, so that it would produce high compressive strength of the product, and the addition of palm kernel shell ash would reduce the compressive strength of the resulting product. The highest average compressive strength was in treatment A0/100/0 (127kg/cm^2) and the lowest average strength was in treatment A5/12.5 (75kg/cm^2).

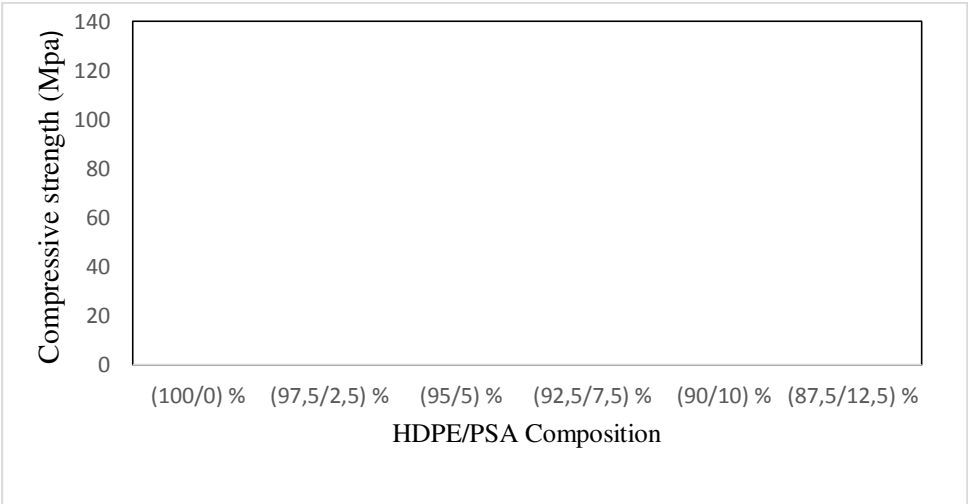

Figure 3. Compressive Strength of Paving block with HDPE/PSA composite.

Figure 3 illustrates the addition of palm kernel shell ash as a filler will reduce the compressive strength of paving blocks [13]. HDPE raw material from plastic bottle waste including

polyethylene terephthalate (PET) group, is a polyester resin that is durable, strong, lightweight and easily formed when hot. The thickness is around 1.35-1.38 gram/ cc, makes its shape sturdy [14], then the addition of palm kernel shell ash will reduce the compressive strength.

The use of Palm Kernell Sell reduce the compressive strength and the use of palm kernel shell ash as a filler is not only intended to minimize environmental problems caused by excessive plastic waste but also to reduce the cost of producing composite plastics [16]. These silica contents will increase the compressive strength if a raw material used is a plastic powder without melting, cement and sand, because HDPE aggregate plastic has a low density of 0.945-0.962 (g/cc) [21].

3.4 Thickness

Figure 4 illustrates that product differences did not change significantly between combinations. The paving block product was replaced with a metal mold (length x width x thickness) about 10x20x6cm, hexagonal shape (hexagonal type with additional hexagonal engraving in the middle) and pressed with a 200 kg.cm^2 hydraulic press about 5 minutes. Then the product was soaked in water for 8 minutes before testing.

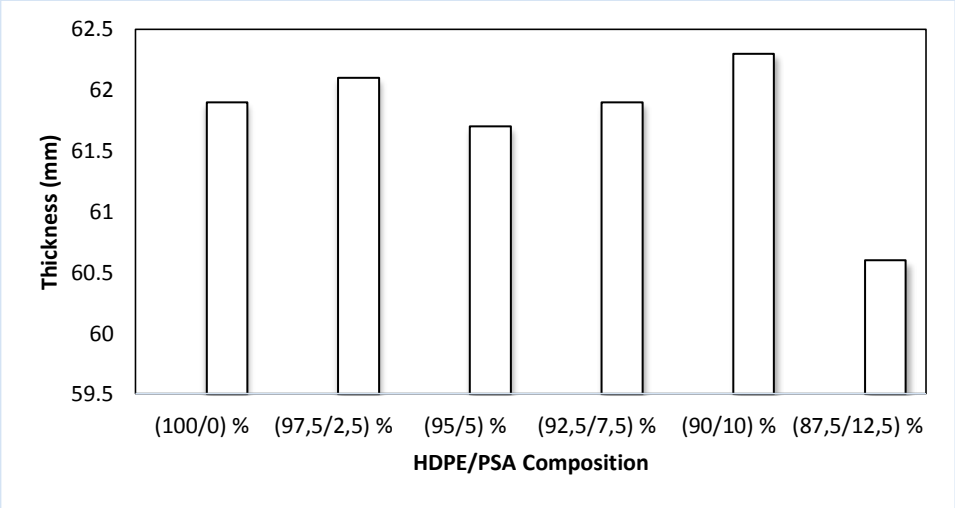

Figure 4. The thickness of paving block with HDPE/PSA composite.

There was no difference in thickness between the printed paving blocks and the metal mold (length x width x thickness) around 10x20x6 cm so it would have an insignificant thickness.

3.5 Major element testing based on SEM test

The results of carbon element testing and oxygen Scanning Electron Microscope (SEM) in table 2.

Table 2. Results test of major elements based on SEM test.

Major element	Treatment					
	100/0	97.5/2.5	95/5	92.5/7.5	90/10	87.5/12.5
Mass C (%)	67.26	59.74	52.55	37.64	37.55	35.64
Mass O (%)	1.22	9.11	17.56	24.55	24.65	24.55

The highest carbon element test results obtained at treatment A0/100/0 of 67.26% while the lowest test results at treatment of A5/87.5/12.5 amounted to 35.64%. These results indicated that the higher percentage of HDPE, the higher the element C while the addition of palm kernel shell ash would reduce the carbon content in paving block products. The element carbon was a non-metallic element with 4 valence, there were 4 electrons which could be used to form covalent bonds, not with the appearance of clear (diamond) and black (graphite). The addition of elements

C in the increasing amount of HDPE plastic was due to the chemical reaction of HDPE with content of palm kernel shell ash consisting of silicates (SiO_2), alumina (Al_2O_3), and iron oxide (Fe_2O_3) and small elements in the form of carbon, calcium, magnesium, and moderate sulfur palm shell containing 1.53% ash, nitrogen (as N) 0.41% [1].

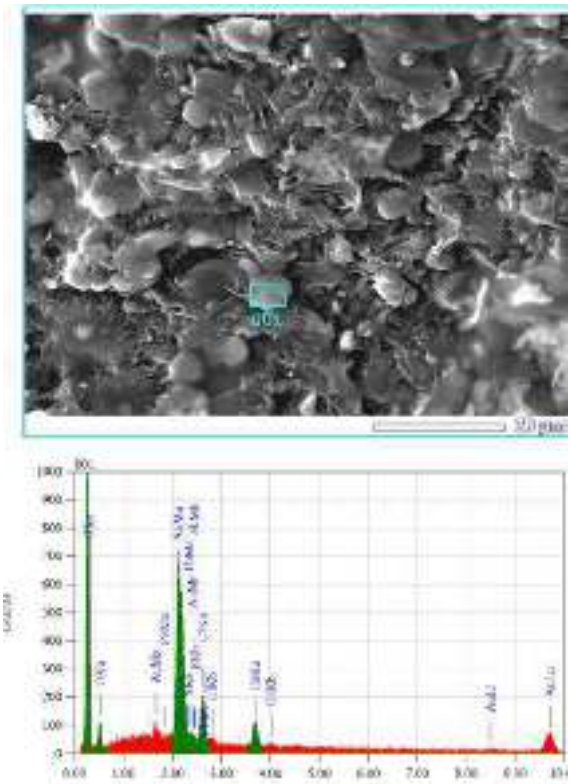

Figure 4. SEM EDX Results, paving block sample A1/97.5/2.5, Magnification 250X, position 1 (coating). Observe the element composition in the composite sampel A1 that contains Carbon (C) 37.34%, Oxygen (O) 5.99%, Sulfur (S) 1.303% , Clorida (Cl) 4.62%, Calsium (Ca) 3.08%, Aurum (A) 43.29% and Plumbum (Pb) 4.38%.

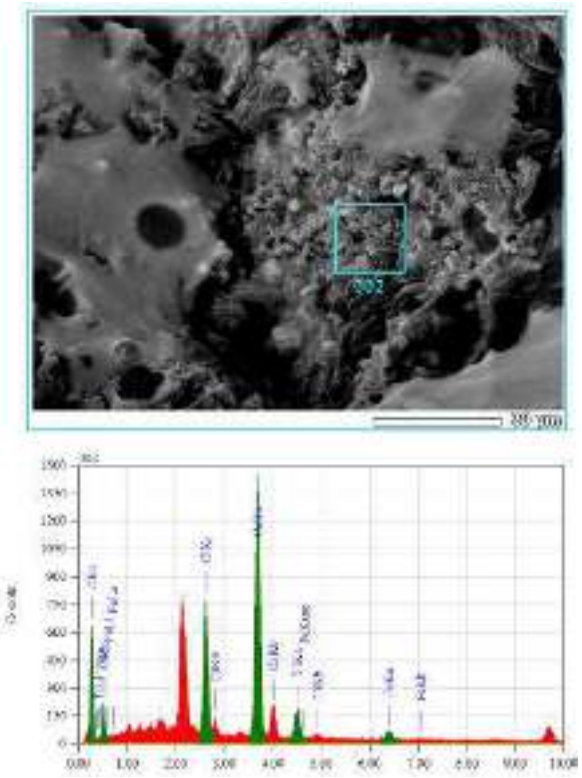

Figure 5. SEM EDX Results, paving block sample A4/ 90/10, magnification 250X, position 2 (no coating). Observe the element composition in the composite sampel A4 that contains Carbon (C) 16.63%, Oxigen (O) 11.36%, Clorida (Cl) 16.03%, Calsium (Ca) 46.11%, Titanium (Ti) 5.89% and Ferrum (Fe) 3.96%.

The lowest oxygen element (O) results in test obtained at A0/100/0 treatment of 1.22%, increased in line with the addition of palm kernel shell ash. These results indicated that the higher percentage of HDPE, the lower the element O while the addition of palm kernel shell ash would increase the oxygen content of the paving block products. Element O was easy to react with almost other elements. The increasing element of oxygen in each addition of palm kernel ash was caused by water from palm kernel shell ash (20.70%) that would be trapped when HDPE plastic melting so that it became an oxygen element in the product. The presence of this oxygen element caused a high porosity and a decrease in compressive strength of the product [1,13]. The decrease in oxygen test results in treatment A5 /87.5/12.5 was likely due to a less homogeneous stirring, thereby increasing the oxygen content to 24.55%. The result from A1 and A4 is in figure 4 and 5.

SEM testing demonstrated the increase of oxygen levels and the reduction of carbon levels in the product. The compressive strength of paving blocks tended to decrease with higher PSA addition but still within the range of paving quality requirements, and the use of palm kernel ash a filler was not only intended to minimize environmental problems caused by excessive plastic waste

but also to reduce production costs. On the contrary, The HDPE/PSA composite water absorption capacity increased slightly due to the addition of palm kernel ash.

4. Conclusion

Recycled plastic composites consisting of HDPE using palm kernel shell ash have been successfully carried out. The addition of palm kernel shell ash to paving block products is physically insignificant, but by recycled plastic composites consisting of HDPE using palm kernel ash have been successfully carried out, but by SEM testing will increase oxygen levels and reduce carbon levels in the product. The compressive strength of paving blocks tended to decrease with higher PSA addition but still within the range of quality requirements of paving block, and the use of palm kernel shell ash as a filler was not only intended to minimize environmental problems caused by excessive plastic waste but also to reduce production costs. On the contrary, the HDPE/PSA composite water absorption capacity increased slightly due to the addition of palm kernel shell ash.

Further research is recommended to study the modifier/plasticizer and coupling agent, anti-oxidants to increase the dispersion of recycled HDPE and PSA fillers to determine the nature of biology degradation and thermal aging.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 77 – 86
ISBN : 978-602-53575-1-0

Phytoremediation of lead on arid land: A review

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Abstract. Lead (Pb) is one of the non-essential heavy metals which can cause soil pollution. Lead within the soil can change the nature of soil. Meanwhile, land is one of the important supporting factors in the life of living things. One technique that can restore the polluted environment by Pb is phytoremediation method. Phytoremediation is a process that utilizes a variety of plants to reduce and/or to remove contaminants in the soil. This paper aimed to discuss various phytoremediation mechanisms of Pb and its potential as a remediation technique that utilizes the ability of plants to remove heavy metals from polluted soils.

1. Introduction

Soil pollution is an environmental pollution occuring due to the contamination of chemicals to the soil that can change the natural soil environment. Meanwhile, soil is one of the important supporting factors in the ecological cycle. However, soil pollution caused by natural factors and human activities is very difficult to avoid [1,2,3,4] including heavy metals contamination. Heavy metals are considered a group of pollutants because they are non-degradable [5]. Lead (Pb) is a kind of heavy metals that can be potentially toxic in excess concentrated [4,6,7].

Lead is a non-essential heavy metal which is toxic for organisms [8]. These toxicities are cumulative meaning the nature of the toxic will arise if accumulated in a large quantity into an organism [9,10,11,12,13].

Phytoremediation is a method to remediate the environment by Pb contamination. Phytoremediation is a technique utilizing a variety of plants to remove and destroy contaminants in soil or water [3,14,15,16,17]. This method has been considered as a cheap and effective technology. Because of its reliability, phytoremediation can replace other technologies that are considered expensive and not optimum in removing heavy metals from the environment [18]. Therefore, this paper aimed to analyse the ability and efficiency of phytoremediation techniques to remove Pb on arid land.

2. Lead (Pb)

Lead is a heavy metal naturally found in the earth crust. It originated from human activities. In fact, the number of Lead from anthropogenic activity is 300 times higher than lithogenic Pb. Lead has an atomic number 82, an atomic weight of 207.19, and a specific gravity of 11.34, a bluish color or silvery gray with a melting point of 327.5°C and a boiling point at atmospheric pressure of 1740°C

[18]. It has a low melting point, is easily formed, and has active chemical properties, so that it can be used to coat the metal to avoid rusting [9, 10,11,12,13].

Lead is a compound that is highly toxic to humans if it is contaminated in a large quantity. It has properties that cannot be decomposed naturally that is very dangerous in biological systems. Lead also has properties that are very difficult to dissolve in the environment. Therefore, if Pb enters the body in a large concentration, it will cause serious health problems for humans such as brain damage and mental retardation. In a study in the USA, where 78% of homes had soil-lead levels higher than 0.5 µg/g, it was estimated that a child eating only half a gram of soil would ingest 250 µg of lead, almost twice the maximum intake limit per day [19,20]. In addition, Pb is not only dangerous for humans, but also dangerous for microorganisms, spills, and animals [21].

The contamination of Pb into the human body can go through air, water, and soil. Lead is considered safe in the soil by a threshold of 0.07 µg/g. Lead in the soil is mostly sourced from vehicles. Several studies reported that areas near highways in urban environments have experienced serious pollution. Furthermore, Pb on the road will be contaminated to the surrounding land including agricultural land. In this case, remediation is needed to reduce Pb from the soil. Various techniques have been proposed including phytoremediation techniques. The term phytoremediation comes from Greek in which "phyto" means plant and "remediation" means to repair, to reduce, or to restore. Phytoremediation is the use of plants to remediate, reduce, or restore polluted lands [3,14,15,16,17,22]. As a result, the objective of this paper is describing the Pb phytoremediation technique on arid land.

3. Phytoremediation

Phytoremediation is defined as a technology that utilizes certain plants to restore a contaminated environment from harmful pollutants to improve the quality of the environment. Phytoremediation can be classified based on the process of absorption and removal of metals, namely phytoextraction, rhizofiltration, phytodegradation, phytostabilization and phytovolatilization [23,24,25]. The process of Pb absorption is shown on figure 1.

3.1. Phytoextraction

Phytoextraction or phytoaccumulation is the absorption of heavy metals by plant roots accumulating heavy metals that have been absorbed into plant parts such as roots, stems, and leaves [22,25]. This method is widely used for metal waste [27]. In this method, the root component is very important to increase the absorption capacity of plants in the waste in the environment [28]. The process of absorption of heavy metals by plants can be seen in the scheme of figure 2 [29].

3.2. Rhizofiltration

Rhizofiltration is a process of utilizing the ability of plant roots to absorb, precipitate, and accumulate metals from waste streams [24,25]. Rhizobacteria can be used to deal with heavy metals contaminated land, especially Pb so that land can still be used for agricultural activities that are safe for human health and the environment. Rhizobacteria can increase Pb absorption in plant tissue (phytoextraction) and some others can reduce absorption (phytostabilization) [30]. Rhizobacteria has a mechanism that can cause changes in the availability of metal elements in the soil to become whether more easily or difficult to be absorbed by plants. Rhizobacteria can interact symbiotically with roots to increase the metal absorption potential [31].

3.3. Phytodegradation

Phytodegradation is the decomposition or metabolism of contaminants (heavy metals) in waste by utilizing the activity of microbes and enzymes such as dehagenase and oxygenation around the roots of plants [32]. The role of rhizosphere bacteria (rhizobacteria) found in roots can break down organic or inorganic compounds [33]. Rhizobacteria plays a major role in plant growth in phytoremediation techniques [34,35,36,37,38,39]. Bacteria can be found living on the surface of

plants or in plants [40]. Most microorganisms that live on the surface of plants are near the root surface (rhizoplane) and narrow zones around the root (rhizosphere) or on the surface of leaves (phyllosphere). The rhizosphere is defined as a narrow zone of nutrient-rich soil that surrounds plant roots and is influenced by root exudates and microbial activity. Beneficial bacteria can produce phytohormones that stimulate plant growth and development and encourage tolerance to environmental stresses [41,42].

3.4. Phytostabilization

Phytostabilization is the ability of plants to excrete certain chemical compounds to immobilize heavy metals in the root region (rhizosphere) or attach certain contaminants to roots that cannot be absorbed into the stems of plants. These substances will stick closely to the root (stable) and will not be carried away by the flow of water [43,44]. This method can help rebuild vegetation in locations that are contaminated with high metal concentrations [45].

3.5. Phytovolatilization

Phytovolatilization is a process when plant absorbs heavy metal contaminants and releases them (transpiration) into the air through the leaves and has been degraded beforehand, so that they are no longer dangerous when released into the air [46].

3.6. Phytotransformation

Phytotransformation is the absorption of heavy metal contaminants by plants to decompose contaminants that have complex molecular chains into harmless materials with molecular arrangements that are simpler and useful for the plant. Phytotransformation process can occur in roots, stems, and leaves and can occur around the roots with the help of enzymes released by plants to accelerate the degradation process [24,25].

The process of decomposition of heavy metals in the phytoremediation process depends on the interaction between the soil, heavy metals, bacteria, and plants. This complex interaction is influenced by various factors, such as plant characteristics and activities, rhizobacteria, climatic conditions, and soil properties

One of the requirements in phytoremediation is that hyperaccumulator plants must be able to grow in any land condition, have a tolerance level of contaminants, be able to remediate more than one pollutant, grow fast and be able to consume large amounts of water in a short time. Table 1 shows the species that have been used in phytoremediation.

From the reports in table 1, the right plants to be applied in phytoremediation techniques are (i) selecting plant species that are able to grow quickly in high toxic environmental conditions, (ii) able to consume large amounts of water in a short time and (iii) able to decontaminate or remediate more than one pollutant and has a high level of resistance to pollutants. The types of plants that are used efficiently are spinach plants, grasses and sunflowers. In addition to choosing the right plant species, the addition of chelation agents as the efforts to increase the absorption and ability of plants to accumulate Pb metal. One of the most powerful and commonly used chelating agents is ethylene diamine tetraacetic acid (EDTA), which forms complexes with many metal contaminants in the natural environment [47].

Ethylene diamine tetraacetic acid is a chelation agent that is capable of chelating heavy metals in the soil. The addition of EDTA chelation agents in plants can increase accumulation in several heavy metals including Pb [48,49,50,51,52]. Ethylene diamine tetraacetic acid is well known for its excellent ability to recover metals from the soil (25-80%) [53,54]. Nascimento et al., 2006 investigated that the effects of EDTA chelation agents were effective in reducing Pb concentrations in soils. [56] explained that the application of EDTA with sunflower plants *Helianthus annuus L.* is able to increase the accumulation of Pb more than (80%) which is cultivated in the hydroponic system. A research conducted by [57] also showed that EDTA applications with different plant species, such as Cannabis sativa, Medicago sativa, Zea mays and Vulghum Sorghum are able to

accumulate Pb, Cd and Zn. The use of EDTA chelation agents is also able to accumulate Pb contaminated soil by more than (81%) [58].

Besides EDTA, the adding of compost is also a source of nutrients for plant growth. The use of compost can increase plant growth and biomass. Nutrients provided by compost can increase plant growth and can accelerate the absorption of metals into plants [66]. Further, compost has a role in improving soil aggregate stability, increasing water absorption, and increasing soil cation exchange capacity [67]. Cow dung extract and poultry dung extract are recommended to increase the metals accumulated by plants because chelant is able to increase the biomass produced by plants [68,69].

Compared with other techniques, phytoremediation has advantages and disadvantages [70,71,72,73,74,75,76] are shown in table 2.

Table 2. Strengths and weaknesses of the use of phytoremediation techniques.

No.	Strengths	Weaknesses
1.	The safest way to remediate the environment is by using plants	Requires a long time
2.	Plants are easily controlled for growth	Waste environmental characteristics
3.	Maintaining the natural state of the environment	Level of toxicity
4.	Operating costs are relatively cheap	Suitability of plants in the waste environment
5.	Plants are easy to breed	Harmful if plants are eaten by animals or insects
6.	Plants are easily controlled for growth	

From the weaknesses of phytoremediation described in table 1, it can be concluded that plant species for phytoremediation must be chosen to ensure that roots can expand throughout the contaminated zone. In addition, plant selection in principle must follow application requirements, contaminants of concern, and potential for growth in contaminated locations. Further, vegetation must be fast growing, strong, easy to plant and maintain [77].

Some engineering processes that are currently used to clean up heavy metal pollution are not only expensive but also damage the environment, causing adverse impacts on the ecosystem. Now, researchers have established a cost-effective and environmentally friendly technology that includes the use of plants/microorganisms to clean up contaminated environments [49]. Various heavy metal decontamination techniques and their advantages and disadvantages are presented in table 3.

It is possible that applying two or more combined methods can minimize obstacles and achieve higher levels of decontamination. The sequential treatment of one of the physical, chemical, and biological methods may be more effective in phytoremediation. For example, methods such as coagulation followed by photocatalysis and then phytoextraction not only save time but can also help increase the efficiency of contaminant removal. Phytoremediation with soil is considered more suitable for the microorganism/plant decontamination process. However, this article merely focuses on phytoremediation techniques having the potential for economically efficient remediation, contaminants turning into less toxic substances, applicable to soil, sediment, mud, accelerating the degradation process and being environmentally friendly.

Phytoremediation has the potential to be applied to various types of substances, including the most severe environmental pollutants such as arsenic contamination in installed chemical weapons land [78]. Phytoremediation is a remediation technology that offers the lowest cost compared to the cost of engineering-based methods. The use of phytoremediation can also provide benefits from an economic perspective, where phytoremediation can progressively improve soil quality for plants [79].

Therefore, phytoremediation techniques are needed in the future considering the intense increase of pollution cases each year especially in Indonesia which has a density of motorized vehicles. Meanwhile, the carrying capacity of land and water resources has declined over time. At

least 35% of Indonesia's territory has been converted to mining areas. This naturally will change Indonesia's landscape and make the potential for pollution even greater in the future [85].

4. Conclusions

In general, Pb phytoremediation on arid land technique has advantages and disadvantages. However, the overall review can help us understand how to choose a process to remediate certain heavy metals based on the duration and efficiency and also able to identify plants that are often used for phytoremediation. Pb phytoremediation is an effective way to restore arid land. Phytoremediation technique has several advantages compared to conventional technology that is commonly used. It is relatively safer for the environment due to the plant's use and natural environment maintenance, and it has relatively low operational costs.

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ICSTSI 2020 | Proceeding ICSTSI 2020 : 87–94
ISBN : 978-602-53575-1-0

The rubber sap bowl from plastic bottle waste as breeding site mosquito

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Abstract. This study examines the use of the sap bowl from plastic bottle waste as an alternative breeding site for various species of mosquitoes. This study used a purposive random sampling method by selecting the location of rubber plantation that no tapped and the sap bowl filled with water. Observations included the type of plastic bottle as a sap bowl, mosquito larvae, pH and volume of water. Samples were taken by plot method and data were analyzed by correlation analysis. Types of plastic waste used as sap bowls from lubricant bottles, beverage bottles, liquid fertilizer bottles, and food jars. Mosquito larvae were found in a sap bowl of 6 species namely *Ae. albopictus*, *Ae. butleri*, *Armigeres* sp., *Tx. splendens*, *Tripteroides* sp., and *Cx. phangngae*. Correlation between the number of mosquito larvae with a bowl, the plastic type, volume and pH of water shows a range of values of 0.96-1. This indicates that mosquitoes in determining breeding sites do not pay attention to specific factors that are in the bowl but based on the number of bowls or more dominant environmental factors.

1. Introduction

Rubber sap contains 93% hydrocarbon compounds in the form of polyisoprene macromelecules (-(CH=CH-C(CH3)=CH)$_n$-). Besides hydrocarbons, it also contains protein, fat carbohydrates, and minerals. These compounds can be broken down by bacteria and fungi [1,2,3]. Rubber sap submerged in water will make it easier for bacteria and fungi to decompose/ferment. This fermentation result becomes a signal for the mosquitoes that will lay eggs in searching for suitable waters as the place to lay their eggs. These fermented nutrient elements become a source of nutrition for mosquito larvae [4,5]. The higher fermentation process becomes a strong signal for mosquitoes to come and lay eggs [6,7].

One of the special tools for rubber farmers is a rubber sap container. Rubber sap bowls have been produced by industry using materials made of clay, plastic, aluminum, and coconut shell [8], and rubber composites [9]. A large plantation area will require a relatively large cost in the procurement of the sap bowl. This makes farmers look for alternatives to the use of used bottles as sap bowls.

Many rubber trees are not tapped and the bowl is left sticking to the tree for a relatively long time. These bowls in the rainy season will fill with water and have the potential to become

breeding sites for mosquitoes. Mosquito breeding sites will cause an increase in the number of mosquito populations in a fast time.

Therefore, in this study, we will explain the used bottles that have been used as the sap bowls and the side effects of the use of the bottles as breeding sites for mosquitoes in rubber plantations around Banjarbaru.

2. Materials and methods

This research was conducted at existing plantations around Banjarbaru, South Kalimantan, Indonesia, from March to May 2020. This study used a purposive random sampling method with regard to rubber trees that had not been tapped for a long time with the sap bowl still attached to the tree. Table 1 explains the locations chosen as the places of sampling.

Table 1. Sampling locations.

No	Location	longitude of the earth		Specific environmental profile sampling location
1.	GK1	-3.4827524	114.8691732	there are several houses, far from water sources (rivers, lakes, ponds)
2.	GK2	-3.4886562	114.8892642	adjacent to a poultry farm
3.	GK3	-3.488188	114.883477	adjacent people's homes and rice fields
4.	GK4	-3.49011	114.8767416	adjacent to water sources (natural pond)
5.	GK5	-3,49011	114.876741	adjacent to a river
6.	MA	-3.46446	114.906883	adjacent to swampy rice fields
7.	PP1	-3.46433	114.914174	adjacent to swampy rice fields
8.	PP2	-3.46607	114.9117217	adjacent to a water source (natural pond)
9.	PP3	-3.457512	114.913265	adjacent to people's homes, poultry farm, and rice fields
10.	PP4	-3.457512	114.913265	adjacent highway

Sampling used quota method, that was, 20 sap bowls containing mosquito larvae were taken from each location. The profile of the sap bowl was recorded, namely: the type of used goods that were used as sap bowls, the number of mosquito larvae, the volume, and the pH of the water in the sap bowls. Mosquito larvae were taken with a dropper and put in a bottle. Mosquito larvae were brought to the laboratory to be identified by the identification key of mosquito larvae [10,11]. Field data retrieval was done 2 times with an interval of 14 days. Data analysis of mosquito larvae populations includes relative frequency, Shannon-Wiener diversity and evenness index and Simpson's dominance index. The relationship of the number of larvae with the type of container and other environmental factors were analyzed by Pearson's correlation analysis.

3. Results and discussion

Sampling was carried out in 10 locations where the condition of rubber trees in productive age, but no tapping was done. The rubber plantations were partially maintained (figure 1 a, b, and c) and partly under-maintained. This could be seen by the amount of grass growing around rubber trees and several bowls strewn on the ground (figure 1d, e, and f).

The sap bowls used by rubber farmers can be classified into 2 types of bowls, namely a special bowl for collecting sap and bowls made from used goods. Used goods used as sap bowls all come from waste plastic bottles. Sap bowls are from lubricating bottles, liquid fertilizer bottles, plastic bottles and cups of beverage and food jars (figure 2). The percentage of bowls of used goods is higher than that of special bowls, which is 71% (table 2).

The types of plastic bowls are classified as follows: High Density Polyethylene (HDPE) (48%), Polyethylene terephthalate (PETE) (29%), Polypropylene (PP) (20%), and Polycarbonate (O) (5%) (table 4). The use of basic material for making the bowl of sap will affect the quality of the sap produced [9].

The sap bowls attached to the rubber trees in the rainy season has the potential to fill with rainwater. The size of the sap bowl determines the volume of water it holds. The sap bowl made from liquid fertilizer bottles, lubricant bottles, food jars, and large beverage bottles will hold more rainwater than special bowls and plastic cups. The volume of water in the sap bowl ranges from 100ml to 600ml. The highest percentage of water volume is in the range of 200ml-300ml (figure 3). The volume of water in the bowl will guarantee the development of the mosquito larvae becoming imago [12,13].

Figure 1. The conditions of the plantations when doing sampling. Pictures a, b, and c show that the plantations were still maintained; Pictures d, e, and f show that the ground was overgrown with various types of grass.

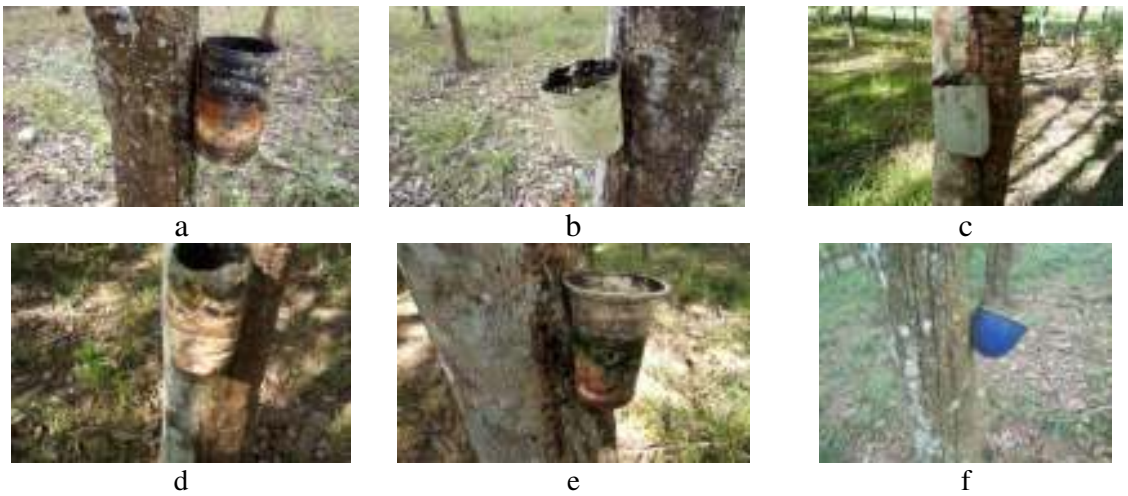

Figure 2. Various rubber sap bowls. In picture a and b, the sap bowls used were dry food jars. In picture c, the sap bowl used was a lubricant bottle, in the pictures d and e the sap bowls were beverage bottles; and in the picture f the bowl used was a special bowl of rubber sap.

On the surface of the inner wall of the bowl there is a sap crust that has been blackened. This sap crust indicates that the bowl is often used and rarely cleaned. The elongated shape of the bowl makes it difficult to get the sap (figure 4). This sap will be fermented by bacteria and fungi which

causes the walls to turn black and produce odors. The blackish color and odor from the fermentation results in attractiveness for mosquitoes to lay eggs [5,14,15].

The results of identification of mosquito larvae show there are 6 species, namely: *Ae. albopictus, Tx. splendens, Ae. butleri, Cx. phangngae, Tripteroides* sp. and *Amigeres* sp. (table 3). Calculation of the diversity of mosquito species in rubber plantations is quite low with a Shannon-Wiener (H) index value of 1.56 compared to a Hmax of 2.56. This causes the species evenness index is also low at 0.45 (range 0-1). The level of species dominance according to Simpson's dominance index is 0.62 (range 0-1). The dominance index of this species is relatively high with one of the dominant species being *Ae. albopictus* and *Ae. butleri*. There are two species that have a high relative frequency of 0.26, namely *Ae. albopictus and Tx. splendens* (table 3).

Table 2. Used bottles, plastic types, and the number of bowls used by rubber farmers as rubber sap bowls with mosquito larvae.

No.	Location	*HDPE*		PP		*O*	PETE	
		Lubricant bottle	liquid fertilizer bottle	Beverage bottle	plastic cup	Food jar	Sap bowl	∑
1.	GK1	28	12	0	0	0	0	40
2.	GK2	25	4	0	5	0	6	40
3.	GK3	7	0	12	0	21	0	40
4.	GK4	7	0	0	0	0	39	40
5.	GK5	25	0	15	0	0	0	40
6.	MA	18	8	12	2	0	0	40
7.	PP1	0	0	0	0	0	40	40
8.	PP2	18	0	8	12	0	2	40
9.	PP3	21	18	1	0	0	0	40
10.	PP4	0	0	7	4	0	29	40
∑		149	42	55	23	21	116	400
%		37	11	14	6	5	29	

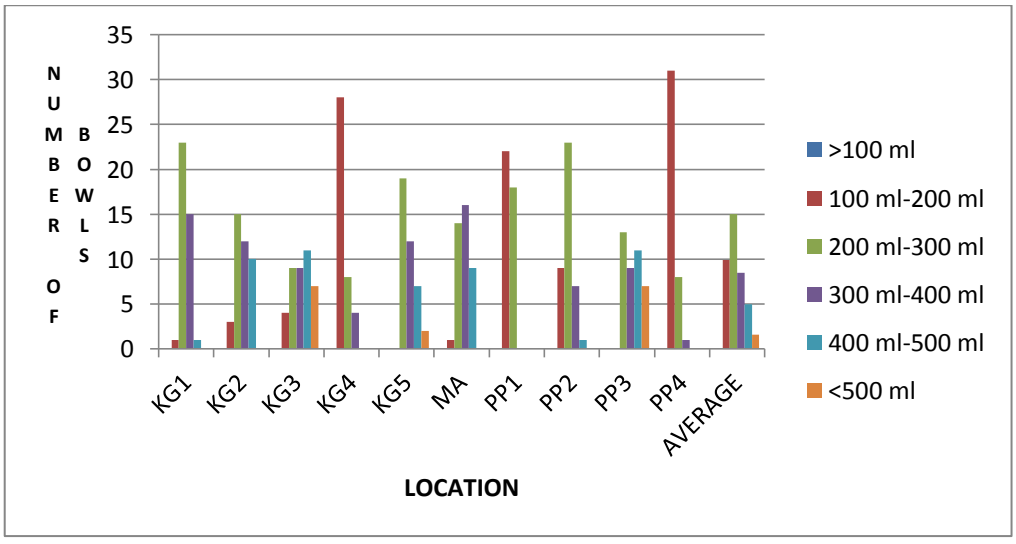

Figure 3. The classification of the sap bowls based on the volume of rainwater that is collected.

Figure 4. The state of the surface in a sap bowl that is still left with sap soaked in rainwater.

Aedes albopictus is a mosquito species that is easily adaptable in rural and forest environments [16,17,18,19]. Good ability to adapt to the aquatic environment is made by humans [20]. Adaptation *Ae. albopictus* in the new environment is also supported by the ability to suck blood from both humans and animals [21,22].

Spread of *Tx. splendens* in the rubber plantations are very closely related to the spread of *Ae. albopictus*. This can be seen from the RF values which are both equal, 0.26 (table 2). The larval phase is one of the larval predators. Larvae *Tx. splendens* eat all types of mosquito larvae but the most preferred is the larvae of *Aedes* sp. [23,24,25]. Instar old larvae are found only 1 individual in a bowl of sap, this is because the larvae are cannibalistic. Cannibalism arises when other mosquito larvae are depleted depleted [26,27]. Larvae *Tx. splendens* control the population of other mosquito larvae so that there is a balance of mosquito populations in the rubber plantations environment.

Three species of mosquitoes namely *Ae. butleri, Cx. phangngae, Tripteroides* sp. and *Armigeres* sp. are generally found in forest areas or villages on the edge of the forest. The larval habitat is found in bamboo fragments and water-filled tree gaps [28,29,30]. These three forest mosquito larvae are able to adapt in the sap bowl microhabitat. There is one species of mosquito that has potential as a disease vector, *Ae. albopictus*. *Ae butleri, Cx. phangngae, Tripteroides* sp. and *Amigeres* sp. vector disease is unknown [31].

Table 3. Mosquito larvae found in the sap bowl and calculation of species diversity index.

No.	Species	∑	Frequency	Relative Frequency (RF)
1.	*Ae. albopictus*	8057	1	0,26
2.	*Tx. splendens*	249	1	0,26
3.	*Ae. butleri*	1368	0,7	0,18
4.	*Tripteroides* sp.	85	0,4	0,10
5.	*Armigeres* sp.	449	0,5	0,13
6.	*Cx. phangngae*	190	0,3	0,08
	∑	10398	3,9	
Shannon-Wiener Diversity Index (H) :				1.16
Maximum Diversity Index (Hmax):				2,58
equitibility (E) :				0,45
Simpson's dominance index:				0,62

Calculation of the correlation between the number of mosquito larvae and a bowl, the plastic type used as a sap bowl, the volume of water and the pH of the water in the bowl shows a range of values of 0.96-1 (table 2). This indicates that mosquitoes in determining breeding sites do not pay attention to specific factors that are in the bowl but based on the number of bowls or more dominant environmental factors.

Table 4. Correlation between the number of mosquito larvae and the number of bowls based on the type of used goods, the type of plastic, the volume of water and the pH of the water in the sap bowl.

Table 4a. Classifying bowls based on plastic type.

No.	Plastic type	Used goods	∑ bowl	∑ larvae
1.	HDPE	lubricating bottle	148	4011
		liquid fertilizer bottle	42	1221
2.	PP	beverage bottle	55	1573
		plastic cups	23	418
3.	O	Food jars	21	681
4.	PETE	Sap bowls	111	2125
correlation of the number of larvae with the number of types of used plastic				0,96
correlation of the number of larvae with the amount of used goods				0,97

Table 4b. Classifying bowls based on the volume of water in the bowl.

No.	Water volume (ml)	∑ bowl	∑ larvae
1.	0-200	93	1920
2.	200-300	149	3575
3.	300-400	91	2551
4.	400-500	51	1067
5.	>500	16	327
Correlation of the number of larvae with the volume of water in a bowl			0,98

Table 4c. Classifying bowls based on water pH in the bowl.

No.	Water pH	∑ bowl	∑ larvae
1.	4-4,5	23	676
2.	4,5-5	22	589
3.	5-5,5	135	3584
4.	5,5-6	108	2713
5.	6-6,5	74	1701
6.	6,5-7	21	462
7.	>7	17	304
Correlation of larvae number with pH of water in a bowl			1

4. Conclusions

The rubber bowls widely used by rubber farmers around Banjarbaru consists of plastic bottles from used lubricating bottles, liquid fertilizer bottles, beverage bottles and food jars. There are 6 species of mosquito larvae found in the bowl of sap, namely *Ae. albopictus, Ae. butleri, Tx. splendens, Cx. phangngae, Tripteroides* sp. and *Amigeres* sp.

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ISBN 978-602-53575-1-0