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Proceeding

The 1st Almuslim International Conference on Science, Technology, and Society

The Institute of Research and Community Services
ALMUSLIM UNIVERSITY BIREUEN - ACEH

COORDINATION OF PRIVATE HIGHER EDUCATION REGIONAL XIII ACEH

CHAPTER III

SCIENCE AND ENGINEERING

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Message from the Rector

Assalamu'alaikum Wr. Wb.
Greetings.

Ladies and gentlemen,

It is an honor indeed to open this conference, the 1stAlmuslim International Conference on Science, Technology, and Society (AICSTS). On behalf of Almuslim University (Umuslim), I would like to extend a warm welcome to all participants and our speakers who are with us to make this a notable and exciting event a success.

At Almuslim University, we emphasize the best possible achievements in education and research and are also committed to innovation and technology. Today, we are faced with more challenges in these spheres, and therefore, as members of the academic community, we have a duty to find innovative research solutions for them. Hence, this conference is an excellent forum for experts, professionals, researchers, and students as well, to present, share, and discuss their knowledge and experiences with all of us. In line with such idealism, it is really a privilege for us to host you, not just this year, but for years to come, to give and provide opportunities to contribute lasting and practical solutions to the challenges that confront us from time to time. This conference includes keynote speeches, oral and poster parallel sessions on topics in the field of sciences, life sciences, engineering, social sciences and humanities.

Finally, we know that in the origination of this conference there may be some shortcomings, for which we would like deeply apologize in advance to all of you. This is the University's first experience in organizing an international conference like this. With deepest sincerity hereby we would also like to thank all the keynote speakers for your contribution, time and support for this conference. Our heartfelt appreciation goes to all the authors of the selected papers for their effort and hard work. I also would like thank the organizing committee of the conference for their hard work in making this event a success. I wish to encourage them to continue organizing more events and to take other initiatives as well in future. To support and sustain important research linkages for dialogue and facilitate exchanges of ideas such as this will certainly generate more new discoveries and innovations in years to come. It is everyone's optimism that all we will learn from this first international conference in 2015 will be used as a reference for the development of research, as well as guidance for the readers in education and in academic profession.

I am sure the committee of this conference has served you in the best way they can to make your brief stay with us a lasting memory.

Thank you.

Dr. Amiruddin Idris, SE, M.Si

Message from the Committee Chairman

Assalamu'alaikum Wr. Wb.
Greetings,

Ladies and Gentlemen,

I would like to take this occasion to cordially welcome all participants of the 1st Almuslim International Conference on Science, Technology, and Society (AICSTS). This conference is held at our beloved campus of Almuslim University (Umuslim), Bireuen, from November 7th to November 8th, 2015. Almuslim University, the home of 7 faculties, is one of the major private universities in Aceh. We are assured that the 416 scientific participants will contribute to productive discussions and exchanges of scientific experiences that will bring about success to this conference. Participants from 9 countries, Indonesia, Malaysia, Thailand, Philippines, United States, India, Taiwan, England, and Qatar, have optimally marked an international scope to the conference.

I would like to express my gratitude to the Coordination of Private Higher Education Regional XIII Aceh, the Institute of Research and Community Services of Almuslim University and the committee members for helping us in organizing the conference. The conference and proceedings are a credit to a large group of people and everyone should be proud of the outcome.

We are delighted with the vast responses of 152 submissions from researchers and practitioners. The knowledge bases that we are aiming to generate in the conferences topics are overwhelming due to the involvement of these experts from various fields of studies. Their papers will be published in the proceedings to provide permanent records of what has been presented. The proceedings are divided into four, Life Sciences, Engineering, Social Sciences and Humanities (Science Educations), and Social Sciences and Humanities (Economics, Social and Arts), and the papers published here will exhibit the current state of development in all aspects of important topics that are instrumental to all researchers in the various fields. They have succeeded in bringing together various aspects of developments and innovations in knowledge and technology that will benefit not only the academic community, but the society itself as well.

We realize that there are still many shortcomings in the implementation of the arrangements of this conference. Therefore at this opportunity we also expect criticism and constructive suggestions from all stakeholders so that the conference arrangements in future will be more successful. Finally we would like to thank you all for all the support and assistance you have contributed to making this conference and its proceedings successful.

Thank you,

Drs. Marwan Hamid, M.Pd

KEYNOTE SPEAKERS

ASEAN ICT Manpower: (Case Study of Thailand, Indonesia, and Vietnam)

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Abstract

This study investigates the situations of ICT manpower in Thailand, Indonesia, and Vietnam in 2012 and performs a projection of ICT manpower for 2018. This study involved both qualitative and quantitative research approaches. It describes the ICT development policies in the three countries to provide some context of the study. In-depth interviews and questionnaires were conducted to collect data from ICT manpower in core ICT industries, non-ICT industries and education sectors. The majority of ICT manpower in Thailand, Indonesia and Vietnam obtained a bachelor's degree, and are currently officer/technician/ engineer. In addition, the average salary rate is 690 USD in Thailand, 630 USD in Indonesia, and 350 USD in Vietnam. In 2018, the number of ICT manpower in Thailand will have about 634,981 persons, 3,122,800 persons in Indonesia, and 868,136 persons in Vietnam. It is found in the study that the ICT manpower in these countries has the same weakness, which is English communication. Regarding AEC, most ICT companies in three countries will gain advantages from AEC by seeking business opportunities and expanding businesses. This is an empirical study which investigates cross-country the profile of the ICT Manpower in Thailand, Indonesia, and Vietnam in 2012. It identifies the strengths and weaknesses of ICT manpower in the three countries based on the survey data obtained. Based on the results, it offers some recommendations on how to develop ICT manpower for a global labour-market competition and ASEAN.

Keywords*:* ASEAN, ICT Manpower, Thailand, Indonesia, Vietnam, ICT Professional Standards

Introduction

Nowadays, information technology has been rapidly changed with respect to an algorithm, structure and platform. In order to cope with the challenges of the waves of innovation and technological changes, ASEAN submitted ICT development in the next five years under the name "ASEAN ICT Masterplan 2015

(AIM 2015)". This Masterplan is driven by six strategies of economic transformation, people empowerment and engagement, innovation, infrastructure development, human capital development, and bridging the digital divide to deliver 4 key outcomes: 1) ICT as an engine of growth for ASEAN countries, 2) recognition for ASEAN as a global ICT hub, 3) enhanced quality of life for peoples of ASEAN, and 4) contribution towards ASEAN integration (ASEAN, 2011). As a result, ASEAN Membership: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnamwill planto develop their ICT infrastructures and ICT manpower. Nevertheless, factors that affect the development and capacity of ICT manpower in ASEAN countries are: 1) the mechanisms of education and innovation, 2) the support for ICT infrastructure in the country, 3) facilities of education/training, 4) the wages of labour, 5) the desire for a country to move forward, 6) the level of the community's economy, and 7) Government policies related to ICT.

The paper first describes briefly the ICT development policies of Thailand, Indonesia and Vietnam. Then, it discusses ICT professional standards, and describes the research methodology and data collection. After that, it provides the results of the quantitative and qualitative analyses on the current situations of ICT manpower, number of the ICT manpower, need for ICT manpower in market, strengths and weaknesses of ICT manpower, professional standards of ICT employees. Finally, it provides the impacts of ASEAN Economic Community (AEC) and ICT business trends in Thailand, Indonesia, and Vietnam.

ICT Development Policies in Thailand, Indonesia and Vietnam

In 2011, Thailand had been upgraded income categorization from a lower-middle income economy to an upper-middle income economy by The World Bank, and rank sixty-seven in the Networked Readiness Index in 2015 by The World Economic Forum. In order to enhance the competitiveness of the Thai industrial sector and prepare Thailand for the ASEAN Economic Community, the Government has revealed the Masterplan under name "Digital Economy". This Masterplan covers in four areas: Digital Commerce, Digital Entrepreneur, Digital Innovation, and Digital Content, and consists of five strategies, namely, Hard Infrastructure, Soft Infrastructure, Service Infrastructure, Digital Economy Promotion, and Digital Society (GSMA, 2015).

According to Thailand ICT Development Policy, the Ministry of Information and Communication Technology (MICT) has formulated the ICT 2020 Policy Framework. According to vision and goals of the ICT 2020 policy, "ICT is a key driving force in leading Thai people towards knowledge and wisdom and leading society towards equality and sustainable economy" (NECTEC, 2011). Furthermore, the ICT 2020 policy framework set five strategies: Strategy 1: Universal and secure ICT and broadband infrastructure, Strategy 2: ICT Human Resource and ICT Competent Workforce to emphasise the development of ICT employees' knowledge and skills and the expansion of a number and quality highly-skilled ICT manpower based on international standard. Strategy 3: ICT industry competitiveness and ASEAN integration, Strategy 4: Smart government: ICT for government service innovation and good governance, and Strategy 5: ICT for Thailand competitiveness and vibrant economy.

Indonesia has the largest of population in ASEAN and ranks seventy-nine in the Networked Readiness Index in 2015. In order to develop Indonesia as one of the world's main food suppliers, the Government has revealed the Masterplan for the Acceleration and Expansion of Economic Development of Indonesia (MP3EI). This plan is implemented for the period of 2005-2025 by focusing on eight main programs, namely the development of agriculture, mining, energy, industry, maritime, tourism, telecommunication, and development of strategic zones. The implementation strategy of MP3EI will integrate three main elements: 1) developing the regional economic potential in six Indonesia Economic Corridors: Sumatra Economic Corridor, Java Economic Corridor, Kalimantan Economic Corridor, Sulawesi Economic Corridor, Bali – Nusa Tenggara Economic Corridor, and Papua – Kepulauan Maluku Economic Corridor; 2) strengthening national connectivity locally and internationally; and 3) strengthening human resource capacity and national science & technology to support the development of main programs in every economic corridor (Ministry for Economic Affairs, 2011).

According to ICT development, this Masterplan emphasises ICT industry development in Java Economic Corridor only. Furthermore, in order to link the producers and users of science and technology, the government of Indonesia established intermediary institutions to achieve this objective such as Business Innovation Center (BIC), Business Technology Center (BTC), Center for Innovation - LIPI, Center for Nuclear Partnership - BATAN, BPPT engineering, and Technology Incubator Center – BPPT.

Meanwhile, Vietnam has quickly and continuously developed all ICT sectors, and ranks eighty-five in the Networked Readiness Index in 2015. In order to develop Vietnam into an industrialised and modernised country in 2020, the government has revealed Vietnam's Socio-Economic Development Strategy for the period of 2011-2020 (Ministry of Planning and Investment, 2012). This strategy is aimed to stimulate investments in major industries through tax incentives, for example, goods export, agriculture and forestry, advanced technology industries (such as manufacturing computer software and components), environment, research and development, labour intensive industries, and natural resources and infrastructure.

Regarding ICT development in Vietnam, Ministry of Information and Communication set the National strategies and plannings on ICT development to drive ICT sector during 2011-2020. . In 2013, the Government of Vietnam established the National Commission on Application Information Technology (NCAIT) to promote the use and development of IT in state agencies. Moreover, Vietnam expanded ICT sector to upcountry by establishing Department of Information Communication in 63 provinces (MIC, 2014). As for ICT manpower development, by the end of the year 2013, Vietnam had 290 universities and colleges and 228 vocational schools which offered training courses on telecommunications and IT majors with the total enrollment quota exceeding 80.000 students (MIC, 2014).

ICT Professional Standards

The ICT professional standards have been used to measure or evaluate each individual ICT employee in terms of potential, skills, attitudes, competency, and knowledge. In addition, the ICT professional standard can enable public and private organisationsto more effectively recruit and develop ICT

employees. Based on the existing relevant data and information, it is found that various ICT professional standards to implement in several countries.InEurope, the European Commission developed and implemented European Qualification Framework (EQF) and European e-Competence Framework (e-CF).The EQF uses to compare the education standard levels between the European Union member countries. The e-CFaims to develop ICT manpower, and support all industries in Europe. In the United Kingdom (UK), government developed The ICT professional standards under name Skills Framework for the Information Age (SFIA). In Asia, Japan proposed standard under name Skill Standards for IT Professional (ITSS).

Meanwhile, ASEANhave developed ICT professional standard, in order to measure ICT manpower knowledge and skills, and use to compare the ICT professional standard between the ASEAN member states. ASEAN ICT professional standard set ICT competency at three levels as follows: Level 1 Basic Level - Has basic knowledge and skills which is adequate to perform a given task(s) under supervision of management. Level 2 Intermediate Level - Has professional knowledge and skills to perform a given task(s) independently, and, if required, can supervise others; understand the number of comparative approaches to problems in their fields; and be able to apply them efficiently, and Level 3 Advanced Level - Has professional knowledge and skills in both technical and management to lead a team in inexperienced environment.

Methodology

This study used qualitative research, and quantitative research approaches. We conducted in-depth interviews with executives responsible for ICT management in public and private organisations, and then questionnaire surveys to collect relevant data during 2012 –2014 in Thailand, Indonesia and Vietnam.

The sampling respondents were selected from ICT manpower in core and non-core ICT industries sectors in the three countries. The total number of returned and usable questionnaires are 589 questionnaires and 87 interviews from Thailand, 214 questionnaires and 15 interviews from Indonesia, and 200 questionnaires and 15 interviews from Vietnam.

Findings

The results of the study on ICT manpower in Thailand, Indonesia, and Vietnam are presented as follows:

ICT Manpower in Thailand

The study of demographic characteristics reveals that there were 589 respondents, 70.6% of which were male and 29.4% were female and the average age of the respondent was not over 33 years old. Most respondents are employed as technician/ engineer. Regarding education, most of them had a bachelor's degree, followed by master's degree, and their average work experiences are between 1-10 years. For salary rate, the average salary rate was 690 USD.

1. *The Number of ICT Manpower in Thailand.* Base on the report of Thailand ICT manpower - National Statistical Office of Thailand and Office of the National Economic and Social Development Board during 2001-2012, in order to forecast the number of ICT manpower in

Thailand during 2013 – 2018, this study uses the Inverse Cobb – Douglas Production Functions, which uses Regression Analysis for the calculation to find the relationship between the number of manpower and gross capital stock, and time. Thus, if the Thai economy keeps expanding with consistent growth of GDP and CAP, the overall number of ICT manpower also tends to increase from 519,703 persons in 2013 to 540,947 persons in 2014, 563,065 persons in 2015, and 634,981 persons in 2018.

2. Need for ICT Manpower in Thailand Market. The result of interviews suggest that hardware sector needed for employees to fill in the position of product managers (who possess understanding and knowledge about ICT businesses and technology), network engineer, system engineer, developer, data communication specialist, security specialist, system manager, project manager, and system architecture specialist. The software and service sectors required employees in the level of software development specialist and project manager with the software specialist abilities. While telecommunication sector required employees in telecommunication engineering, radio network, database administration, IT security, network security and data analytic (Employee with IT knowledge and abilities to analyse data to find out customers' needs which will enable the company to better respond to their needs).

3. Strengths and Weaknesses of ICT Manpower in Thailand. As for strengths of Thai ICT manpower when compared with those of other ASEAN countries, the executives of the sample organisations viewed that Thai employees are careful and can work effectively in programming. They have problem solving skills and can effectively develop systems. Also, they are flexible and helpful, which are good for consultation services. Meanwhile, the weaknesses mentioned by the interviewed executives include the following: lack of presentation skills, lack of management skills, lack of business knowledge, lack of overall business pictures, lack of discipline, lack of responsibilities, impatience, lack of determination, lack of motivation to seek more knowledge by themselves, and lack of English skill.

All the executives advised that English texts are necessary. Thus, Thai ICT manpower must be increased English skills because English is important for development of knowledge and abilities since ICT technology originated from the West while Eastern countries adopted such technology from them.

4. Professional Standards of ICT Employees in Thailand. According to the professional standards of ICT Employees in Thailand, several government offices,such as Thailand Professional Qualification Institute (TPQI), Council of Engineers, Department of Skill Development, Office of the Education Council, etc.are attempted to develop professional standards to evaluate the potential of ICT manpower. This might affect the ICT manpower or entrepreneurs. Meanwhile, private sectoremphasised universal standards, such as ISO, ITIL and COBIT, as well as vendor certificates, such as MCITP (Microsoft Certificate IT Professional), CCNA (CISCO Certified Network Associate), VCP (VMware Certified Professional), SAP and ORACLE.

However, the results of surveys and interviews suggested a advantages of ICT professional standards to support the ICT manpower and companies as follows: 1) increase potential: ICT professional standards enable employees to learn about their own knowledge and abilities, it is a way to encourage

themselves to learn and meet the set standards; 2) clear self-development strategies: ICT professional standard framework set requirements for ICT employees to pass criteria in each level so employees see how they can grow in their professions, set the goals for themselves, and learn which areas they need to develop to meet the goals; 3) reliability and acceptance: ICT professional standards are criteria for setting the minimum knowledge and expertise in professions, employee passing professional standards will receive certificates certifying the knowledge and abilities in accordance with what is specified in the professional standards; 4) employee planning: ICT certificates that an employee receives from passing the professional standards certifies skills, knowledge and the minimum abilities of that person, it is an additional information useful for recruiting employee for work to suit each position; 5) build mutual understanding: ICT professional standards enable all the sectors related with ICT systems in Thailand to understand correctly about ICT ability levels in different fields. This professional standard framework can also be used as a reference for developing ICT manpower; 6) upgrade industries: ICT professional standards help develop the ICT manpower in terms of knowledge and abilities, they can perform tasks better. Once employees possess knowledge and abilities in accordance with the set standards, the overall productivity of the industry will be better, meet the standards, and is more widely accepted.

In addition, the results of the surveys and in-depth interviews showed disadvantages of ICT Professional Standards to impact ICT manpower and companies as follows: 1) lack of knowledge in the field of work: as professional standards encourage employees to have expertise; this may lead to the fact that ICT employees view the tasks only in the dimension of their own expertise. As a result, the overall Thai ICT employees may lack the comprehensive ICT knowledge; 2) higher expenses: Various businesses will have more expenses on employee as they are needed for supporting ICT employees to pass the professional standard tests.

5. The Impacts of AEC and ICT Business Trends in Thailand. AEC will bring advantages to Thailand in term of businesses, technologies and manpower. At the business level, most companies are expected to be able to rapidly expand business and outsource their business activities in the ICT service sector. Furthermore, they can recruit foreignmanpower with lower wage. On the other hand,In order to compete in AEC market, Thai companies should be developed and adjusted products quality to high standards, including technology change. At the same time, ICT manpower should be developed individual skills such as English language skill and working skills.

Regarding the new ICT business in the future, the results of technology and customer behaviour continued to change in Thailand market. As a result, most of ICT companiesand non-ICT companies will adjust business plans and develop new products/services by focusing on Cloud Computing, Big Data, and Mobile Application and Business.

ICT Manpower in Indonesia

The study of demographic characteristics found that there were 216 respondents, 74.10% of which were male and 25.90% were female and the average age of the respondent was 30 years old or below. Most respondents were employed as a technician/ engineer. Regarding education, most of them had a

bachelor's degree, followed by diploma, and the experience was 1- 5 years. For salary rate, the average salary rate was 630 USD.

1. The Number of ICT Manpower in Indonesia. Based on the information of ICT manpower in Indonesia during 2005-2010 by The Economic and Social Commission for Asia and the Pacific (UNESCAP or ESCAP), this study used the method of Linear Regression to predict ICT manpower in Indonesia during 2011-2018. The result suggested that, the ICT manpower in Indonesia will increase from 2,042,000 persons in 2013 to 2,258,000 persons in 2014, and 2,474,000 persons in 2015. Moreover, Indonesia will have about 3,122,800 persons of ICT manpower in 2018.

2. Need for ICT Manpower in Indonesia Market. According to a study by the Economist Intelligence Unit conducted for British Council in June 2012, it was found that the Indonesian economy is experiencing changes, from the focus on agriculture to manufacturing industry. According to Indonesia's economic plan for 2011 – 2023 (MP3EI), most of the budget is allocated for coal, mine, petroleum and natural gas. Meanwhile, the ICT industry is one of the ten industries the government aims to develop. The ICT industry development developed the broadband business to reach the growth of 8% in 2014 (from 0.5% in 2010) and aimed to stimulate four main businesses, including device manufacturing, professional and consulting services, content and applications development, and ecosystems innovation. In order to develop these businesses, Indonesia needs to have employees with a degree in computer science, which is still rare at present.

For Indonesian market need, important knowledge and expertise for the ICT manpower were in network, databases, integrated systems, software engineering and the ability to analyse needs, system planning, quality assurance, filing system, and integration with Cloud Computing.

However, there are some factors about how significant changes can affect demand for Indonesia ICT manpower: 1) when companies use computerized devices and modern tools, 2) the entry of foreign companies in the pioneering technology to Indonesia, 3) the flow of information and communication needs that are quite high in every work unit/institution/company, 4) started to use the system information in doing a job that is considered to be more practical and easier than the job manually.

3. Strengths and Weaknesses of ICT Manpower in Indonesia. According to a review of strength in ICT manpower in Indonesia when compared with other ASEAN countries, the executives of sample organisations who were interviewed gave the opinion that IT manpower in Indonesia is of high potential, particularly in software operation and adoption. Some Indonesian employees possess qualifications suitable for job positions in ICT large companies. The ICT manpower in Indonesia has some weaknesses, for instance, initiatives, innovation, diligence, access of information, lack of interest from the government sector to develop ICT knowledge and English skills, and breadth of knowledge.

In order to increase ICT manpower performance, some organisationsrecognised the importance of aiding technology of developers, such as programming, education, knowledge and experience development, logics in problem solving, importance of computer systems, and organisation leadership. Moreover, mutual guidance for operation should be established, for example, arranging regular training to

develop new knowledge, undergoing training, workshops and seminars to gain modern knowledge and expertise by including the Employee training budget in the annual budget, and organizing internal and external training.

4. Professional Standards of ICT Manpower in Indonesia. For professional standards of ICT manpower in Indonesia, the standards mentioned by Indonesian respondents are for certificates issued by some companies like Cisco, Mikrotik, Microsoft and others. Furthermore, there are some standards in Indonesia which have received the international certification, for instance, standards for ICT graduates or SKKNI. It was mentioned that the standards should link with the international standards. The organisation with the role to set Indonesia's professional standards is the Ministry of Communications and Informatics). In general, professional standards are one of the factors for determining the manpower's salary rates. The sample respondents viewed that the current professional standards are good and sufficient, for example, certificates of various companies, such as CISCO, MSEE, ORACLE, JAVA, etc. which are accepted in Indonesia and internationally.

In their view, The advantage of ICT professional standards are: 1) develop universal language system to facilitate ICT jobs without having to undergo long training 2) have manpower with widely accepted certification 3) potential of ICT manpower is determined by the same standard, and they have a chance to prove their potential both at national and international levels 4) professional standards help increase skills of ICT manpower. Despite a lot of advantages, ICT professional standards also had some loopholes, including 1) financial problems related with the certificate issuing organisations as they are not located in Indonesia. 2) ICT professional standards will not be taken into consideration or neglect to process the application portfolio. When ICT employees have the knowledge and accept their performance by their agencies. 3) It will be more difficult to search for employees which meet ICT professional standards. As a result, all the related organisations should involve ICT curriculum, including private and foreign organisations, in the same way as Indonesia's governmental organisations.

5. The Impacts of AEC and ICT Business Trends in Indonesia. Regarding the impacts of AEC, most of the ICT executives thought that they can gain benefits from AEC by seeking business opportunity into AEC market, exchanging knowledge and technology, sharing technological development, and expanding cooperation. On the other hand, some ICT executives thought that they will not gain advantages from AEC.

For the ICT business trends in the future, enterprise state and private sector firms have important roles to drive ICT industry in Indonesia. Most of companies expect changes in the ICT industry such as: 1) a more "user friendly" technology, 2) the establishment of strong technology-based companies, like Google, Microsoft or Macintosh, in Indonesia, 3) the ability to compete internationally, 4) the shift towards the use of mobile devices (mobile device), 5) the development of software industry as well as hardware industry. Based on telecommunication structure and ICT manpower skills, ICT companies in Indonesia will use joint venture strategy to develop new products/services by focusing on Cloud Computing, Mobile Business, ICT Outsourcing, and Call Center.

ICT Manpower in Vietnam

The study of demographic characteristics found that there were 200 respondents, 69.5% of which were male and 30.5% were female and the average age of the respondent was not over 30 years. Most of the respondents were employed as a technician/ engineer. Regarding education, most of them have a bachelor's degree, followed by diploma, and their work experiencesare in the range of 1- 5 years. For salary rate, the average salary rate was 350 USD.

1. The Number of ICT Manpower in Vietnam. Based on Vietnam ICT White Book in 2009 - 2014, this study used the method of Linear Regression to predict ICT manpower in Vietnam during 2013 - 2018, and found that, Vietnam ICT manpower will have about 441,008 persons in 2013, 505,086 persons in 2014, 578,324 persons in 2015, and 868,136 persons in 2018. However, the ICT personnel development plan of the Ministry of Information and Communication (MIC) aims to increase the number of Vietnam ICT manpower to 1 million persons in 2020 in order to support ICT Industry and export ICT manpower to global market (Minister of Information and Communications, 2012).

2. Need for ICT Manpower in Vietnam Market. The result of in-depth interviews suggested that the ICT manpower should possess knowledge and expertise in hardware and software. Employees must be able to control themselves emotionally and be flexible in stressful working environment, develop specialisation and accomplish tasks assigned by the company. In addition, Vietnam market need manpower with good communication skills and could communicate with foreigners. Thus, the most important elements are foreign language skills, abilities to do research, management, team work and presentation skills. In other words, Vietnam has a lot of knowledgeable ICT manpower, but without expertise.

3. Strengths and Weaknesses of ICT Manpower in Vietnam. According to a review of strength in the ICT manpower in Vietnam when compared with other ASEAN countries, the executives of sample organisationsviewed that Vietnam has large number of ICT manpower who are youths with creativity, and love for learning and new experiences. They are active and dedicate themselves to work, and can learn fast. Its ICT manpower has high skills and the wages are lower than in other countries. Strength of Vietnam's ICT is knowledge. Vietnam possesses knowledge and the ICT manpower with the right degree and potential in research and development in specialised ICT. In general, Vietnam manpower is hard-working and determined. Each employee has various abilities. For example, programmers can learn about network or system integration. For weaknesses, the ICT manpower in Vietnam has limitations in language and professional training. These include the lack of creativity, independence, teamwork skills, knowledge and experience. As a result, they are required for more technical training. Their working environment is not professional and there is no training in educational institutions. But the training in Vietnam is not systematically organised. Many training institutions have been established without trainers' quality control. The ICT manpower can increase their skills only through work experiences. As a result, new graduates have low-level skills.

4. Professional Standards of ICT Manpower in Vietnam. Based on the result of interviews, this study found that ICT professional standards do not affect the worker's salary rate. The salary rate is dependent on the employee's ability, knowledge and work experiences. However, the Vietnam government has a plan to develop professional standards of ICT manpower in the future.

5. The Impacts of AEC and ICT Business Trends in Vietnam. Most of the ICT executives believed that AEC will bring advantages in that Vietnamese ICT manpower will get to learn new technology more. Manpower with required skills will be easier to find, their wages will be cheaper than those in ASEAN, and more cooperation will be enhanced. The chance to export software and expand markets will also increase, with the focus on Indonesia or Malaysia market. The cooperation with other ASEAN countries can help promote the company among their overseas counterparts. In addition, there will be transfers of manpower, knowledge, new working methods, and exchanges of expertise or problem solving strategies.

Regarding the new ICT business trends in the future, most of the ICT executives viewed that ICT companies in Vietnam will use joint venture strategy to develop and launchnew products/services. There are 1) Software Outsourcing Cluster 2) Data Center Service, and 3) Cloud Computing.

Conclusion

Regarding ICT demographic data of Thailand, Indonesia, and Vietnam, most of the ICT manpower in the three countries were male. Vietnam ICT manpower had a higher ratio of female manpower than Thailand and Indonesia, and most respondents in the three countries are employed as a technician/ engineer. Regarding education, most of the respondents have a bachelor's degree, followed by master's degree for Thailand, and diploma for Indonesia and Vietnam. Their ICT work experiences range from 1-10 years for Thailand and 1-5 years for Indonesia and Vietnam. For the average salary rate, Thailand has higher salary rates than Indonesia and Vietnam (690 USD in Thailand, 630 USD in Indonesia, and 350 USD in Vietnam). According the forecast of the number of ICT manpower in 2018, Thailand will have about 634,981 persons, 3.2 million persons in Indonesia, and 887,025 persons in Vietnam. Thus, Indonesia has the largest number of ICT manpower in ASEAN. As a result, Indonesia can quickly develop and launch ICT products/services to domestic markets and global markets. As for strengths and weaknesses of ICT employees in Thailand, Indonesia, and Vietnam, the interviewed executives of sample organisations viewed that the strengths of ICT employees in each country is different. Meanwhile the ICT employees in every country have the same weakness, which is English communication.

Based on AEC in 2015, most ICT companies in three countries will gain advantages from AEC by seeking business opportunities and expanding businesses. However, they must be emphasised manpower skill development. For ICT businesses in the future, Thailand has planned to develop Cloud Computing, Big Data, and Mobile Application and Business. Indonesia will develop Cloud Computing, Mobile Business, ICT Outsourcing, and Call Center. Meanwhile, Vietnam has emphasiseddevelopment in terms of Software Outsourcing Cluster, Data Center Service, and Cloud Computing. Thus, these countries should plan to developed ICT manpower skills to serve new ICT businesses.

In sum, the result of this study can help the public and private sectors in these three countries as well as in other countries in ASEAN to plan for the development of ICT manpower for a global labour-market competition and ASEAN.

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Water Quality Evaluation System for Assessing the Status and Suitability of the Citarum River Water for Various Uses and Its Aquatic Ecosystem

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Abstract

The Citarum river water is the most important water sources in Indonesia. The river that supports a population of 28 million people, delivers 20% of Indonesia's gross domestic product, and provides 80% of surface water to carry through the West Tarum Canal to the Jakarta's water supply authority, is one of the most polluted rivers in the world. Water quality degradation of this river increases from the year to year due to the increasing pollutant loads when released particularly from Bandung region of the upstream areas into river without treatment. This will be facing the chronic problems of water pollution for supporting the suitability of water for different uses. This study used the Water Quality Evaluation System to asses the suitability of water in term of the Water Quality Aptitude (WQA) for five different uses and its aquatic ecosystem. The assessment of ten selected stations was found that the WQA ranges from the suitable quality for agriculture and livestock watering uses to unsuitable for biological potential function, drinking water production, and leisure and sport upstream the Saguling reservoir, generally. The role of Citarum river water in providing the demands of multipurpose uses particularly for Jakarta's water supply will still be present in question for the years to come. The aptitude of water along the river is evaluated to contribute to decision support system for decision-making process and to provide as proper information for water users in allocating their water right wisely.

Keywords: Citarum River, water quality aptitude, water quality evaluation system, water use.

Introduction

The problems of water quality degradation in the Citarum river will increase from the year to year due to the increasing of the pollutant loads particularly from Bandung region located in the upper areas of the river basin when released without treatment. Deterioration of water quality causing by the human activities in upper river basin reduces the usability of the resources for stakeholders in the down-stream

areas. Over the past 20 years, rapid urbanization and industrial growth have resulted in growing quantities of untreated domestic sewage, solid waste and industrial effluents being dumped in the river. Pollution levels now compromise public health, and the livelihoods of impoverished fishing families have been jeopardized by widespread fish kill (DGWR, 2007). To handle the problems in implementing of integrated water quality management are necessary to consider all the related aspects entire the basin to ensure the quality of stream water managed will improve gradually. For example, a refined the waste load allocation process is proposed with a reexamination of water quality violation to improve the allocation decision under uncertainty (Chen and Ma, 2008). Participatory surface water management is emphasized in order to achieve a holistic and sustainable water management decision-making process (Hartmann et al., 2006).

The government of Indonesia has been acquainted with integrated approach since the Government Regulation No. 82 on water quality management and pollution control (PP No. 82/2001) was enacted in the year 2001. The PP No. 82/2001 serves as the national guideline to be referred in managing of water quality especially for water managers and operators who work at the national, provincial, and river basin level institutions. Although this regulation guides the role sharing amongst the related institutions and provides the technical arrangements including the classification of the national water quality criteria, the operational guidelines in implementing of the regulation to the specific characteristics of a river basin are still not envisaged properly. However, conducting an adaptive guideline in managing of water quality to the specific local condition is necessary (Fulazzaky, 2005). For example, salinity tolerance of macro-invertebrate communities varies in Eastern Australia; hence, water quality guidelines should be developed at a local or regional scale (Dunlop et al., 2008), and the nutrient pollution effects of moderate eutrophication to Runde river in Zimbabwe need to be addressed by appropriate agricultural and environmental policies that relate to water pollution and land use (Tafangenyasha and Dube, 2008).

Water quality evaluation system (WQES) has been developed to aim two objectives that are (1) to classify the water quality in accordance with the actual condition of water in the stream and (2) to classify the water suitability for different uses and its ecosystem in accordance with the available water quality in the river (Oudin et al., 1999). Thus, the WQES serves to assess the status of water quality in the stream and to identify what the level of water is suitable to provide for the different uses and its ecosystem. This tool is considerable to a comprehensive approach in evaluating of water quality. The earlier study showed that a modeling approach can be used to estimate the impacts of water quality management programs in river basins (Holvoet et al., 2007). The models are possible to analyze the best recommendations needed for different levels of treatment derived in order to improve the water quality (Muhammetoglu et al., 2005). The results of water quality analysis using the WQES are offered to be considered in formulating of the water quality standards and the priority of measures needed to each region in the country, or anywhere, based on the specific local conditions. A systematical analysis of water quality data scientifically introduces to translate the data to actual explanations may be envisaged as decision support system (DSS). The accurate information obtained helps the decision makers in preparing the locally adaptive

policies and guidelines to water quality assessment and management besides serves as the proper tool to water users in allocating their water right wisely.

The objectives of this study are (1) to identify the suitability of Citarum river water in providing the different water uses and its aquatic ecosystem, (2) to warn the water users in allocating their water right wisely based on the actual quality of water, and (3) to recommend the priorities of measures needed to be envisaged by the local authorities, central government, and all related stakeholders for improving water quality.

The importance of WQES to assess the Citarum river water

The Citarum river is the largest river in western Java, the region which contains Jakarta, the capital of Indonesia. The river originates in the mountain range near the southern coast of Java that includes many high volcanic peaks including Mount Wayang (elevation 2,200 m), and travels in a generally north-westerly direction for about 270 km until it empties into the Java sea east of Jakarta. Its drainage area is about 6,600 km^2. The upstream reaches of the river run in mountainous to gently undulating hilly lands for about 200 km while the lower 70 km stretch drains a vast plat alluvial plain. The total area of the river basin to include certain bordering rivers and its tributaries as shown in Figure 1 is about 11,500 km^2 situated at *latitude* of 6°43′ S to 7°04′ S and *longitude* of 107°15′ E to 107°55′ E. The climate of the basin area is characterized by two distinct seasons: rainy season and dry season. The rainy season occurs during the months of November to April, while the dry season occurs during the remaining months. January is the wettest month, while August is the driest month. Naturally, runoff follows the same seasonal pattern. The average annual rainfall varies from 1,500 mm in the coastal areas to 4,000 mm in the mountainous areas in the upper part of the basin. This total runoff from the catchments is generally considered to be adequate to supply demands for all uses well into the future. To regulate surface water the Citarum river system has three cascade reservoirs, i.e., Saguling in the uppermost, Cirata in the middle, and Jatiluhur in the lower location. However, the spatial distribution of surface water resources is not uniform, and shortages do occur from time to time in certain areas.

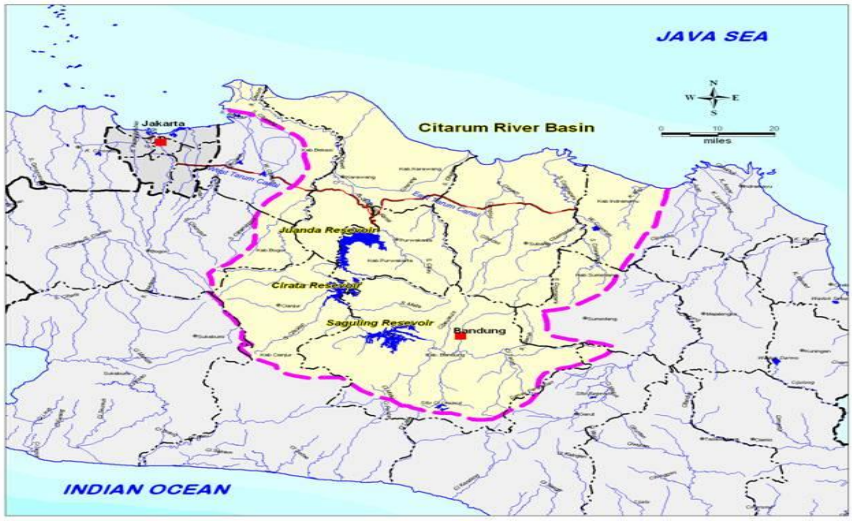

Figure 1. Location of Citarum river basin

The population in the river basin area in 2003 was 17.8 million, with 4.1 million households – 30% derived livelihood from agriculture, 25% from industry and 45% from services. The population is projected to rise to 21.3 million by 2010. Industrial locations are generally interwoven with settlement and there is no clear zoning or separation of these land uses in the region. The area is a key rice producer for the country. There are a total of 390,000 ha of irrigated paddy fields, with 240,000 ha served by the Jatiluhur reservoir and canal system in the lower basin. Average annual demand from the Jatiluhur dam has increased from 140 m^3/s in 1996 to 156 m^3/s in 2004. The river that supports a population of 28 million people, delivers 20% of Indonesia's gross domestic product, and provides 80% of surface water to carry through the West Tarum Canal to the Jakarta's water supply authority is one of the most polluted rivers in the world (DGWR, 2007). Urbanization in the last three decades was followed by rise in untreated household sewage, solid waste and industrial effluents. The more waste enters the river the more chances for spreading diseases, and already there are many fishing families that are starving because of tremendous decrease in fish population due to heavy pollution.

Methodology

General of quality evaluation system

The assessment of river quality as shown in Figure 2 is commonly based on three choices, which are: (1) water choice, referred to as the WQES, to assess the physicochemical and biological quality of water in terms of the water quality index (WQI) and the suitability of water for supporting natural functions of the aquatic environment and water uses in terms of the water quality aptitude (WQA); (2) physical structures choice, referred to as the physical quality evaluation system, to assess the level of manmade change on the main channel, channel margins, and river banks; and (3) biological choice, referred to as the biological quality evaluation system, to assess the state of the biosciences of the aquatic environment (Oudin et al., 1999). The qualities of water and physical structures of a river influence the quality of biological aquatic substances component. This economically influences the exertions of water resources management in order to ensure the sustainable environmental development technicality.

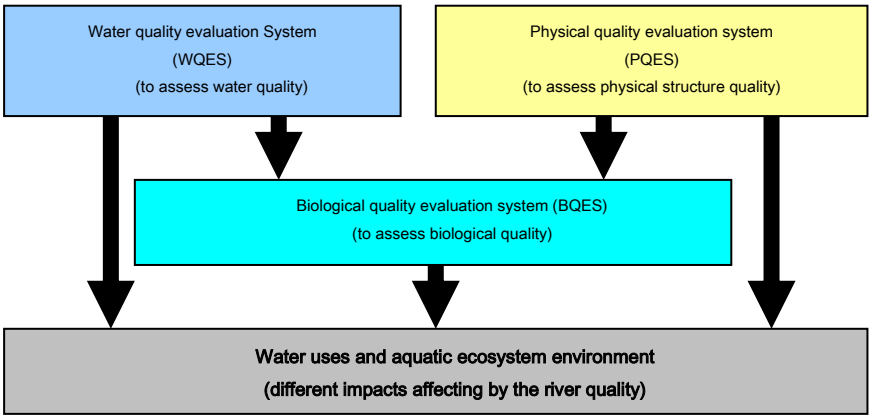

Figure 2. Global quality assessment of a river

The aims of the system are to assess river quality according to the qualities of each component, to identify the alterations in water quality or physical environment which are the cause of biological inbalances, and to assess the effects of an alteration of the river quality for human uses or on the natural functions of rivers. The tools for the assessment of the quality of rivers have been defined in a modular way and are adaptable to scientific and technical development as well as regional peculiarities. For example, water quality is assessed by reference to average alterations of parameter groups; new parameters can be included later in the description of quality by modifying the framework and functions of the evaluation tool. The evaluation tools for river quality consider three quality evaluations system that are: (1) common to all water partners consisting of the technicians, decision makers, and water users, (2) consistent with the international, regional, and local water regulations, and (3) help appreciate the environmental and asset problems. They make a link among partners. In this way, they are a tool for decision-making in the monitoring and the planning of the protection of rivers.

Application of WQES is a part of river quality assessment that aims to convert the data of water quality to information is more suitable. This envisages possess the operational procedure standard generating the data to information based on all the parameters monitored. The information produced from the WQES as shown in Figure 3 provides two categories that are the water quality status and the water suitability for different uses and its aquatic ecosystem (Fulazzaky, 2009; Fulazzaky at al. 2010). Besides, to identify the critical parameter(s) affecting the quality of water and to verify the sources of pollution discharged to the stream water are reasonable (Fulazzaky, 2005). The WQES is based on the notion of indicators of modification from natural conditions. Parameters of similar nature and impact on environment are grouped into 15 alterations of indicators of water quality (see Table 1).

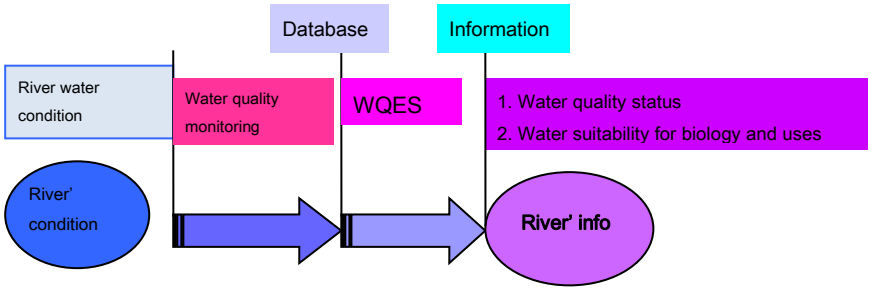

Figure 3. Link of river water quality condition to river water quality information

Sources: Fulazzaky 2009; Fulazzaky et al. 2010

Certain institutions have the different objectives of water quality standardized such as WHO's water quality standards specifically aim to standardize drinking and recreational water qualities, it is not compatible to only use the standard formalized by an institution to assess all the criteria of river water quality for the different uses of aquatic biota, drinking water production, recreation and aquatic sports, irrigation, livestock watering, and aquaculture comprehensively. This study used the thresholds criteria of French Water Agencies Study No. 64 original from the different sources of water quality standards i.e., Directive European, France, EPA USA, WHO and Canada, and completed by the rational advices from

the water quality experts (Oudin et al., 1999). The WQES promotes a tool to synchronize the evaluation of all water quality parameters data monitored to convert to the WQI or WQA. Hence, this study only focused on the analysis of WQA for understanding the suitability of Citarum river water for the different uses and its aquatic ecosystem.

The use of WQES in examining the valid data to assess the suitability of water for different uses and aquatic biota is systematized using an aggregation method. Since the aggregation method to study the data of water quality monitored from a river is not necessary to conduct with a statistical analysis, the probability of exceptional situation takes account into evaluation in excluding the inconvenient results of lower than 10% from the list of useable data when the anomalous consequences of samples monitoring were verified. To assess the classes of WQA of stream water in a river using the WQES is to carry out after screening of the data via the Rule of 90% that is

$$F = (i - 0.5)/N \text{ or } i = 0.9\ N + 0.5 \quad (1)$$

where i is row of the results, N is total number of results; and $F = 0.9$ is percentage or 90% of acceptable data to evaluate.

To assess the alteration of suspended particles, the withheld rule is the 50% percentage, to avoid qualifying water after rainfall events which no exceptional characteristics and with a frequency superior to 10%. The formula is then

$$i = 0.5\ N + 0.5 \quad (2)$$

The rules need to be implemented due to the results monitoring the same parameter(s) of water quality are numerous. For instance, the parameters used to be analyzed as the valuable data in preparation of water quality management plan are indispensable to monitor regularly for certain locations along the river.

Table 1 Water quality parameters in accordance with their alteration

No	Alteration	Parameters
1	Oxidized organic matter	O_2, $\%O_2$, COD, $KMnO_4$, BOD, DOC, NKJ, NH_4^+
2	Nitrogen matter	NH_4^+, NKJ, NO_2^-
3	Nitrates	NO_3^-
4	Phosphorus matter	PO_4^{3+}, P-total
5	Suspended particles	SS, Turbidity, Transparency
6	Colour	Colour
7	Temperature	Temperature
8	Mineralization	Conductivity, Salinity, Hardness, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, K^+, Na^+, TAC, Hardness
9	Acidification	pH, Dissolved Al
10	Micro organisms	Total Coliforms, Feacal Coliforms, Feacal Streptococci

11	Phytoplankton	ΔO_2, ΔpH, $\%O_2$, and pH, Chlorophyl a + pheopigments, Algae
12	Mineral micro pollutants in raw water	As, Hg, Cd, Cr-total, Pb, Zn, Cu, Ni, Se, Ba, CN
13	Metals in Bryophytes	As, Hg, Cd, Cr-total, Pb, Zn, Cu, Ni
14	Pesticides in raw water	List of pesticides (see Oudin et al., 1999)
15	Organic micro pollutants non pesticides in raw water	List of organic micro pollutants non pesticides (see Oudin et al., 1999)

Sources: Oudin et al., 1999

WQA assignment for different purposes

The assignment of WQA as shown in Figure 4 is fixed to assess the suitability of water for different destinations of water uses and to verify the impact of pollution downgrading biodiversity. The biological potential function shows the suitability of water for aquatic life, when hydrological and morphological conditions of the habitat are good. The pollutants in the stream water such as metals and organic matters affect the declination of biodiversity and sediment quality. For instance, despite high metal concentrations associated with roots, the major part of the metals in the marsh soil is still associated with the sediment as the overall biomass of roots is small compared to the sediment (Teuchies et al., 2008). Five suitability classes of WQA have been defined. They indicate a gradual impoverishment of the biological structure, including the disappearance of the taxa most sensitive to pollution.

Defining the suitability classes for drinking water production depend on (1) the related regulations which are held as priorities for defining the blue/green class thresholds associated with suitability for consumption and orange/red class thresholds associated with unsuitability for production of drinking water and (2) the opinion of the producers and of the suppliers in defining intermediary thresholds for simple and complex treatments of raw water. The definition of suitability classes is grouped into five classes. The use of leisure and aquatic sports is mainly applied in bathing areas and the legislation thresholds which principally relate to the turbidity of the water and the occurrence of microorganisms. Three suitability classes for recreation and aquatic sports have been defined.

The main factors to classify the suitability of water for irrigation are: ground texture, irrigated crop, frequency, and duration of irrigation. Crops have been divided into four sensitivity groups, ranging from very sensitive plants to very hardy plants. The crops taken into account in these groups are liable to differ from one parameter to another, meaning that the composition of each group is also variable. For instance, the arsenic content in soil and plants is influenced by the degree of arsenic amount in irrigated water (Dahal et al., 2008). It is equally necessary to take into account the type of soils. These have been divided into two groups which overlap, i.e., (1) all soils including the most sensitive and (2) neutral or alkaline soils, which are the most resistant. Combinations of soil/plant groups have been limited to

sensitive-very sensitive plants/all soils and to resistant-very resistant plants/alkaline or neutral soils. Five suitability classes for irrigation uses have been defined. Water quality indices provide a simple and understandable tool for managers on the quality and possible uses for irrigation water (Almeida et al., 2008).

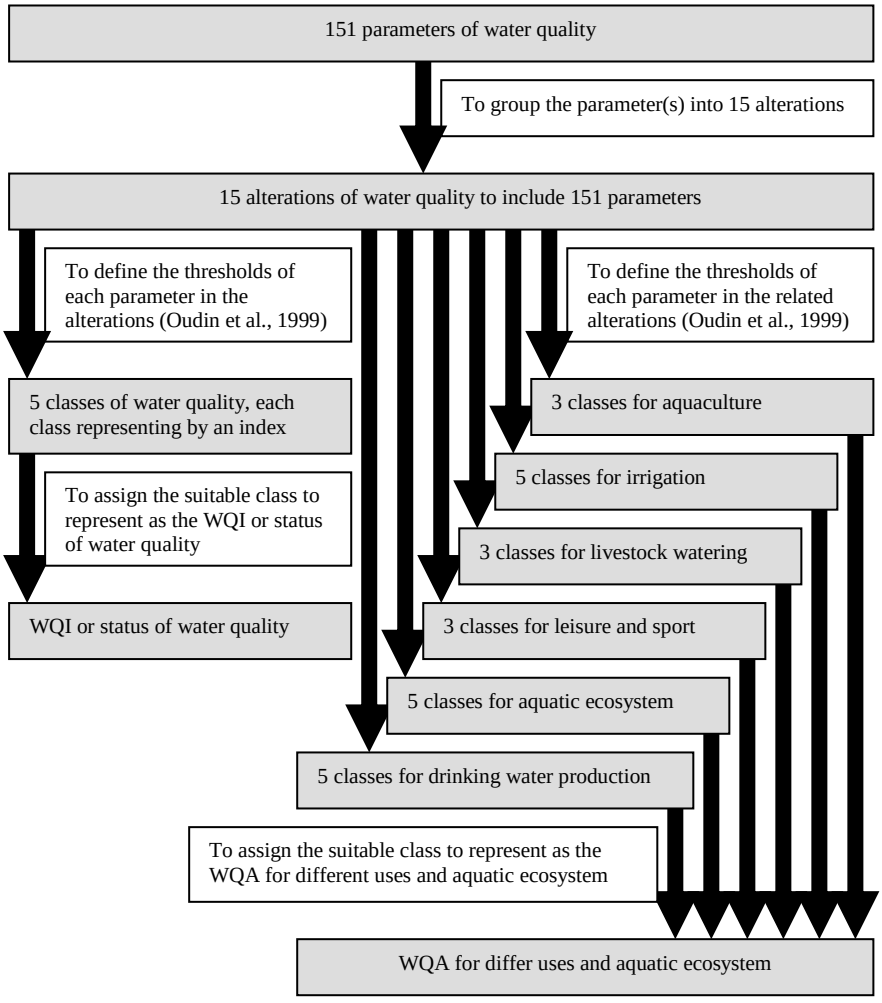

Figure 4. Flow chart of WQI and WQA class assignment

Livestock watering use is the suitability of water to allow the watering of breeding animals. These can be classified according to three age classes and sensitivity i.e., (1) young animals as chicken, pigs, calves, which are growing fast and are very sensitive to all pollutants, (2) animals of mature age which have a slow growth and are less vulnerable, and (3) animals for reproduction, they have strict needs during the gestation and milking period. In the case of livestock watering, water has to be useable immediately by the breeder. If the water is not useable, the breeder will then turn to the water supply. Three suitability classes for livestock watering use are adopted (Oudin et al., 1999).

Aquaculture use mainly shows the water suitability to be used in fish breeding. Water is the main factor of production in intensive fish breeding, particularly in salmon breeding. Water carries oxygen, eliminates

wastes, and conductions production performances by its physicochemical variability. Three suitability classes for aquaculture have been defined.

WQES to assess the suitability of water for different uses

Since the aggregation method is only performed to assess the suitability of river water for the different uses and its aquatic ecosystem, the following steps are carried out using the WQES that are: (1) grouping 151 parameters of water quality into 15 alterations that classify in accordance with their similar nature and its impact on environment (see Table 1); (2) defining the thresholds of each parameter into five classes with respective colors of blue, green, yellow, orange, and red to express the most suitable aptitude of unpolluted water, good suitable aptitude, moderate suitable aptitude, bad suitable aptitude, and unusable aptitude of very polluted water, respectively, except thresholds defining by three classes with respective colors of blue, yellow, and red to asses the water uses suitability for leisure and sports, livestock watering, and aquaculture; (3) formulating the classes that are five classes to assess the WQAs of aquatic ecosystem, drinking water production and irrigation uses and three classes to assess the WQAs of leisure and aquatic sports, livestock watering, and aquaculture uses, as shown in Figure 4 and the aptitude of water for the different uses and its ecosystem in accordance with the level of suitability or WQA that ranges from the most suitable to unsuitable water, as shown in Figure 5; (4) assessing the value of each parameter and put it into the respective classes of WQA for water suitability to the different uses and its ecosystem; (5) verifying the worst quality of parameter(s) and choose it to represent the aptitude of related alteration; and (6) identifying the worst quality of alteration(s) and choose it to represent the WQA for water suitability for the different uses and its ecosystem (aquatic biota).

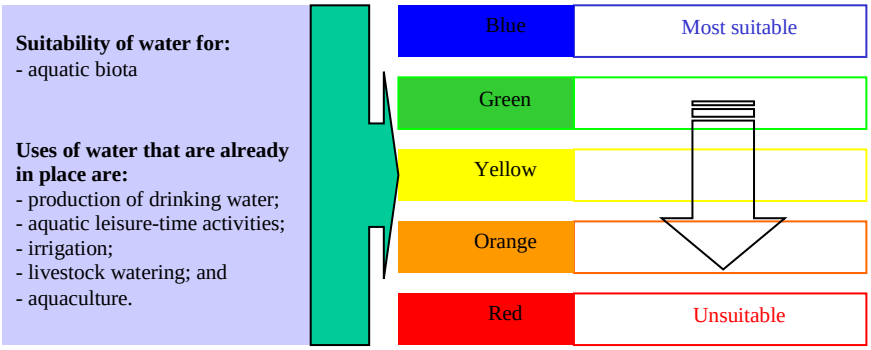

Figure 5 Classification of water suitability for different uses and aquatic biota

Source: Oudin, et al., 1999 modified by Fulazzaky, 2008

Results and Discussions

Application of WQES for the Citarum' river

The Citarum river segments distinguish into three different parts of water uses destination. The government of West Java province in the local regulation No. 39 Year 2000 (Perda Jabar No. 39/2000) enacted the water quality category in the upper and lower parts of the river as the standards Class C and D for the segments of main river in the upstream of Curug Jompong station and immediate the

downstream of Tanjungpura station. The middle parts from immediate the downstream of Curug Jompong to the upstream of Tanjungpura station as shown in Figure 6 is destined as the standards Class B, C and D. Whereas, the stream water in all the tributaries entire the river basin is the standards Class B, C and D. The Class B, C and D means the class of water which is suitable to provide the uses of drinking water production, aquaculture, livestock, agriculture, municipal and industrial affairs, and hydropower energy. The Class B and C means the class of water which is suitable to provide the uses of aquaculture, livestock, agriculture, municipal and industrial affairs, and hydropower energy. The stations of water quality monitoring were chosen at 10 locations that are: 01 Cijeruk, 02 Margahayu, 03 Nanjung, 04 Curug Jompong, 05 Saguling dam, 06 Cirata dam, 07 Jatiluhur dam, 08 Bendung Curug, 09 Tanjungpura and 10 Rengasdengklok along the main river (see Figure 6).

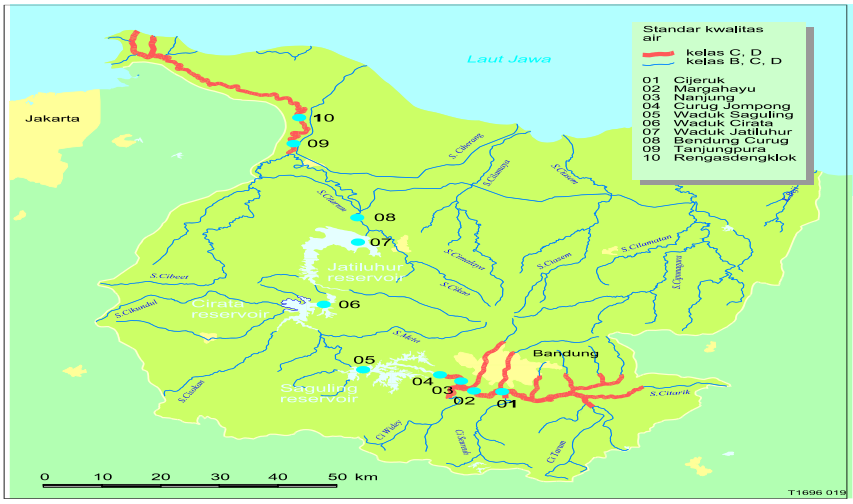

Figure 6. Water quality monitoring stations along the Citarum river

The rules in the Equations (1) and (2) need to implement due to the results of water quality monitoring along the Citarum river are numerous. Since 1990, the Jasa Tirta 2 Public Corporation (PJT2) as the institution in charge to monitor water quality of this river has been traditionally monitored at 10 locations, as shown in Figure 6. This study specifically uses the data that were monitored by the Centre for Water Resources Research and Development of the Indonesian Ministry of Public Works in 2005 to concentrate in the upstream areas of river segment. The data monitoring as shown in Table 2 were tested of 33 parameters. To assess the classes of quality and water suitability in the river were used the data monitored from 10 stations that are: 01a Wangisagara, 01b Majalaya, and 01c Sapan as the additional stations in the upstream of Cijeruk, 01 Cijeruk, 03a Dayeuhkolot and 03b Brujul as the additional stations in the upstream of Nanjung, 03 Nanjung, 08 Bendung Curug, 09a Bendung Walahar as the additional stations in the upstream of Tanjungpura, and 09 Tanjungpura along the main river. This is due to the pollutant loads are more important to discharge the river coming form the Bandung region. The need to insert three additional stations in the upstream of Cijeruk and two stations in the upstream of Nanjung is to investigate the impacts of untreated household sewage, solid waste and industrial effluents on the quality of stream water. One more additional location was also monitored in the upstream of Tanjungpura to understand the impact of industrial pollution loads discharging from the industries located in the

downstream areas. Because of the lack of data monitoring, two alterations i.e., pesticides in raw water and organic micro pollutants non pesticides in raw water as shown in Table 2 were no included to evaluate in this study. To assess WQA, this study examines 3,960 testing results that were specially monitored from 10 selected stations above along the main river during the period of 1 year with the frequency of monitoring was one per month.

WQA of the Citarum River

The excessive pollutants in the stream water will face the problems of biodiversity degradation. The earlier study supports the need for incorporating functional measures in evaluations of stream ecological integrity (Castela et al., 2008). The effects on zooplankton were caused by changes in habitat structure due to the strong decline of macrophytes. The slow degradation of metazachlor combined with the absence of recovery in both chlorophytes and macrophytes is likely to cause long-lasting effects on aquatic ecosystems (Mohr et al., 2008). Considering the results of WQA analysis, this study remarks that the stream water in the upper part of Saguling dam as shown in Table 2 is unusable to conduct the sustainability of aquatic ecosystem, judging the WQA class is red. This translates water capability of considerably reducing the number of sensitive taxa or eliminating them with a very low diversity. In the downstream areas of Jatiluhur dam, water quality causing the disappearance of certain sensitive taxa with adequate diversity is evident, see location 09a Bendung Walahar, judging the WQA class is green, or water capabilities of considerably reducing the number of sensitive taxa with adequate diversity are manifested, see locations 08 Bendung Curug and 09 Tanjungpura, judging the WQA classes are yellow. To improve the quality of the stream water particularly in the upper part of the basin is still will be suitable for aquatic biota this study recommends to the related local authorities including all the stakeholders to envisage as high priority the problems of river pollution. This suggests the need to have a specific legal instrument of integrated water quality management plan in order to guide all the participatory of multiparty entire the river basin to involve in improvement of water quality in accordance with the role and responsibility of each participant.

A deeper understanding of the practical and theoretical underpinnings of risk management can be made between organizational capabilities in the essential water business process (MacGillivray and Pollard, 2008). This preventive feature lies at the core of risk management for the provision of safe drinking water (Hrudey et al., 2006). Referring to this study, water in the upper Citarum river as shown in Table 2 is not recommended to produce drinking water generally excluding in the stream water from the upper part of Bandung city see upper part of the station 01a Wangisagara and at the station 03a Dayeuhkolot, judging the WQA classes are red. Because of no more industries located in the upstream areas of Bandung city, water quality upper the station 01a Wangisagara was justified as moderate (yellow). The improvement of water quality at the station 03a Dayeuhkolot was verified as orange due to a good water quality from Ciwidey river penetrates the water quality of Citarum' river. Utilization of Citarum river water from the upstream areas of Bandung city is acceptable to produce drinking water. This study recommends to perform the conventional technologies in producing of drinking water for raw water in the stream from the

upper Bandung and the advanced technologies to treat water from the station 03a Dayeuhkolot. Because the intake of raw water from the Jatiluhur dam to supply water for the Jakarta city in the downstream area is still operated, the study recommends to the Jakarta water supply authority to use conventional technology in treating the water since the closed conveyance is used to transport the water from the Jatiluhur dam to Jakarta. This recommendation based on the moderate quality of river water, judging the WQA class as show in Table 2 is yellow. Unfortunately, to date the transport of water is still operated in the open canal. The use of this system will face the risk of pollution discharged from the industrial and domestic wastewaters along the canal when water flows. The contamination of water eventually declines the WQA of such as from the yellow classes at the stations of 08 Bendung Curug and 09a Bendung Walahar to orange class at the station of 09 Tanjungpura so the advanced technologies should be considered to be implemented by the Jakarta water supply authority in treating the river water purposed to public consumers.

Table 2. Application of WQES to assess the WQA for the Citarum river water

Type of water uses	Results of WQA analysis									
	01a	01b	01c	01	03a	03b	03	08	09a	09
Aquatic ecosystem	r	r	r	r	y	r	r	y	g	y
Drinking water production	y	r	r	r	o	r	r	y	y	o
Leisure and aquatic sport	r	r	r	r	r	r	r	y	y	r
Irrigation	b	g	g	g	g	g	g	b	b	g
Livestock watering	b	b	y	y	y	y	y	b	b	b
Aquaculture	r	r	r	r	r	r	r	y	y	r
Number of parameters	33	33	33	33	33	33	33	33	33	33

Notes: 01a Wangisagara, 01b Majalaya, 01c Sapan, 01 Cijeruk, 03a Dayeuhkolot, 03b Brujul, 03 Nanjung, 08 Bendung Curug, 09a Bendung Walahar, 09 Tanjungpura, b = blue, g = green, y = yellow, o = orange, and r = red.

Water in the main river as shown in Table 2 is not acceptable to be used for leisure and aquatic sports excluding the stations 08 Bendung Curug and 09a Bendung Walahar, judging the WQA class is red. A moderate water quality at these stations caused by self purification occurs in three cascade reservoirs, i.e., Saguling, Cirata, and Jatiluhur. Due to the pollutant loads from industries discharging the river in the downstream area are evident, degradation of water quality as shown in Table 2 increases gradually in the stream towards the sea. Considering the strategic role of Citarum river regulated effectively by three cascade reservoirs functioning as the potential recreational parks, hydropower generation, sources of

water for domestic, municipality and industry, as well as the source of irrigated water for paddy fields and fishponds, delivers 20% of Indonesia's gross domestic product, this study recommends to the central government of Indonesia to envisage as first priority the problems of this river pollution. This suggests the need to install correctly the wastewater treatment plants for each industry and for each city of the entire the Citarum river basin particularly for the upstream areas of the basin to reduce the pollutants of organic matter, microorganisms, and suspended particles. Besides to improve the quality of water related to suspended particles, there is a need to consider the occupation of lands to implement the best practice of soil conservation effectively.

To analyze the suitability of water for irrigation purpose is summarized in Table 2. This informs that water quality in the river is still suitable to irrigate especially for paddy fields of as the major part of water uses in the region, judging the WQA classes for all the station selected are classified as blue or green aptitude. It is remarkable that the Jatiluhur dam serves suitably water for 240,000 ha of paddy fields in the downstream areas. Unfortunately, the overflow of irrigated water is usually to drain back into the river. The runoff from paddy field as verified in the Ile de Camargue, France, carries important loads of dissolved pesticides to the wetlands including river (Comoretto et al., 2008). Drinking water pollution in the Evros region Northern Greece can be attributed to excessive fertilizer use from agricultural sources (Nikolaidis et al., 2008).

For more accurate assessment of the effects of water quality, for a given livestock production system the format should be based on ingestion levels, as opposed to a mg/l basis, and should take into account site-specific synergistic and antagonistic interactions within and external to the water to a greater extent (Meyer et al. 1997). The aggregation method of WQES using in this study led to the formulation of a water quality guideline index system based on WQA basis. Referring to the classification in the literature (Oudin et al., 1999), this study concludes that utilization of Citarum water to provide the livestock watering of all animals including the most sensitive such as young animals, animals in gestation or milking is still suitable for the stream waters from the upper Bandung city (see the stations 01a Wangisagara and 01b Majalaya) and the downstream of Jatiluhur dam (see the stations 08 Bendung Curug, 09a Bendung Walahar, 09 Tanjungpura), judging the WQA classes are blue (see Table 2). The stream water along the river segments between Bandung city and Saguling dam is suitable to provide the livestock watering of mature animals that are less vulnerable such bovine and ovine and needs to control strictly the quality of water used, judging the WQA classes as shown in Table 2 are yellow (see the stations 01c Sapan, 01 Cijeruk, 03a Dayeuhkolot, 03b Brujul, 03 Nanjung).

Fish and crayfish perform all bodily functions in water which include eating, breathing, excreting wastes, reproducing and taking in or removing salts. Water quality can affect these functions and therefore will determine the health of the fish and consequently the success or failure of a fish farming operation. For example, carbohydrate addition in water affects to (1) increase the nitrogen retention in harvested shrimp biomass, (2) reduce the demand for feed protein, (3) reduce the concentration of NKJ and NO_2^-, and (4) reduce nitrogen discharge making extensive shrimp farming more ecologically sustainable and economically viable (Hari et al. 2006). Despite the stream water in the river is unsuitable for direct use in

aquaculture generally, judging the WQA classes are red (see stations 01a Wangisagara, 01b Majalaya, 01c Sapan, 01 Cijeruk, 03a Dayeuhkolot, 03b Brujul, 03 Nanjung, and 09 Tanjungpura), Table 2 shows that the river water immediate the downstream of Jatiluhur dam is suitable for all adult fishes which are not very sensitive to pollution, judging the WQA classes are yellow.

Conclusion

This study used the WQES to assess the suitability of water for different uses and its ecosystem for the Citarum river water. The suitability of the river water was examined through WQA assessment to forbid strongly the uses of water in the upstream the Saguling dam to provide (1) the suitability of biodiversity growth and productivity, (2) drinking water production except the stream water upper Bandung city, (3) leisure and sport activities, and (4) aquaculture uses. Although the stream water of the river segment between the Bandung city and Saguling dam needs to be controlled strictly, the quality of water is still suitable to be used for irrigated lands and livestock watering. The improvement of water quality was verified immediate the downstream areas of Jatiluhur dam due to the self purification occurs in three cascade reservoirs, i.e., Saguling, Cirata, and Jatiluhur, consecutively. This gives the advantage to supply raw water from the Jatiluhur dam to Jakarta city for drinking water production with adequate quality since the closed conveyance is used for transporting the water.

The stream water upstream the Suguling dam (see upper the station 03 Nanjung) is totally prohibited for supporting the biological potential function, leisure and aquatic sports, and aquaculture purposes judging the WQAs of these water uses are unsuitable, indicating as red color (see Table 2). This study justifies that the factual water quality of the river no matches the standards regulated in Perda Jabar No. 39/2000. This gives the rational argument to urge the local authorities, central government, and all related stakeholders to concern for improving the river water quality. This study shows that the use of WQES practically remained comprehensive in evaluating water quality systematically. There is the analysis of water quality data to convert into the usable information that serves as DSS in managing of available water comprehensively.

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Religious Memory and Scientific Ethics after Hiroshima and Nagasaki

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Abstract

2015 has been a year of anniversaries, notable for the 70th anniversaries of the events of the last year of World War II (or the Asia-Pacific War) and the advent of our still postwar world. Japan's surrender on August 15th, 1945, followed a series of heavy fire-bombings of Japanese cities, including Tokyo on March 10th; the fall of the German Reich in April; the invasion of Okinawa in April and its surrender in June, culminating in mass, coerced suicides; the Potsdam Declaration promising "complete and utter destruction" in July; and then, on August 6th, and again on the 9th, the destruction in a flash of two Japanese cities. Because Indonesian independence was declared immediately after the collapse of the Japanese empire and because Americans were anticipating an invasion of the main islands as intensive as the one in Okinawa, the general perspective in both countries has been that the Atomic Bombs were somehow necessary, a perspective we can call "from above the mushroom cloud." At the same time, to consider what happened "below the mushroom cloud" and even begin to recognize the sheer horror of the instantaneous destruction and annihilation also forbid us to think only from that perspective, as this events as two more in the long history of hostilities, but rather as unparalleled, as also outside history. I went back to Hiroshima and Nagasaki this August. I went partly to grapple with what happened there and how it is remembered in the present and partly to try to see how religion and religious studies can be a helpful framework for examining the process of memory, which is at once deeply situated in political contexts and transcending such limits for the taste of existential destruction that happened there. In this paper, I attempt to ask about religion and memory after seventy years and to then raise the questions of science and ethics, given that Hiroshima (like Auschwitz) was a marvel of science, the result of intensive and secretive scientific inquiry, the largest in world history to that date.

Religious Memory

On August 6th 1945, 90% of Hiroshima was incinerated. Thousands in the immediate zone of the hypocenter disappeared, sometimes leaving a shadow of carbon on concrete or a bit of metal—a lunchbox, a watch, a tricycle. 140,000 were dead by the end of 1945 and as of this year a total of almost

300,000 victims—called in Japanese *hibakusha*-- have been entered into the memorial books. This was a city with military operations but it was a city and the victims were men, women, and children; Japanese citizens and Korean forced laborers, Southeast Asian students, European prisoners of war. A smaller city in the far southwest, Nagasaki was not the first target for the 9th but cloud cover over Kokura led the plane carrying the second atomic bomb to be redirected. Nagasaki has a long history as a trading port, the one place the Dutch were allowed to maintain a base during the 250 years during which the country was closed to the West, and a center for Catholics who just thirty years earlier had dedicated a cathedral barely a kilometer from where the bomb was detonated. 70,000 were dead by the end of 1945 and the memorial books now record close to 170,000. The average age of the survivors is now past 80 but it still possible to hear their testimonies directly, of the flash and the boom (*pika* and *don* in Japanese), of the blistering bewildering heat, of making their way home to discover who among their family and community was still alive, of health problems without end, of discrimination.

Memory can be understood in at least three interconnected senses here. First, memory as an operation of the human mind to store and recall the past in the present is paired with the two operations which disrupt this humanly fallible process: forgetting, on one hand, happens to us all and trauma, on the other, follows injury to the body, the psyche, the community. Such memory is also at times set against history that is defined and seemingly supported through a documentary basis and bias. As in the case of the so-called comfort women or *jugun ianfu* whose memories of sexual enslavement by the Japanese military have challenged the documented and often male official narrative, it can be what the subaltern possesses in order to make claims on dignity and justice. Second, as famously explicated by Pierre Nora and his research team in their search for the *lieux de memoire* that define the French nation, memory can mean the explicitly political narration of a past that holds together a nation or other community. Two decades ago, a controversy over the exhibition of the B-52 called *Enola Gay*, from which the atomic bomb was detonated on Hiroshima, was reduced to simplistic terms and then reached the United States Senate which felt compelled to pass a resolution declaring the use of the A-bomb morally good and force the elimination of nuanced historical explanation, an indication of the moral ambivalence still pervading the U.S. Third, memory can mean remembrance, the obligation to the dead to hold onto and honor their existence until it too, with us, slips into oblivion. Memory is pursued through the activities of memorialization and commemoration, of holding rituals and erecting monuments, of visiting graves and memorials as a moral and emotional obligation. This is one of the tasks of religion, though one it often rejects.

To inquire into religion likewise means to take on two interconnected meanings. First, there are the ways that religious language and ritual patterns pervade memory and the ways of commemoration, particularly at sites and on occasions that are sanctified with reference to memory and the community—which remains, by design, not clearly designated. Second, there are the activities of specifically religious groups that extend beyond this occasion and which bring religious and inter-religious purposes to the project of memory. Though Robert Bellah reportedly described “civil religion” in response to questions from Shinto priests visiting Washington in the 1950s and asking how it could be that American

nationalism was so full of God-talk while the American occupiers had banned the State Shinto of the prewar state, this is not quite his civil religion because it does not make clear who it defines—indeed it is generally, on one hand, a specific community of experience transposed onto a modern city, often at odds with the national government, and, on the other, a "universalized" experience that could easily be the fate of any person anywhere, regardless of the specificities of culture or history. It does however retain the prophetic potential pointed to by Bellah to make demands from its own logic and sense of what is right

In the first category, I can point to four ways religious forms pervade these commemorations.

1. **Prayer**. In the official ceremonies, "prayer" occupies a prominent place in the name and function of the ceremony. Consider the very names of the official annual ceremonies held on the anniversaries of the two atomic bombings: (in my literal translation; the usual English is simply "Memorial") the Hiroshima City Atomic Bomb Dead Spirit Consolation Ceremony and Peace Prayer Ceremony and the Nagasaki Atomic Bomb Sacrificed Spirit Consolation Peace Prayer Ceremony. There is a homonym at work here as well: *ki'nen*, with one of two other characters pronounced *ki*, ones meaning to record, indicates memory in the sense of memorial: such a *ki'nen* appears in the names of the museum and park at Hiroshima though not at Nagasaki: the setting for transcendent memory is within secular memory. Prayer, in the form of silent prayer (*mokutō*), is at the heart of the official ceremonies which are timed such that the moment of the detonation of each bomb—8:15am, 11:01am—is one of silence and/or the tolling of a bell. Wordless and led by no one, no direction is suggested for this prayer and it concludes as the moment of the detonation passes. In both locations, silence is immediately followed by speech act by the central event of the commemoration: the peace declaration read by the mayor. Beginning in 1947 and 1948, these declarations have issued annually without interruption since 1951. They are appeals to world leaders to enact and enforce treaties against nuclear weapons and to the Japanese government to provide adequately for the surviving *hibakusha*. One might also see prayer in the practice of folding origami cranes and bringing strings of a thousand to lay before the children's monument recalling the story of Sadako Sasaki, a girl who was exposed to radiation in the womb and died of leukemia.
2. The **concept** of witness is also key to the memory of the atomic bombs and of particular importance at this juncture of 70 years, for as was noted repeatedly the average age of the survivors has now passed 80. Because of instant annihilation of untold thousands followed by the agonized deaths from internal and external burns of thousands more, many beyond recognition (totaling, by the end of 1945, 140,000 in Hiroshima and 70,000 in Nagasaki), the physical presence of those who did survive has come to be of great importance. As Lisa Yoneyama has shown, the process of narrating memory as *kataribe* or testifiers is fraught with a kind of politics of recognition as survivors (for whom access to specialized health care

was contingent on proving where one was at the moment of the blast or if one entered the city later) but at the same time it carries a kind of urgency on behalf of others who cannot speak and on behalf of a future peace in which nuclear weapons will not be used again.

3. **A third way religious concepts** are central to memory is in the hallowed ground of the memorial sites, the two Peace Parks and adjacent areas. In the delta of Hiroshima, the park was built between two branches of the river, below a T-shaped bridge said to have provided the target, and a central memorial was put in place in line with the ruins of one of the few structures to have survived the blast, the Prefectural Products Exhibition Hall now known as the A-Bomb Dome. It is now known that the architect Tange Kenzō's cenotaph is the repurposing, on a smaller scale, of an earlier design that was meant to align with Mt. Fuji and commemorate Japan's victory in Asia. Few other traces of the mostly wooden neighborhood remain in Hiroshima, though one of the many smaller ceremonies each year commemorates that neighborhood. Instead, a new park was built on the burned out grounds, centered on the museum and the cenotaph, but with space for a variety of monuments that met certain "universalizing" gestures. Famously, the monument to Korean victims was constructed outside the park, on the facing river bank, and was moved into the grounds only in the late 1990s. At Nagasaki, the Peace Park or grounds for the annual official ceremony face a statue of a seated man with arms and legs in different directions, echoing in that way a Buddha but looking more like a Greek god. (for years I assumed it represented Prometheus who brought down fire from the heavens to the earth) This "sacred ground" is in fact the site of a prison, the foundations of which remain visible, in striking contrast to the structure that parallels most closely the A-bomb dome: the Urakami Cathedral which was reconstructed with only a few pieces of its previous existence preserved in statuary. The monuments that fill this peace park are of two types: memorial greetings primarily erected in the 1980s by socialist states and recent monuments to the diversity of the victims, including for example the Chinese (forced laborers) who died in the prison. On the anniversaries, these grounds and the surrounding streets become the site of multiple commemorations as well as protests. Perhaps because of its more central location and its historical position, there were far more groups in Hiroshima, high school students with petitions, leftists with alternate publications, religious groups considered outside the mainstream, peace commemorators seeking out foreigners, and so on. Most moving were the *hibakusha* who came to speak without a platform other than their story. There were also government directed memorial activities in the twilight: the famous floating lanterns in Hiroshima echoed by wax candles at Nagasaki.

4. The language of "comforting souls" *irei* is present in the titles of the Hiroshima cenotaph and the memorial ceremonies in both cities. It is linked to what we might call a Japanese "mystic

synthesis," in which the spirits of the dead are present alongside the divinity within nature and do need consolation, especially when they have died traumatically. One unique and moving addition to atomic bomb commemorations is water imagery, recalling how those who were badly burned but not killed instantly sought water to relieve their unquenchable thirst and cool their burned flesh. They were often heard crying "*mizu kure*" "give me water" but often their badly shocked systems could not accept the water they did find and they died immediately. When water is poured from individual containers—as in those carried by various religious leaders into their shared ceremony in Hiroshima or when, in the official ceremony in Nagasaki, brought from springs in various corners of the city—into one bowl, it can be a reminder of the collectivity of life itself. The second is that the most material remains honored in these places is a set of books containing the names of the atomic bomb dead. These books have been and will be updated annually until the last *hibakusha* has died. This August, 5,359 names were added to bring the total to 297,684 (recorded in 109 books) in Hiroshima and 3,373 names were added in Nagasaki to bring the new total to 168,767 (recorded in 170 books). Each city maintains an office to manage the books and to process applications for inclusion and the names of non-Japanese are also included. Curiously, the other place this act of memorializing through names handwritten in books is at the Yasukuni Shrine in Tokyo, where nearly 2.5 million war dead from Japan's modern wars from 1868 to 1945 are enshrined as kami. There are significant differences in that the Yasukuni Shrine is formerly part of a state civil religious apparatus and now technically a private religious organization that uses religious language a ritual, which, when patronized by government officials, potentially violates the Constitution's proscription against government use of religious activities. Moreover, there have been no new entries into enshrinement register since 1978, when the top-level officials executed as a class-A war criminals were added, ratcheting up the controversy over the lack of remorse the shrine represents to the countries in Asia Japan invaded. Still, the same question of how physical presence following the devastation of war, either through the advanced weaponry or through death in distant lands and oceans, is part of memorialization. These books, stored deep inside monuments, are also different from the Cornerstone of Peace in Okinawa, an extensive black granite monument carved with the names of combatants and civilians from all sides killed in the Battle of Okinawa (April to June 1945).

The second meaning of religion and memory is, of course, the activities of religious groups and surrounding the official ceremony in each place are both joint and specific memorial services and actions. At Hiroshima, this took the form of first a joint Buddhist-Shinto-Christian service early on the morning of the 6th, followed throughout the day by various sects of Buddhism as well as Catholicism and Protestantism. Not included are the so-called new religions which originated in Japan (some of which,

like Tenri, date to the nineteenth century). These services face the *genbaku kūyōtō*, a mound-style grave containing unclaimed *hibakusha* remains, with a list nearby inviting families to take these ashes back to the family graves. *Kuyō* is Buddhist language originating in the concept of *pūja* or reverence for the presence but seemingly shared here.

At Nagasaki, the 43rd Genbaku Junnansha Ireisai (Festival to Console the Spirits of those who Suffered from the Atomic Bomb) was held on the night of the 8th in the park surrounding the hypocenter, at the base of the hill where the peace ceremony would be held the next day. While this service had many of the same elements as the public ceremony, each was led by a different religious leader and member of the sponsoring organization which translates its name to English as the Fellowship of Religionists in Nagasaki for Dialogue. According to its roster, it is made up of clergy of Japan's religions including eleven Christians (among them the organization's advisor, the archbishop), eight Shinto priests, thirty-six Buddhist priests, and nine "miscellaneous," including Tenri which invited a Turkish Sufi to do whirling meditation. This category of religionist (*shūkyōsha*) was a new one for me, invoking a category as reified in law and academia as agama but one which most Japanese reject as requiring some kind of extreme doctrinal loyalty that takes them into dangerous territory, as with AUM Supreme Truth which launched apocalyptic terror in the subways in 1995: it seems to recognize that religion has a definite interest in certain issues, especially peace and the memory of atrocity (regardless of the religious identities of the victims) and it is always plural. The most prominent use of the terms is in the name of the global network Religions for Peace which was launched in Kyoto in 1970, but its Japanese branch dates to 1951 and a sense of the shared responsibility of religious organizations for the war, an opportunity for penitence (metanoetics).

Scientific Ethics

In the weeks following this commemoration, from the perspective of many Japanese, the memory of the A-bomb victims was violated in two ways by the actions of the current Liberal Democratic Party-led government of Prime Minister Shinzō Abe. First, two days after the Nagasaki memorial, the Sendai Nuclear Power plant 100 miles to the south was restarted, the first nuclear power plant to go back into operation since all were taken offline in the wake of the triple disaster that hit northeast Japan on March 11th, 2011. In its wake, and in the fears of long-lasting radiation contamination over a wide area, Fukushima has become a third disaster in which a city name is written with phonetic syllabary. But this requires a redefinition of what happened at Hiroshima and Nagasaki, from technologically advanced atrocities that have not been repeated and serve as warning to the use of nuclear weapons and the need for disarmament to a broader warning against nuclear energy in all forms. While the Nagasaki Museum and the Nippon Myozan (Buddhist) peace marchers already included those exposed to radiation from nuclear weapons tests in the South Pacific and elsewhere (most famously the Japanese fishing boat Lucky Dragon #5, exposed in the Marshall Islands in 1955), Fukushima is something new and unresolved (and part of a history in which the U.S. foisted "atoms for peace" onto the same country it had used two atomic bombs on just years earlier.). Where the appeals remain directed against nuclear weapons and in

support of the non-proliferation treaties, the Religionist group fasted instead for "a 21st century without nuclear weapons or nuclear power."

Second, as the commemorations were going on, Japan was being shaken by perhaps the most substantial public political demonstrations since Prime Minister Abe's grandfather forced through a renewal of the U.S.-Japan Joint Security Treaty in 1960. The bill the government finally did push through the Diet in September re-interprets Article 9 of the 1947 Constitution, "forever renounc[ing] war as a sovereign right of the nation," as allowing something called a "right of collective self-defense" through which Japan may enter, for example, U.S.-led military interventions. The movement against it, which took form in mass demonstrations in many cities as well as surrounding the Diet building, was quick to name it the "War Bill" and to see in it a dark turn in Japanese politics away from democracy and peace. Prime Ministers have spoken at both ceremonies for several decades and their remarks, which follow the "pledge for peace" (*heiwa he no chikai*) read by local children, are the one unscripted part of the program. Abe's remarks at Hiroshima were criticized for mentioning neither Article 9 nor Japan's so-called "Three Nuclear Principles" (not making, not possessing, not harboring nuclear weapons) and in Nagasaki he did make a gesture at the latter. Because the programs are timed so carefully around the exact moment of the detonation, demonstrators were able to intrude sonically on Abe as he spoke, reminding the assembled that he had not earned a sacralized atmosphere.

By way of conclusion, I would like to go a little deeper into the work of religion in memory: to the concept of sacrifice. Recently, the secular philosopher Takahashi Tetsuya has named a sacrificial system which inculcates the belief that some part of the community must accept that it must be sacrificed for the whole: his examples are Okinawa, where American military bases are an obnoxious and destructive presence, and Fukushima, the cost of which is far from understood but the calculations were made long ago by politicians, electric company executives, compliant scientists and the public. Since I first visited Hiroshima and Nagasaki in the mid1990s, the Japanese State has built its own memorial halls in each place (Hall to Pray for Peace and Eulogize the Atomic Bomb Dead). Borrowing methods from Holocaust memorials, these halls seem set to counter the city-run museums which set the cities apart as universalized sacrifices (hence the slogans: no more Hiroshima, no more Nagasaki, to which is now added no more Fukushima) apart from the nation. Even so I was surprised by the statement at the entrance in Hiroshima: in the official translation: "The National Peace Memorial Halls for the Atomic Bomb Victims in Hiroshima and Nagasaki are an effort by the Japanese national government to remember and mourn the sacred sacrifice of the atomic bomb victims. They are also an expression of Japan's desire for genuine and lasting peace." Sacred sacrifice by whom, for what? Can we continue to allow there to be sacrifice without meaning? Is that a question religions and/or religionists should try to answer?

One answer is in the refusal to sacrifice or to sacrifice others. Here the example of a second Japanese intellectual Takagi Jinzaburō. Takagi promoted the idea of the "citizen-scientist" who can utilize the knowledge and method of science but is self-consciously independent of power, including the intimate relationship of the university with the military, government, and the corporate world. For a nuclear

chemist like Takagi, severing ties with this kind of power meant loss of access to the high-tech methods of research but it also gave him the freedom to use his knowledge to counter the government and academic experts, particular in their interpretation of data most citizens cannot make sense of, which sometimes, as with nuclear power, has life-and-death consequences. With the prize money from the 1997 Right Livelihood Award, sometimes called the alternative Nobel Prize for lives well lived, his little community gives small grants to independent science and, after the March 11th triple disaster, they, the Citizens' Nuclear Information Center (www.cnic.jp) were some of the very few independent experts who could understand what was happening and counter the official government-corporate assurances that nothing was wrong. On one hand, citizen science might be understood as the most secular conclusion to the idea of the rational scientist, but on the other was Takagi's Buddhist ethic of reverence for all life, which came through less in some kind of religionist practice than in his love of the Buddhist Japanese writer Miyazawa Kenji, who died in 1937 and did not see the destruction of August 1945. But we have seen it and we must learn to see it from below the mushroom cloud. And remember.

Undertaking Global Health Issues through Research and Innovation

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Abstract

There is an estimated 8.2 million under –five child deaths per year, and from this number, 3.3 million occur during the neonatal period – babies in their first 28 dyas of life. Around 66.67% of these newborn deaths are preventable if effective health interventions are provided at birth & during the first week of life.Moreover, maternal mortality is exceesively high, around 830 women die daily from preganancy or childbirth - related complications globally and these deaths could have been prevented. The aim of this study is to identify the contributory factors of maternal and neonatal mortality globally and to determine interventions in addressing these global health issues. Meta – analysis showed that the contibutory factors of both maternal & neonatal deaths include LACK, this is an acronym, which stands for L- location, A – age, C – cultural beliefs, and K – knowledge deficit.For the location, it has been validated by published researches that the distance of the home residence among pregnant mothers would greatly affect their utilization of maternal health care services, as to age, it has been found out that extreme age, adolescents (13 – 17 years old) and 42 years old and above have been associated with both high maternal & neonatal deaths, in addition, cultural beliefs was the priority measure that pregnant mothers would embrace in dealing with their pregnancy problems, and employing health care services would be their last resort, regarding knowledge , it has been revealed that insuffient knowledge of mothers on the complication of pregnancy and the importance of pre natal check up affects their utilization of health care services, furthermore, deficient knowldge of the health care providers also contributed to the increasing maternal & neonatal deaths. For the interventions, HEALTH should be implemented, H – stands for health education, educating mothers, families, communities on the importance of pre- natal and post – natal check – up, nutrition, exclusive breastfeeding, complications of pregnancy, would change the mothers behavior, there will be improvement in their utilization of health care services, educating health care providers through trainings, seminars and workshops, E – stands for empowerment , building capacities of mothers families and comminity, A stands for access, health care insurance should be provided to all mothers, focusing on those living in the remote areas, establishing birth camps should also be introduced to those far away areas, E also refers to the implementation of

Essential Intrapartum Newborn Care, L – stands for leadership and governance, which specifically comprised five (5) equally important variables, and these include, transparency & accountability, community participation, fair access to quality care, increase coverage of skilled care at birth in health facilities, and sustainable programs, T – stands for technology, all health care facilities should be equipped with sufficient supply of medicines, devices, laboratory agents, equipments for medical and surgical procedures, laslty, H – stands for home visits, health care providers should visit the mothers and their newborn on the first day, third day and seventh day after delivery, to thoroughly assess the mothers and their babies , to be able to address any untoward complcations. Employing the HEALTH interventions may be able to solve the maternal and neonatal deaths.

Keywords: Location, access, cultural beliefs, knowledge, health education, empowerment, essential intrapartum newborn care, leadership & governance, technology, home visits, maternal & neonatal deaths

Climate Change: Its danger for our production and why it escapes our prediction

Cornelis Johan (Keess) Stigter
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Abstract

Our planet earth has a unique but complicated climate that presently is changing due to the influence that our (mankind's) activities appear to have on the composition of its atmosphere. It is called anthropogenic (man made) climate change. The world's agricultural systems face an uphill struggle in feeding a projected nine to ten billion people by 2050. Climate change introduces a significant hurdle in this struggle. There is general and widely held scientific consensus that the observed trends in atmospheric & ocean temperature, sea ice, glaciers as well as climate extremes, during the last hundred years, cannot be explained solely by natural climate processes and so reflect human influences. The argument that what we experience could be natural climate change can also be refuted by the fact that present understanding of cyclic climatology of the past points to a cooling planet without the presence of mankind. On the simplest level, the weather is what is happening in the atmosphere at any given time. The climate, in a narrow sense, can be considered as the "average weather". In a more scientifically accurate way, it can be defined as: "the statistical description in terms of the mean and variability of relevant quantities over a period of time". One may argue that "global warming" is like "ageing": You can reduce the consequences but it will continue to happen. Stopping it is impossible, so adaptation is necessary.

SCIENCE and ENGINEERING CHAPTER

Experimental Study on Cooling of Solar Panel Using Airas Cooling Medium

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Abstract

Utilization of solar panels as electricity power supply shows an increased tendencies. Nevertheless, solar panels seem to have efficiency problem. Particularly, at a higher level of solar radiation absorption, therefore, solar panel temperature increased above its maximum allowed temperature. This has caused solar panel to produce smaller amount of energy compared to its operational temperature during mild wheater day. During this research, a testing device to study the cooling of solar panels using air coolant has been assembled. Solar panel used in this study is measured to have 839 mm in length, 537 mm wide, and 50 mm thick, with maximum output power at 50 W. This study utilized two solar panels, where one panel was leave without cooling system while the other one is cooled with air. Solar panels is mounted at 15^{o} inclination, air is supplied at various speed ranged at 1 to 2 meter per second using 3W air blower. There are several variables on solar panel was measured, they are, temperature of solar panel at air inlet and outlet, surface temperature, voltage and current output from solar panel, wind speed around solar panel, and solar radiation. The study is conducted during daytime between 09.00 to 17.00 o'clock local time. It has been resulted that maximum surface temperature inside solar panel without cooling system ranged between 46-49 ^{o}C, and electrical efficiency ranged between 6.1 to 6.7 %. Meanwhile, at solar panel with air cooling system, maximum temperature is achieved at 42^{o}C, and its efficiency increased to 7.0-7.8%. Therefore, the study concluded that air cooling system is able to increase output power and efficiency of solar panel.

Keywords: Surface temperature, solar panel, electrical efficiency, cooling, air flow.

Introduction

During the last couple of years, many countries has utilize renewable energy power supply extensively. Solar panel or photovoltaic cell (PV cell) is one of the most popular products in this field. Solar panel equipped with PV cell, has the capability to directly convert solar radiation into electricity, which in turn

used as daily power source to energize the household, road lamps, and water pumps. Unfortunately, during the operation of solar panel, only 15% of solar radiation is converted into electricity while the other 85% is converted into heat, therefore, electricity efficiency is decreased when temperature is increased significantly.

Many researches have been conducted to lowered surface temperature of solar panel in order to increase its efficiency. Generally, surface temperature is decreased using air or water as coolant medium. Some of them were aimed to understand how to decrease device price by merging PV panel with thermal system, where thermal energy taken from PV cooling system is utilized by another application at lower temperature. The result from modified configuration of PV panels using such cooling system is reported by Dubey et al. (2009), which show that by merging solar panel with air collector has results a rated efficiency of system ranged from 9.75 % to 10.41%.

Tiwari (2007) has conducted experimental research and numerical simulation to evaluate the performance of PV/T air collector (equipped and non-equipped with glass casing, with and without tedlar). The results show that PV/T air collector without tedlar has shown better performance.

Garg and Adhikari (1999) have developed a computer simulation model to study the impact of absorber on solar collector efficiency. The analysis shows that the efficiency of solar collector absorber that is not laminated with solar cell is higher compared to the laminated one. This was merely caused by radiation received by solar cell layer was converted into electricity.

Zondag, et.al (2003) has conducted test and evaluation on nine prototype of modified PV/T, and the result shows that there was a decreased of solar panel temperature will increase the efficiency more than 50%. Infield, et.al (2004), conducted a study to lowered solar panel temperature by channelling air between two layers of glass casing during heating process.

Joshi and Tiwari (2007), has analysed on air collector PV/T system that was connected in series. The analysis was validated by experimental data which show that total efficiency of the system was reduced due to module length as a result of overall process of system efficiency.

In this research, it has been developed a PV cooling system utilizing air as cooling medium. The research was conducted based on local climate situation in Langsa City Town Province Aceh.

Materials and Methods

To conduct this research, it has been designed and fabricated a test unit which is suitable to study the impact of air cooling on PV panel performance in term of electricity efficiency.

PV panels used in this study are *50 Watt Photovoltaic Module*, with *nitride multi crystalline silicon cells.* The panels are 839 mm length, 537 mm wides, and 50 mm thick. To cool PV panels, air has been used as a cooling medium which was channelling in from top of PV panel and flow out below the panel. The shape and dimension of air channel of PV panel cooling system is shown in in Figure 1.

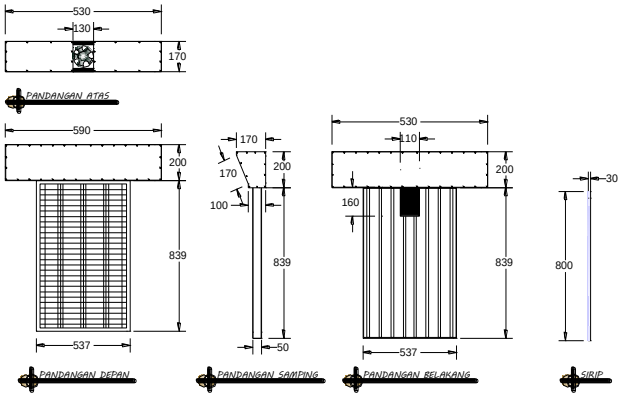

Figure 1. PV panels equipped by air cooling channel.

The observation was conducted in an open field inside University of Samudra, Kota Langsa Province Aceh, on June 26-29 2014 starting from 09.00 to 17.00 at local time.

To gain related information about the impact of air cooling on PV panels, there was also similar test conducted to PV panel that has not been equipped with air cooling systems shown in Figure 2.

Figure 2. Solar panel used during the study

Variables measured in this research includes top and back surface temperature of PV panels, inlet and outlet temperature of cooling system, ambience temperature, speed of air from inlet an outlet channel, and intensity of solar radiation, voltage and current produced by PV panels. Air to cool this system as channelling using 3W *fan*. Outlet speed of air was set at 1-2 m/s. And air flow acceleration (m) was calculated with eq. 1:

$$m = \rho_{air}.A_s.V_{air} \qquad (1)$$

Electric efficiency (η_e) of PV panel was determined using following equation:

$$\eta_e = \eta_o\left[1 - \beta\left(T_p - T_r\right)\right] \qquad (2)$$

Standard electric efficiency (η_o) is calculated with:

$$\eta_o = \frac{V_m I_m}{G A_p} \; x \; 100\ \% \qquad (3)$$

And thermal efficiency of PV panel with air cooling system was calculated with following equation:

$$\eta_{th} = \frac{m\, C_p (T_o - T_i)}{A_p G} \; x \; 100\ \% \qquad (4)$$

Result and Discussion

The result of observation conducted on June 28 2014, that the changes of PV panel surface temperature, which solar radiation intensity for PV panel with and without air cooling mechanism is shown in figure 3. The graphic shows that maximum intensity of solar radiation was achieved at 12.00 o'clock which is at 732 W/m^2, followed by maximum temperature of PV panel surface without cooling system at 52.1 ^{o}C. While rated temperature was ranged between 46 to 49 ^{o}C. This also in line according to solar radiation intensity. Significant impact of lowering surface temperature is shown during air cooling, where maximum temperature was only at 42 ^{o}C. As comparison, PV panel without cooling system recorded that during 09.00 to 12.00 o'clock, the temperature was rise up to 24^{o}C, while PV panels with cooling system only 14^{o}C. This emphasized that test device is working properly.

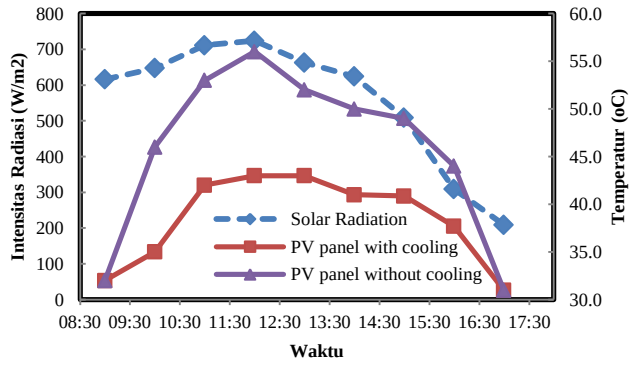

Figure 3. Result of temperature change at PV panel surface and solar radiation intensity.

Figure 4, shows the relation between radiation intensity to the increase of surface temperature of PV panel. The graphic indicated that both panel shows an increased value as the increase of solar radiation received by PV panels. For PV panels without cooling system, there are rapid increment of surface temperature compared to PV panel equipped with cooling system.

Figure 4, shows the impact of surface temperature of PV panel on PV electricity efficiency. Electricity efficiency was determined using eq. (2) and (3). The graphic shows that electricity efficiency of PV panel without cooling system is ranged between 6.1 % - 6.5 %. While for PV panel with air cooling system the efficiency is ranged at 7.0 % - 7.8 %. This proved that air cooling is capable to increase the efficiency of PV panel.

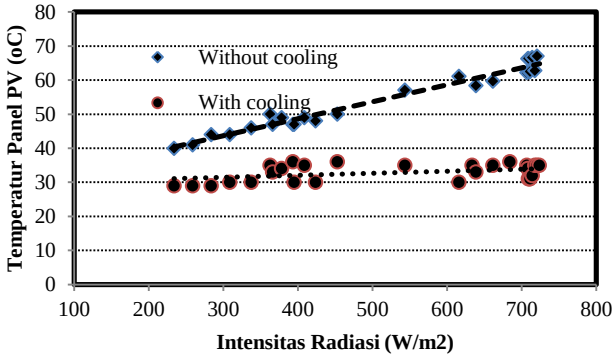

Figure 4. The relation of surface temperature of PV panel with solar radiation intensity

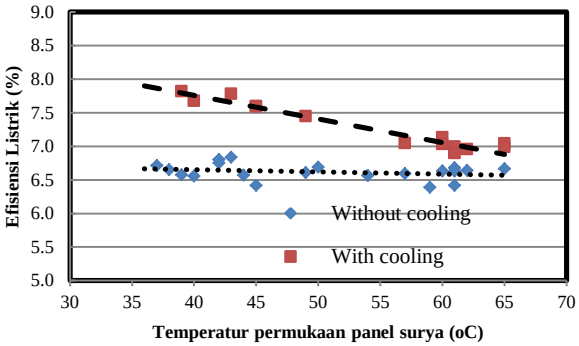

Figure 5. Relation of electrical efficiency with PV panels surface temperature.

The result is calculated using eq. (1) and (4), based on observation data result on June 28 2014, with mass air flow acceleration is 0,052 kg/s, it has been resulted that maximum thermal efficiency is 42.2%.

Conclusion

During this research, the study of PV panel cooling system using air as cooling medium has been conducted. The result is also compared with the performance of PV panel without cooling system. This study shows that maximum efficiency of PV panel without cooling system is 6.7% at surface temperature 40°C and the value is decreased as the PV surface temperature is increased. The maximum efficiency of PV panel with air cooling system is about 7.8% at surface temperature 40°C. While system thermal efficiency is 42.2 % with mass air flow acceleration maintain at 0.052 kg/s. this research concluded that cooling system is working properly to keep PV panel works at its best performance.

Nomenclatures

A	Area(m^2)
G	Radiation intensity (W/m^2)
T	Temperature
m	Mass air flow acceleration (kg/s)
Cp	Air specific heat (kJ/kg.°C)
V	Voltage(Volt)
I	Current(ampere)

- T_r Referencetemperature = 25 ^oC

Greek letters

- β Temperature coefficient(1/^oC)
- η Efficiency (-)

Subscripts

s Air inlet
p PV panel
c Panel
i In
o Out
m Maximum

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Surface Roughness Optimizationin Machining of Face Turning

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Abstract

Surface finish is one of the prime requirements of customers for machined parts. The purpose of this research paper is focused on the analysis of optimum cutting conditions to get lowest surface roughness in facing by regression analysis. This present paper presents an experimental study to investigate the effects of cutting parameters like pindle speed, feed and depth of cut on surface finish on EN-8. A multiple regression analysis (RA) using analysis of variance is conducted to determine the performance of experimental measurements and to it shows the effect of cutting parameters on the surface roughness. Multiple regression modeling was performed to predict the surface roughness by using machining parameters. The investigation of influence of cutting conditions in facing operation of EN-8 in this paper. Machining was done using cemented carbide insert. The objective was to establish correlation between cutting speed, feed rate and depth of cut and optimize the turning conditions based on surface roughness. These correlations are obtained by multiple regression analysis (RA).

Key words: Machining, Dry Facing, EN-8, Surface roughness, Regression analysis (RA)

Introduction

Surface roughness has received serious attention form years. It has formulated an important design feature in many situations such as parts subject to fatigue loads, precisión fits, fastener holes, and a esthetic requirements. In addition to tolerances, surface roughness imposes one of the most critical constraints for the selection of machines and cutting parameters in process planning (Feng and Wang, 2002). Surface finish is the method of measuring the quality of a product and is an important parameter in machining process. It is one of the prime requirements of customers for machined parts. Productivity is also necessary to fulfill the customers demand. For this purpose quality of a product and productivity should be high. In addition to the surface finish quality is also an important characteristic in turning operation and high MRR is always desirable (Singh *et al.* 2011). Even in the occurrence of chatter or vibrations of the machine tool, defects in the structure of the work material, wear of tool, or irregularities of

chip formation contribute to the surface damage in practice during machining (Boothroyd and Knight, 1989).

Facing is the process of removing metal from the end of a work piece to produce a flat surface. Most often, the work piece is cylindrical, but using a 4-jaw chuck you can face rectangular or odd-shaped work to form cubes and other non-cylindrical shapes. When a lathe cutting tool removes metal it applies considerable tangential (i.e. lateral or sideways) forcé to the work piece. To safely perform a facing operation the end of the work piece must be positioned close to the jaws of the chuck. The work piece should not extend more than 2-3 times its diameter from the chuck jaws unless a steady rest is used to support the free end.

Materials and Methods

Procedure

The experiment was conducted using one work piece material namely EN-8 with coated ceramic tool. The cutting parameters are shown in the Table 1. Three levels of cutting speed, three levels of feed and three levels of depth of cut were used and are shown in the Table 1. The different alloy in elements present in a work piece and cutting insert are shown in the Table 2 & 3.

Table 1. Cutting parameters

Cutting parameters	Level 1	Level 2	Level 3
Cutting speed (rpm)	100	360	560
Feed (mm/rev)	0.14	0.15	0.16
Depth of cut (mm)	0.50	1.00	1.50

Table 2. Chemical composition of EN-8.

C	Si	Mn	S	P
0.4%	0.25%	0.8%	0.015%	0.015%

Table 3. Typical composition of Cemented Carbide cutting

Co	TiC	WC
8%	15%	77%

The dependent variable is surface roughness. In total 27 experiments were conducted and responses are shown in the Table 4. It gives the various cutting parameters for each experiment the results are measured and shown in the last column of the same Table 4. The different units used here are cutting speed (rpm) Feed-(mm/rev), depth of cut (DOC) – mm, surface roughness Ra -µm. Mini-Tab software was used for Regression analysis. Dry Facing process was used.

Results and Discussion

It is used to investigate and model the relationship between a response variable and one or more predictors. Minitab provides least square, partial least square and logistic regression procedures. A multiple regression analysis was conducted on the tested data. Coefficients of The analysis of variance results of the regression model also supported linear relationships in the model (Table 5)

Table 4. Values of Predicted Surface Roughness and error

No	Speed N(rpm)	Feed (mm/rev)	DOC (mm)	Ra (μm)	*Predicted* Ra (μm)	*Residuals*
1	100	0.14	0.5	4.98	4.9724	0.0076
2	100	0.14	1	5.3	5.2519	0.0481
3	100	0.14	1.5	5.44	5.5313	-0.091
4	100	0.15	0.5	4.49	4.6569	-0.167
5	100	0.15	1	5.01	4.9363	0.0737
6	100	0.15	1.5	5.34	5.2158	0.1242
7	100	0.16	0.5	4.33	4.3413	-0.011
8	100	0.16	1	4.59	4.6208	-0.031
9	100	0.16	1.5	4.88	4.9002	-0.02
10	360	0.14	0.5	3.81	3.7346	0.0754
11	360	0.14	1	3.97	4.014	-0.044
12	360	0.14	1.5	4.28	4.2935	-0.013
13	360	0.15	0.5	3.46	3.419	0.041
14	360	0.15	1	3.69	3.6985	-0.008
15	360	0.15	1.5	4.01	3.9779	0.0321
16	360	0.16	0.5	3.15	3.1035	0.0465
17	360	0.16	1	3.41	3.3829	0.0271
18	360	0.16	1.5	3.66	3.6624	-0.002
19	560	0.14	0.5	2.73	2.7824	-0.052
20	560	0.14	1	3.11	3.0619	0.0481
21	560	0.14	1.5	3.37	3.3413	0.0287
22	560	0.15	0.5	2.42	2.4669	-0.047
23	560	0.15	1	2.73	2.7463	-0.016
24	560	0.15	1.5	2.98	3.0258	-0.046
25	560	0.16	0.5	2.18	2.1513	0.0287
26	560	0.16	1	2.49	2.4308	0.0592
27	560	0.16	1.5	2.62	2.7102	-0.09

Table 5. Analysis of Variance

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.5868	0.2334	41.0689	5.017E-23
Speed N(rpm	-0.0048	6.64E-05	-71.6263	1.542E-28
Feed (mm/rev)	-31.5556	1.5330	-20.5829	2.582E-16
DOC (mm)	0.55889	0.0306	18.2275	3.618E-15

S = 0.0650437 R-Sq = 99.6% R-Sq (adj) = 99.6%

PRESS = 0.137065 R-Sq (pred) = 99.45%

Source	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	3	24.90272406	8.30090802	1962.075609	7.63936E-28
Residual	23	0.097305569	0.004230677		
Total	26	25.00002963			

Table 6. Sequential sum of squares

Source	DF	Seq SS
Spindle speed (rpm)	1	21.7048
Feed(mm/Rev)	1	1.7924
DOC (mm)	1	1.4056

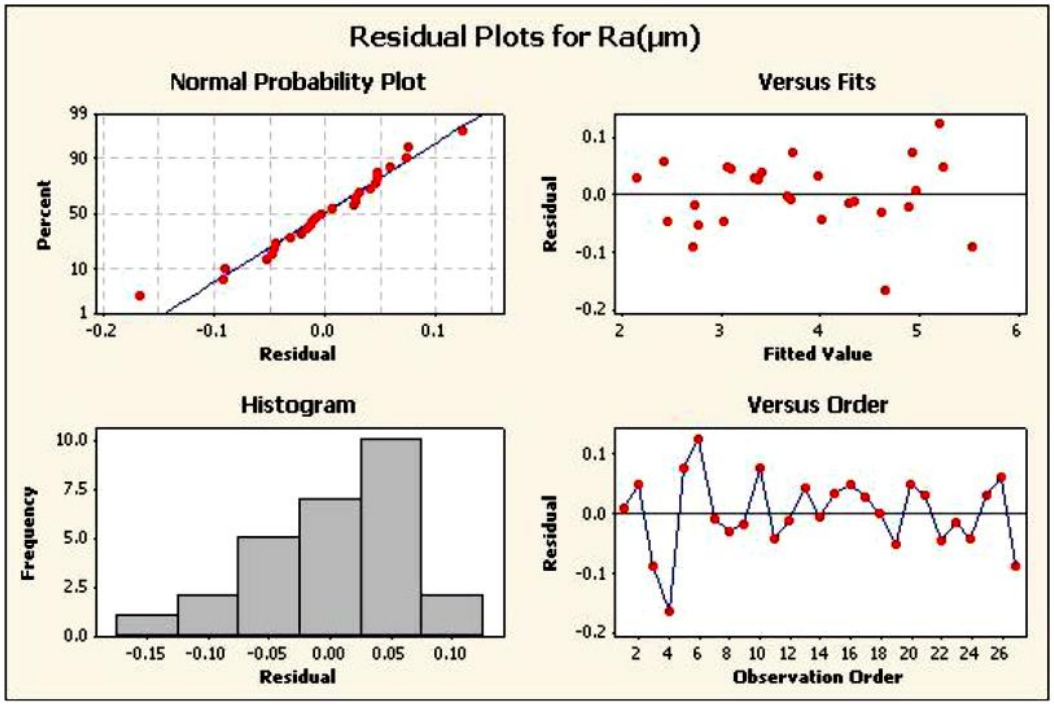


Figure 1. Residual plots for surface roughness

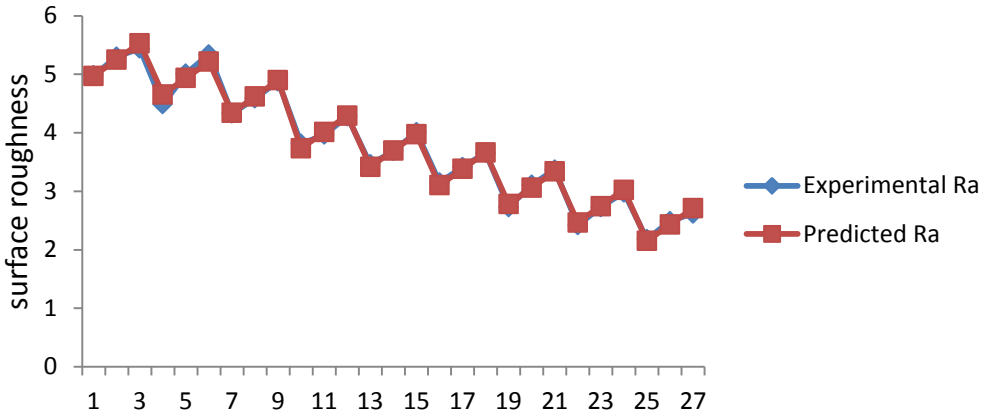
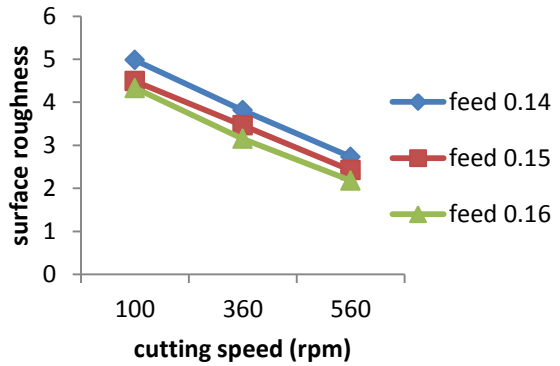
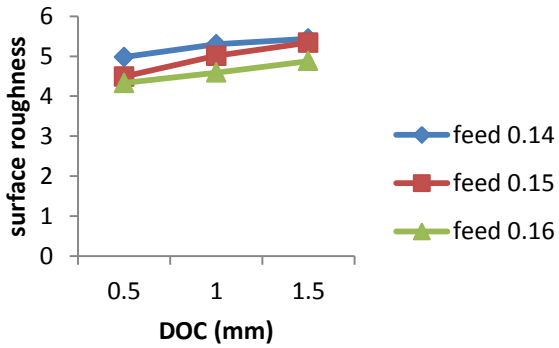


Figure 2. Comparison of Experimental surface roughness and Predicted Surface Roughness



a.



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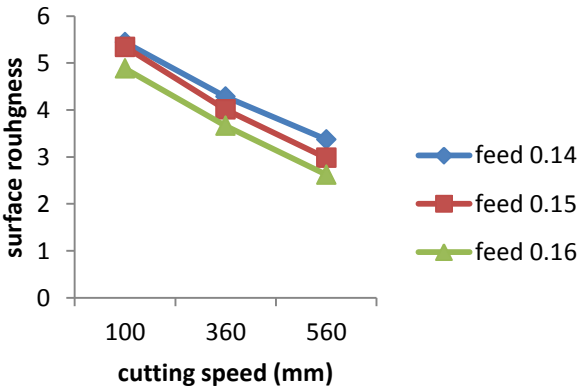

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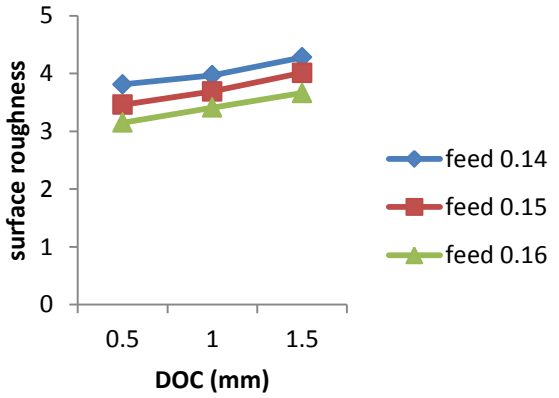

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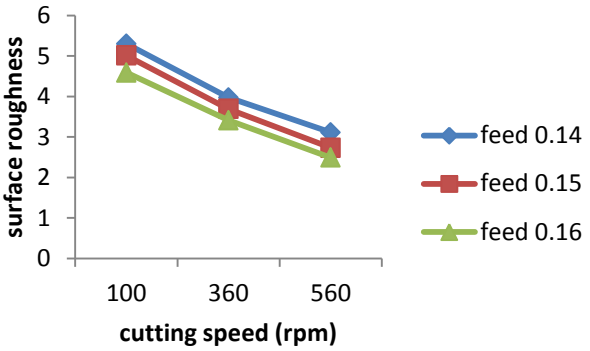

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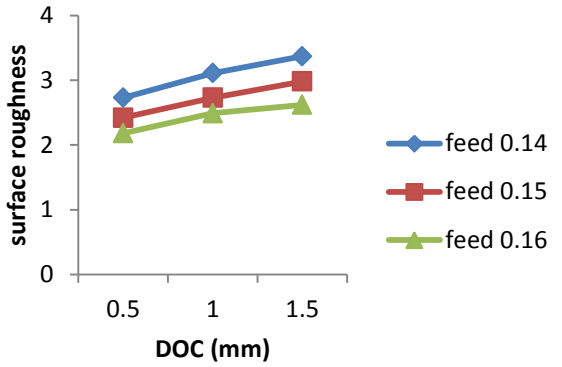

f.

Figure 3. a. Surface roughness Vs Cutting speed at Constant Depth of cut = 0.5 mm, b. Surface roughness Vs Depth of cut at Constant Cutting speed =360 rpm, c. Surface roughness Vs Depth of cut at Constant Cutting speed =100 rpm, d. Surface roughness Vs Cutting speed at Constant Depth of cut = 1.5 mm, e. Surface roughness Vs Cutting speed at Constant Depth of cut = 1 mm, f. Surface roughness Vs Depth of cut at Constant Cutting speed =560 rpm.

Conclusions

In this paper the effect of machining parameters speed, feed, depth of cut, were studied on surface roughness for face turning operation using EN-8. Regression Analyses (RA) technique was used to study the effect of these parameters and their interaction on surface roughness. An empirical equation was formed by using Regression Analyses (RA) in Mini-Tab software to predict the surface roughness. The surface roughness model produced during this research work may be used in enhancing the surface quality of a product as cutting parameters were optimized and can give better surface finish. In this paper observed the results the influence of cutting speed and feed rate and depth of cut on surface roughness, the test was performed and it was seen that the effect of feed rate is greater than the effect of cutting speed. The feed has the variable effect on surface roughness. The relationship between feed rate and surface roughness is proportional, figure 3 shows the relation that increasing the feed rate, increases the surface roughness. On surface roughness, the effect of feed rate is more considerable tan cutting speed.

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Design and Development of Micro Hydropower By Using Pump Centrifugal To Supply The Water Into Turbin

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Abstract

The development of alternative energy sources such as harnessing the water to be a potential energy. It is really useful that can be applied to obtain electrical energy on a micro or pico watts. The research development makes the water possible to do conceptually where the potential energy from the water can be made easily as micro hydro power plant. This is a power plant generator that utilizes the current circulation of water as a source of driving force. Conversion of water resources into electrical energy are done by utilizing water pump centrifugal equipment. Micro hydro power plant is designed for using numerical method. Based on mathematical analysis shows the potential power of water able to held water pump centrifugal until 1024.4 Watt and turbine power potential has 816.2 Watt Head. H 80 m and water discharge Q 80 liters per minute. From the results of research at a pressure of 35 lb/in^2 to obtained water discharge 89 litres per minute, rotation turbine generator 430 rpm and 810 rpm rotation. While the voltage of 185.8 volts generator resurrected at 192.5 Watt load electric power alternating current,

Key words: Micro hydropower, hydropower potential and hydropower turbine potential.

Introduction

Today, the developments of alternative energy in any sources are seeking such as harnessing the energy from the water into potential energy. It has a potential that can be applied to obtain electrical energy on a micro or pico watts. Micro hydropower plant based on the water pump that is done regularly by using the generator power plants. That utilizes circulating water flows as the driving source. Currents flowing water has the energy that can be used to rotate the turbine wheel. Generally pumps driven by electric motors to increase the amount of water up to a certain level. In this application, water pump centrifugal is used to

increase the rate of water flow (water flow), Q (m^3/sec) and total head, H high (meter) is used to drive a turbine electric generator, so as to revolve round the nominal generator.

Potential Energy Resources on Centrifugal Pump

The pump is one type of machine that is used to move liquids from one place to the desired place. At the pump will be a change of the mechanical energy into fluid energy. This fluid energy is called head or energy unity heavy liquid. There are three forms of head undergoing changes that head press, speed and potential. Figure 1 shows a water pump centrifugal is used in this study. Data mechanical water pump centrifugal is used maximum flow rate, Q=100 l/m and Head total, H=100 m, and the data electric water pump centrifugal is real power, P=1050 watts and voltage, V= 220 Volt.

Figure 1. Water pump centrifugal

Based on data from the pump, water velocity can be determined by the equation (Nasir, 2013).

$$C = \frac{Q}{A} \quad m/det \qquad (1)$$

So the potential hydropowers that can be generated are: (Steffi *at al.,* 2011)

$$P_H = \rho * g * H * Q \quad Watt \qquad (2)$$

Hydropower Turbine

The hydropower turbine is a turbine which water has function as the fluid. Turbine change or convert the potential energy of water into mechanical form of rotation of the turbine shaft. The turbine shaft rotation that will be passed to rotate the shaft generator, so that it can be developed electrical energy in a generator. Figure 2 shows the pelton turbine models (Nasir, 2013).

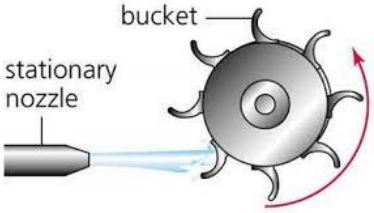

Figure 2. The pelton turbine models

At these micro hydropower plants, the type of turbine is used pelton turbines. The selection of using the turbine is based on the type of turbine specific speed turbine specific speed turbine which is obtained by the equation:

$$N_s = n * \frac{\sqrt{Q}}{H^{\frac{5}{4}}} \quad \text{Per-minute} \qquad (3)$$

So the selection of the turbine can be determined according to Table 1 is the type of turbine that based on the specific speed (Nasir, 2013).

Table 1. Turbines based on its specific speed

Type of Turbines	The specific Speed (N_S) rpm
Crossflow	40≤Ns≤200
Francis	60≤Ns≤300
Pelton	12≤Ns≤25
Kaplan dan Propeller	250≤Ns≤1000

To obtain the hydropower turbine potential can be used the equation: (S. J. Williamson *at al.*, 2011)

$$P_{net} = \rho * g * H * Q * n \quad Watt \qquad (4)$$

and Table 2 shows the classification of hydropower plants.

Table 2. Classification of hydropower plants

Term	Power Output
Pico hydropower	< 500 W
Micro hydropower	0.5 – 100 kW
Mini hydropower (MHP)	100 – 1000 kW
Small hydropower (SHP)	1 MW – 10 MW
Hydropower Big Scale	>10 MW

Dimensions of Turbine

In the research prototype hydropower by utilizing the kinetic energy of water for lighting (Winanti *et al*, 2014), mentions the main dimensions pelton turbines include:

- The outside diameter turbine
- The inner diameter turbine
- The number and diameter of the nozzle
- The number, width, height, curvature and thickness turbine bucket
- The diameter shaft

In this research, the main dimensions of the turbine pelton namely:

- The outside diameter turbin =340 mm
- The inner diameter turbine =224 mm
- The diameter runner turbine =300 mm
- The number of nozzle =1

- The diameter nozzle =10 mm
- The number of bucket =20
- The width turbine bucket =30 mm
- The high turbine bucket =72.3 mm
- The curvature of the turbine bucket =65 mm
- The distance between the turbine bucket =35 mm
- The thick turbine bucket =10 mm
- The turbine shaft diameter =19.05 mm

Power Generation Systems

Electric generating system functioning electrical energy through a variety of power plants. At the micro hydropower plants, the source of the water kinetic energy is converted into mechanical energy in the form of speed and then changed again into electrical energy by a generator. Speed synchronous generator will be affected the frequency of the electrical generator. An installed power capacity of the generator is equal to 1 kW voltage of 220 Volt single phases. Figure 3 shows the construction of an alternating current generator. (Yadav and Chauchan, 2014)

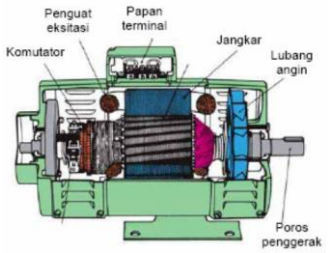

Figure 3. The construction of an alternating current generator

Materials and Methods

In this study, prototype micro hydropower plant has developed by using the numerical method. So the design of this system include:

1. The design of mechanical micro hydro system;
2. The design of turbines.

Figure 4. Mechanical design for micro hydro system

Mathematical Analysis

Based on technical data obtained by a water pump centrifugal velocity, (equation 1) for:

$$C = \frac{Q}{A} = \frac{0.0013}{1{,}83*10^{-7}} = 7103.8 \quad m/det$$

So the potential hydropower that can be generated are (equation 2):

$$P_H = \rho * g * H * Q = 1000 * 9.81 * 0.0013 * 80 = 1020.4 \quad Watt$$

Calculation of the specific speed of the turbine is obtained by equation (3):

$$P_{nt} = \rho * g * H * Q * \eta = 1000 * 9.81 * 0.0013 * 80 * 0.8 = 816.2 \quad Watt$$

Calculation of the specific speed of the turbine is obtained by equation (4), namely:

$$N_s = 3000 * \frac{\sqrt{0.0013}}{80^{\frac{5}{4}}} = 4.043 \quad \text{Per-minute}$$

From the calculation of the specific speed of the turbine, then the selection of the type of turbine is used pelton turbines. Because based on Table 1 only pelton turbine which has a specific speed (Ns) that is below 12 rpm. Table 2 classifications and based on hydropower plants, power plants can be classified as micro hydropower plants where power output is 0.5 to 100 kW.

Analysis Of Measurement

To obtain the physical and electrical quantities of system performance micro hydropower plants, several measurements were performed, such as:

- Measurement of pressure;
- Measurement of flow rate;
- Measurement of electrical power water pump centrifugal:
  - Voltage
  - Current
  - Real power
  - Power factor
  - Frequency
- Measurement of turbine rotation
- Measurement of the electrical power output of generator:
  - Voltage
  - Current
  - Real power
  - Power factor
  - Frequency
  - Rotation

Table 3 shows the results of measurements of flow rate, turbine rotation, water pump centrifugal electric power and generator power on the set pressure.

Table 3. Results of the measurement of flow rate, turbine rotation, water pump centrifugal electric power and power generator

Calculation of Analysis	Pressure (p) (lb/in²)					
	5	10	15	20	25	35
Flow rate (lpm)	55	68	76	79	83	89
Centrifugal Water Pump:						
Voltage (Volt)	215.5	214.5	214.6	214.3	213.2	224.6
Current (Ampere)	5.11	5.35	5.6	5.78	5.95	6.10
Real power (Watt)	1069	1133	1188	1227	1260	1342
Power factor (Cos phi)	0.97	0.99	0.98	0.99	0.99	0.98
Frequency (Hz)	50.1	50.1	50.1	50.1	50.1	50.1
Turbin:						
Rotation (rpm)	350	355	358	360	400	430
Generator:						
Voltage (Volt)	145.5	155.3	158.3	163.1	170.3	185.8
Current (Ampere)	1.1	1.3	1.4	1.38	1.45	1.52
Real power (Watt)	105.6	133.4	146.4	147.2	163.6	192.5
Power factor (Cos phi)	0.66	0.66	0.66	0.66	0.67	0.68
Frequency (Hz)	38.4	39.3	42.5	42.6	43.1	45.7
Rotation (rpm)	700	720	728	740	760	810

Figure 5 shows the curve of the pressure different of discharge water, turbine rotation and generator. In the water pressure measurement 5-35 Lb/in² obtain and significant change in the flow rate that is 55-89 liter per minute.

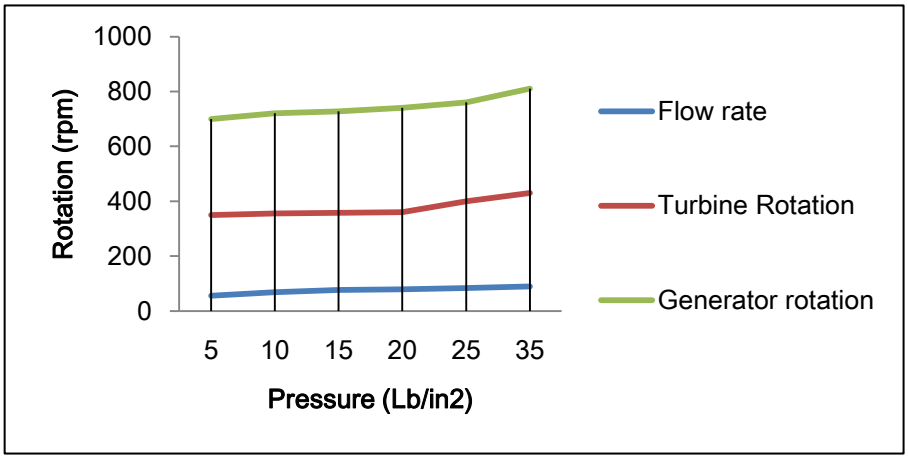

Figure 5. Curve pressure different

From the measurement results show that obtains an high is charge value at 89 liters per minute requires high pressure stream of water that is 35 lb/in^2, so that the turbine wheel can be reached 430 rpm, 810 rpm generator rotation. Voltage generator resurrected to reach 185.8 Voltage and real power 192.5 Watt.

Conclusion

From the results of the mathematical analysis on the head, H=80m and discharge water pump centrifugal, Q= 0.0013 m^3/s can be concluded:

1. Has the potential hydropower=1020.4 Watt;
2. Has the potential turbine power=816.2 Watt;
3. The specific speed turbine=4.043 per minute;
4. The type of turbine used is pelton turbines;
5. Microhydropower plants.

And based on analysis of the pressure measurement 35 Lb/in^2 obtained:

1. Flow rate =89 liter-perminute;
2. Turbine rotation =430 rpm;
3. Generator rotation =810 rpm;
4. The voltage generator =185.8 Volt;
5. Real power =192.5 Watt.

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On this occasion the authors would like to thank for P2M Unit Ministry for Research and Technology and Higher Education and Lhokseumawe state of Polytechnic who give support this research.

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Experimental Study On Mechanical Properties Of Wood Flour Polyester Sandwich Composite Reinforced With Glass Fiber

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Abstratc

The use of wood floor (WF) as filler in thermoset polyester composites has some advantageous because it is cheap and abundant, mild, not abrasive, and environmentally friendly. Then some of these advantages will be explored in depth in this study to produce innovative sandwich composite materials and meet the requirements of engineering and mechanical properties as construction material for various purposes. Study of mechanical properties will be focused on the preparatory process of the wood floor until the formation of a composite sandwich. Manufacture and testing of the mechanical properties specimens made by using the ASTM C 1341-06 (3-point bending test). The results showed that the treatment process at the wood floor (alkali treatment and borax) and the addition of coupling agent MAH did not have a positive influence on the mechanical properties of wood floor polyester composite. The soft wood filler (Jeumpa and Damasui) with the medium to coarse size of filler and the composition within ± 60% polyester resin has the best bending strength. So the size factors, dimensions and type of wood floor as filler has the influence on the mechanical properties, where the filler size of 2-3 mm eligible as economically and technically to be used. While wood floor composite reinforcement with glass fibers as the sandwich type has been able to increase its bending strength up to ± 45% and making this material allows it to be used as construction material. The types of glass fibers also have an effect, in which the type of woven glass fiber (rovings) has a reinforcing effect that up to 45% better than glass fiber type CSM, but use 2 layers of fiber CSM, gains almost the same as the first layer Roving glass fiber type.

Key words: Wood floor (WF), Polyester Composite, Mechanical Properties, Treatment, glass fiber, sandwich.

Introduction

Throughout the human history, wood has been used widely in almost all facets of human life both for structural or non-structural purposes such as housing, furnishings, bridge structures, vehicles, boats,

ships, railroads, paper materials, etc. As a result the wood always sought to meet the needs of various sectors so that due to an imbalance of demand and supply, wood with the good quality become expensive and scarce. Then the engineer looking for some alternatives material that design base on the wood into the alternative solutions are constantly being developed to meet the increasing demands. The wood composite is one of the products that are made, wherein the wood in various forms (powder, wood fiber, sheet) at the join using an adhesive to form a new material in the form such as particle board, fiber board, plywood, hardboard, plywood, thermoplastic and thermoset of wood composite. The use of various types of material tailored to the needs of the product to be made that the mechanical properties (mechanical behaviour) of wood composite must be meet to the technical requirements of the product.

When compared to the fiber composites, the wood floor composite tend to be more brittle because the wood floor is lack of capability of absorbing energy as well as that carried by the fiber composite. However the wood floor that has dimension and size of longer form look like the short fibers have the energy absorption better so it is more resilient than the wood floor composite square-shaped (Cerbu and Motoc, 2010). Then create of composite sandwich between the wood floor composite as a core and a thin layer of glass fiber composites on both sides can improve the mechanical properties. The use of wood floor as filler will also improve the efficiency of wood floor utilization which has not been fully utilized and many were wasted in vain. In Aceh Province, the potency of wood floor as filler is huge, that producing by the wood processing home industry. Filler type of wood dust is very economical in its use, because it is easy to obtain and inexpensive, nature also can prevent the occurrence of slippage in the resin and can be fastened properly by resin.

Materials and Methods

The materials are used in this research is unsaturated polyester resin BQTN 157-EX, hardener peroxide. The glass fiber type of chopped strand mat (CSM) 300 gr/ m^2 and type Roving (woven) 550 gr/m^2. While the equipment used is the universal testing machine (UTM) for testing the mechanical properties, optical microscopy and high-resolution digital camera for macro photos and fractografy structure; molding, digital scales, sieves, fiber glass roller, fiberglass brush, glass Measurement and Scissors, micrometer, vernier calliper, Jig Saw machines and milling machine for the formation of the test specimen

Research Procedure

The research was designed in stages: (1) preparing an open mold and (2) Preparing the wood flour in various sizes (fine, medium, coarse to very coarse) through screening, (3) provide treatment borax alkaline and borax on the wood flour (4) preparing the unsaturated polyester resin, hardener Mekpo in the mixing container and fiber glass, (5) mixing the resin with wood flour with a volume fraction of 50:50 % volume and stir for ± 3 minutes, and then allowed to stand for ± 3 minutes so that air bubbles disappear, then mixing with hardener Mekpo as hardeners ± 1% by weight of the resin and stirred slowly for ± 1 minute, (6) to prepare the mold and molding process to produce a composite polyester sawdust, (7) the composite sandwich is made through the stages of making one layer of composite glass fiber (± 1 mm thick) on the bottom of the mold. Then a mixture of polyester resin and wood powder and hardener is

poured into the top layer of the composite polyester glass fiber with a thickness of 8 mm; then on the upper surface of the first layer of the composite made of polyester fiber glass with a thickness of 1 mm, so that the test specimen thick to 10 mm, (8) the process of hardening (curing time), which takes between 10-15 hours, until the mold can be opened. The process sequence is repeated by varying the size and type of wood powder and the type of glass fiber. Furthermore, 3-point bending test specimens were made through the process of cutting and sanding follows the standard ASTM C 1341-06 (Standard Test Method for Flexural Properties of continuos Fiber-Reinforced Advanced Ceramic Composites) with the specimen size refers to the L / D = 16/1; thickness (d) = 10 mm, support length (L) = 16 mm, length of material = 18 mm and specimen width = 20 mm.

Result and Discussion

Effect of the Alkaline and the Borax Treatment of the Woof Flour Filler on the Bending Strength of the Woof Flour Polyester Composite

The alkaline treatment is intended to improve the surface of the wood flour for improving the interface bonding with polyester resins and the borax treatment is done to preserve the wood flour. The effect of these two types of treatment on the bending strength of wood flour composite is indicated by Figure 1.

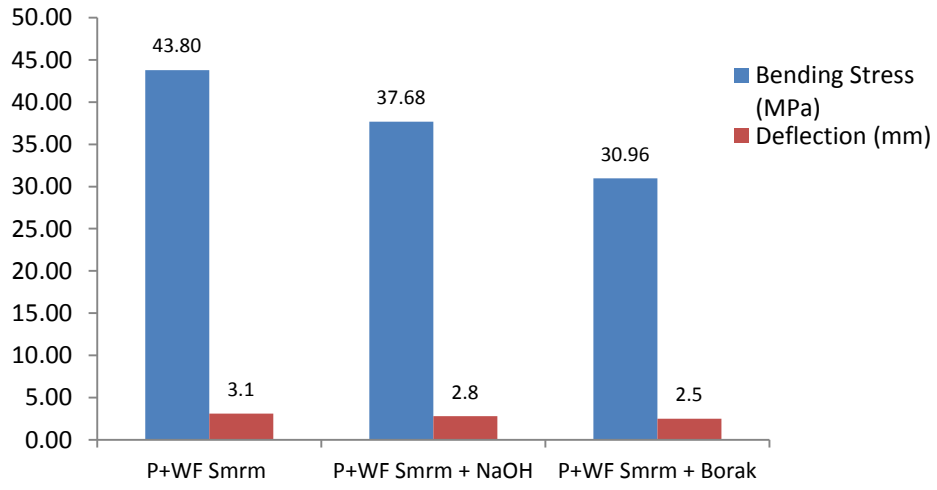


Figure 1. Effect of alkaline treatment and borax to the bending strength of polyester composite wood powder semaram (smrm).

Figure 1 illustrates that the wood flour of Seumaram polyester composite that do not undergo the process of alkaline or borax treatment have better bending strength, so it is seen that the experimental treatment on wood flour filler no positive effect fot increasing the strength of the composite material . This is related to the condition of the wood flour used is the wood flour option that has been dried naturally so that alkaline treatment to remove lignin and cellulose does not give a positive effect, even possible for damaging the structure of the wood flour filler that contributed to reduce the strength of material as

indicated in Figure 1. Economically, this is very beneficial, given the abundant and les usefull wood flour can be directly processed into wood flour composite materials without having to go through a chemical process that is expensive, but it possible to process as naturally through drying.

Effect of Size and type of wood flour as a filler on the woof flour polyester composite bending strength.

The size and dimensions of wood flour obtained from wood processing home industry in various of size and dimension. There are 4 types of the size and dimensions of wood flour in the investigation that is moderate/medium (1-2 mm), coarse (2-3 mm) and very coarse (3-5 mm) and the length dimension as shown in Figure 2.

Figure 2. Macro Structure of wood flour (WF) in square dimensions (very coarse, coarse, and medium) as well as the length and rough dimensions

The calculation of bending strength of wood flour polyester composite material used wood flour in the various sizes and a square dimension shown in Figure 3.

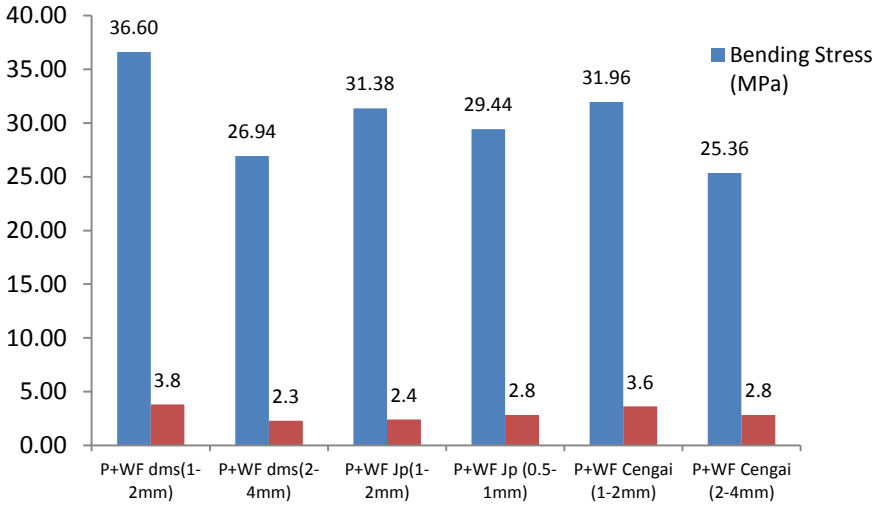


Figure 3. Effect of the size of the wood flour particles (WF) Damasui (DMS), Jeumpa (Jp) and Cengai on the bending strength of the wood flour polyester composite.

The size and type of wood flour have an effect on the strength of the wood flour polyester composite material. The types of wood flour that studied was the kind Damasui, Jeumpa as soft wood species and hardwood species as Cengai made with the composition of 50 : 50 volume percent. The wood flour of medium size (1-2 mm) and fine powder has the most strength compared to coarse wood flour. The strength of wood flour polyester composite tat use the rough of wood flour also has a pretty good strength that can be improved further through the sandwich process with the glass fiber. So that the manufacture of the wood flour polyester composite or sandwich composite with glass fiber can directly use the wood flour the wood processing home industry, without having to go through a complex treatment process such as smoothing that required an additional costs .

The influence of dimensions of wood flour

The dimensions of wood flour as the filler are investigating both a square shape and the shape resembles a short fiber length . The influence of the dimensions of wood flour on the bending strength of the wood flour polyester composite material shown in Figure 4.

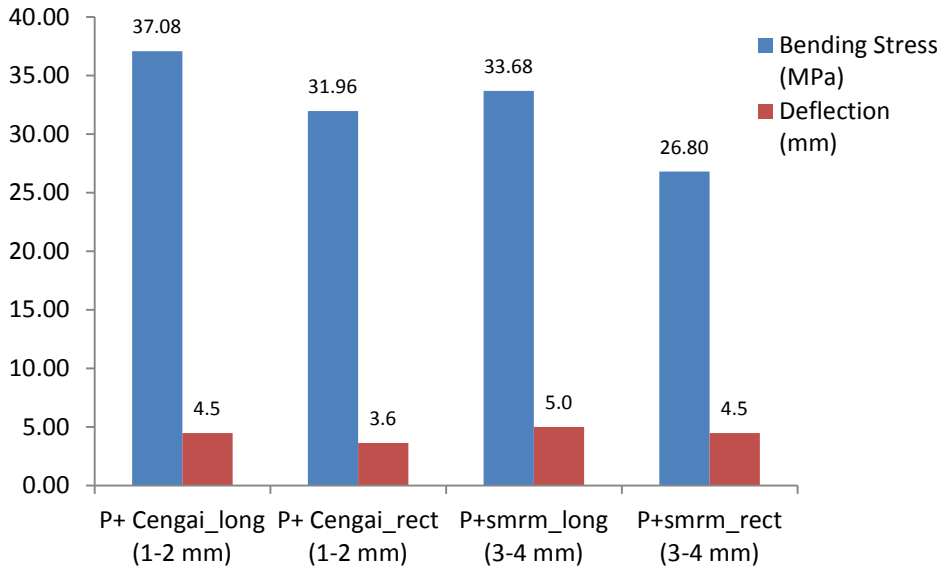
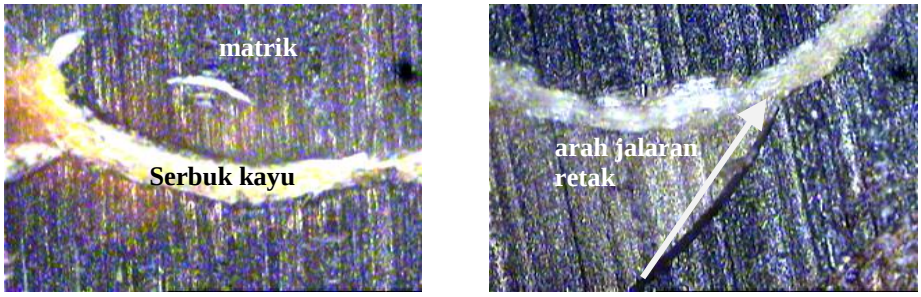


Figure 4. The influence of the dimensions of the wood flour filler of cengai and seumaram (long and square) on the bending strength of the wood flour polyester composite materials

Dimension or shape wood flour as filler has an influence on the strength of wood flour polyester composite materials, the dimensions of length and short fibers resembles coarse will produce the composites material with a more compact structure with better reinforcing effect as shown in macro structure pictures below. The specimen failure was initiated by cracks and will spread due to loading up the material to failure. The presence of wood flour as filler in length shape was possible to become an obstacle to crack propagation, or can change the direction of crack propagation. The size of the course

wood flour and the longer dimension that goes down well in the matrix will give the effect of inhibiting the propagation of cracks that make the material stronger, as shown by Figure 5.



(a) (b)

Figure 5. a) The micro structure coarse wood flour filler (100x), b) the wood flour can inhibit or change the direction of crack propagation

The fine of wood flour filler cant play a role as that of coarse and the length of wood flour filler so its existence serves as a filler rather than as reinforced as shown in Figure 6.

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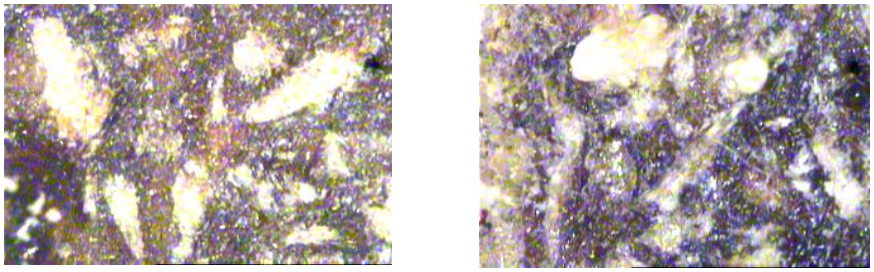

Figure 6. The distribution of the fine wood flour fillers with the square dimensions (100x)

The influence of the type of wood flour Filler

There are 5 types of wood flour filler were investigated such as: wood flour filler of Jeumpa, Meuranti, Damasui, Seumaram and Cengai. The 3 kinds the first wood flour are classified as softwood, while the latter two types are classified as hardwood. Figure 7 shows the influence of the type of the rough wood flour on the bending strength of the wood flour polyester composite materials.

Figure 7 explains that the wood flour of Jeumpa has the highest bending strength, followed by Meranti, Damasui, Seumaram and cengai. This indicates that the hard wood filler of wood flour have lower bending strength than the soft wood filler. This phenomenon is closely linked to the condition of the bond formed between wood flour and the polyester resin matrix. The good bonding will establish when the polyester resin can enter seep into the wood powder to form 'cross lingking' between resin and wood flour.

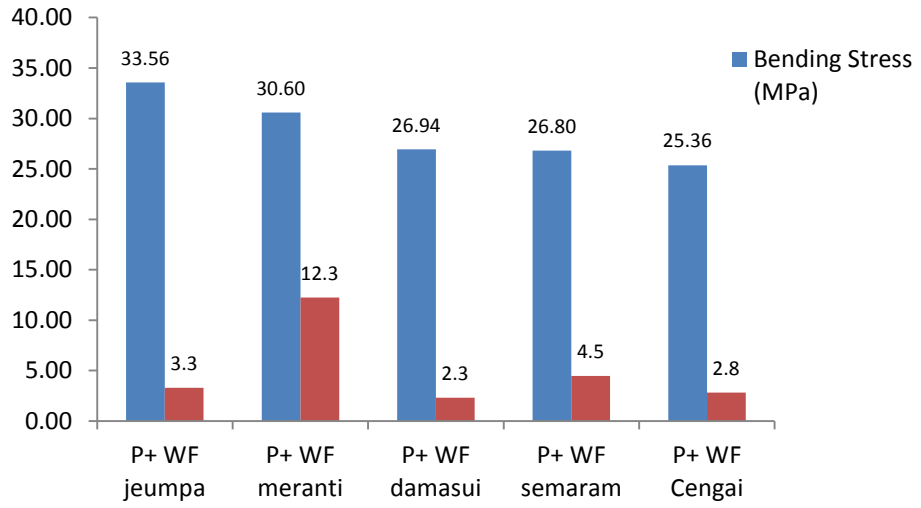

Figure 7. An effect of the type of the coarse of wood flour with a 50:50 % volume of composition on the bending strength of wood flour polyester composite materials

The ability of softwood filler in absorbing resin (wettability) looks good enough to produce a bond which is quite compact on the inteface, while coarse sawdust filler looks less solid at the interface as shown in Figure 8 below. The wood flour fillers of Cengai types showed a cavity in the interface between wood flour filler and polyester matrix. This cavity becomes a source of crack initiation as a trigger for the specimen failure. This is one reason why fillers hardwood species cengai have lower bending strength than soft wood powder filler.

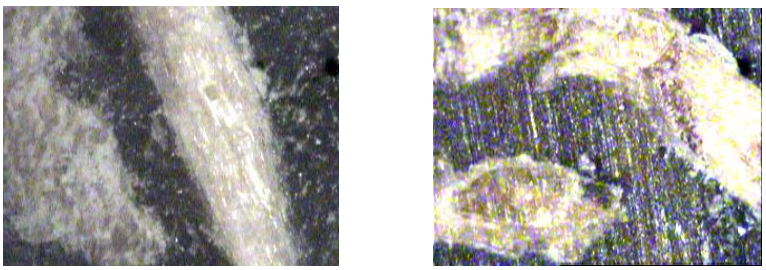

Figure 8. Macro Structure of the Jeumpa wood flour shown more cohesive at interface and the Cengai wood flour shown less coherent within the polyester matrix (100 x) .

An Increasing the Bending Strength of Wood Flour Polyester Composite due to reinforce by glass fiber to form the Sandwich Composite Material.

The influence of reinforcement using glass fiber on both surfaces of the wood flour polyester composite are shown in Figure 9.

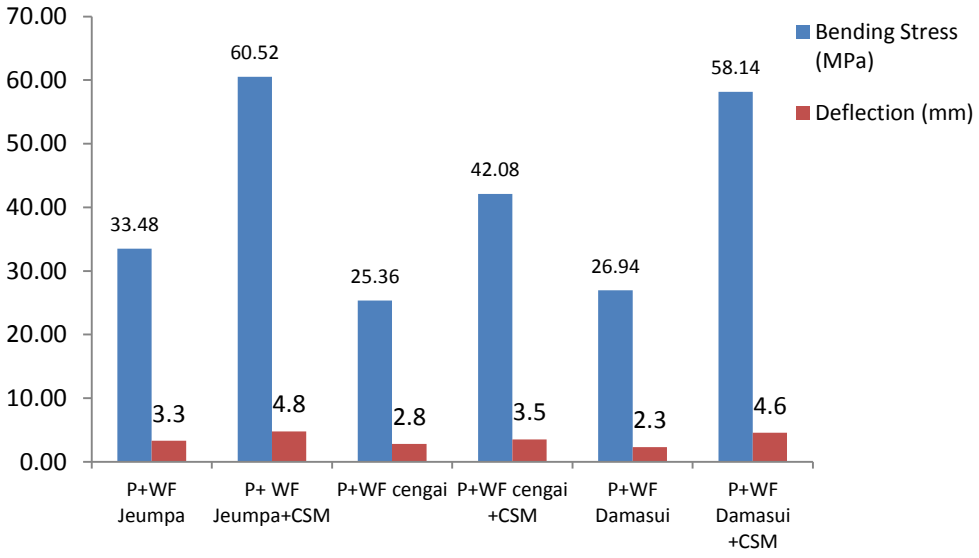

Figure 9. An effect of the glass types CSM reinforcement on the bending strength of the wood flour polyester composite in forming the sandwich composite materials.

The wood flour Polyester composite material has a low strength so it can't be applied to the engineering structural materials. By reinforcing with the glass fiber on both surfaces to form a composite sandwich, it was expected to be more robust and suitable for structural applications. Based on the figure 10, the sandwich with polyester glass fiber composite can improve the strength of the wood flour polyester composite up to 45 % so that the material has good prospects for structural applications. It was resulted from a good combination of both that produce the good bonding at the interface.

The Influence of glass fiber type (CSM and Roving) on mechanical properties.

The glass fiber plays an important role in the process of making the sandwich composite materials between the wood flour composite dan glass fiber composite. There are two types of glass fibers used widely by the community; it was Chopped Strant Mat (CSM) and the type of fiber roving. The effect of strengthening that produced by these two types of fibers to the wood flour polymer composite was very different, as shown in Figure 10 below.

It can be shown that the reinforcement with glass fiber reinforcement type Roving provide a greater effect than the glass fiber type CSM. However, if the glass fibers in the CSM give two layers (double) the increase in strength is proportional to 1 layer of fiber glass roving type. This indicates that the density of the fibers has a considerable influence on the reinforcing effect produced.

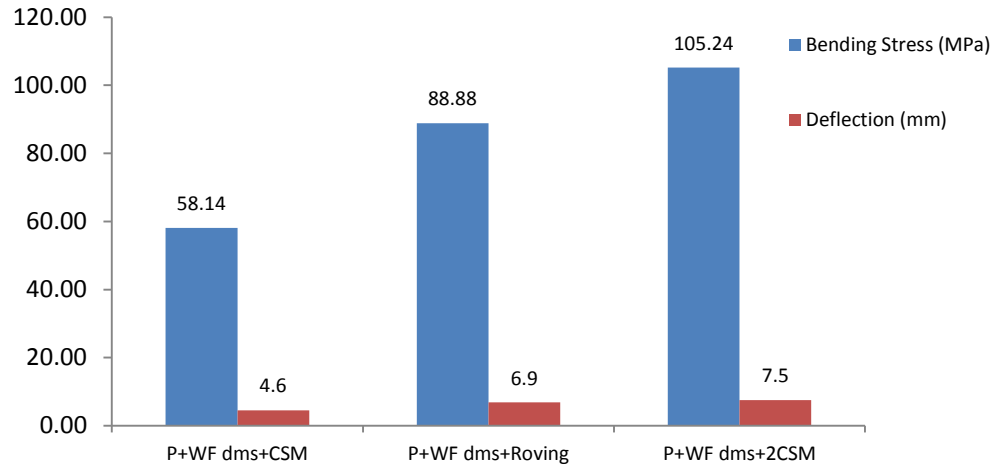

Figure 10. The effect of type of fiber reinforcing (CSM and Roving) on the bending strength of the wood flour polyester composite material

Conclusions

The alkaline and borax treatment for the wood flour and the addition of coupling agent MAH did not provide a positive influence on the strength of the wood flour polyester composite materials. The size and dimensions of wood flour filler have the influence on the bending strength, in which a medium-size (± 2 mm) and the length dimensions can provide a good reinforcement effect. While the type of soft wood flour filler can produce a better bending strength than the hardwood filler. Furthermore, the process of sandwiches using 1 layer of glass fibers can increase the strength of the wood flour polyester composite materials up to 45 %, where the type of woven glass fiber (Roving) has a reinforcing effect that up to 45 % better than glass fiber type CSM. But when CSM fiber in use 2 layer , the effect is almost the same gains with 1 layer of glass fibers Roving type .

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Performance Assessment Method of Irrigation Water Practices to Enhance Efficiency and Rice Productivity: A Survey Approach

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Abstract

Detailed water use records are needed for the accurate evaluation of irrigation performance. Unfortunately, the availability of reliable flow data is not given high priority in most irrigation system of developing countries. The objective of this study is to assess performance of farmer's use irrigation water in rice fields by using survey approach. It was achieved through in deep face-to-face interviews with a total of 27 farmers. The water level variation in a rice plot was recorded in accordance to the measurement by scale method. The question parameters for interviews were the first and last time of irrigation supply, water standing, duration between two irrigation turns and harvest yield. The study was conducted in 2010 at a large scale of the Pante Lhong irrigation system in Indonesia. The results show that the declared data were comparable with measured values at 1 to 39 DAT. At later growth stages, the measured water depth was much lower than declared data. The ratio of yield to the target value ranged from 0.79 to 0.98, suggesting high water use does not contribute significantly to the yield growth. This suggests the successful of developing method to achieve the objective of the research study. However, the hydrograph of daily water level in the rice fields during rice growth stages is needed for validation of farmers declared water practices data purpose.

Key words: assessment method, performance, efficiency, rice productivity, survey approach

Introduction

Many irrigation schemes are not performing the benefits expected (Gao *et al.*, 1999). In many countries, actual irrigated rice yields amount to only about 4 – 6 t/ha, as compared with a potential of 10 – 11 t/ha (Poussin *et al.*, 2006) and irrigation water efficiency is only 20 – 30% (Garg *et al.*, 2009). A number of studies in Asia rice irrigated system have indicated that large amount of water is being lost due to inefficient water supply and the ways farmers use it in the field (Moya et al., 2004). Vandersypen *et al.*, (2006) found that the reason on the poor efficiency is due to excess water delivery in tertiary canals

compared to demand and excess application to the field. Therefore, improved water distribution will help farmers use less water to obtain increased yields and environment of the river basin (Phengphaengsy & Okudira, 2008).

Water resources limitations threaten the sustainability of irrigated rice system in many countries (Zhao *et al*., 2011). In 2015, 15 out of 75 million hectare of Asia's irrigated rice systems is predicted will experience water shortage (Patel *et al*., 2010). Therefore, performance improvement of existing irrigation systems has been a major concern in international irrigation development. This involves not only infrastructure improvement but also changes in management (Okada *et al*., 2008). The term of irrigation performance can be quantified from irrigation water use (Akbari *et al*., 2007). It determines when to irrigate, how much irrigation water to apply, and uniformity of water application (Hanson & Ayars, 2002). However, this needs a good knowledge of the frequency and the duration of water use (Raes *et al*., 2000). As an example, average water depth in the rice field at any growth stages resulted from the farmer's experiences can be considered as indicative of appropriate water management (Anan *et al*., 2004).

The accurate evaluation of irrigation of irrigation performance needs a detailed water use records data (Lorite etl al., 2004). Unfortunately, the availability of reliable flow data is not given high priority in most irrigation system of developing countries. Meanwhile, although farmers are the most important water users, they often receive low attention in performance assessment (Ghosh *et al*., 2005). Besides, although flow data may be effective in understanding and identifying the cause of the problems, it is not easy to achieve in a large-scale irrigation system (Wongtragoon *et al*., 2010). Direct measurement of flows data such as using current meter, weir or flume devices are fairly expensive (Leib *et al*., 2003). Therefore, in the absence of flow data, the assessment of quality of irrigation services can be realistically only be provided by farmer (Sam-Amoah & Gowing, 2001). The objective of this study is to assess performance of farmer's use irrigation water in rice fields by using survey approach. It avoids the need of direct measurement of flow data. The study concentrates on performance evaluation from the perspective of farmers as a key stakeholder. The survey was conducted in 2010 at a large scale of the Pante Lhong irrigation system in Indonesia. The measured of irrigation water practices in the rice plots were recorded from the first rice growing season during December 2010 till March 2011.

Materials and Methods

Selection of research site

In this study, selected tertiary area was obtained by dividing the representative secondary canal network into three approximately length sections. An off-take structure for each of length section was selected using the criteria of availability of water gates, adequacy of distribution canals, drainage system facility and no flooding problem during precipitation. It was chosen to minimize irrigation supply constrains to the entire of farmer's plots. It was identified through visual observation of secondary canal section with cooperation from gate operators and water user associations (WUA) or *Keujruen Blang*. In this study, the selected tertiary site is 50.79 hectares with distance from main diversion structure is 8.59 km. The selected site is at the middle of irrigation system at sub-district of Kuala in Bireuen district.

Table 1. Questions related to irrigation water use throughout planting seasons and rice yield

Parameters	Unit	Description	Question for farmer's interviews
The first time of irrigation supply	day	It is defined as the first time of supplying irrigation water to the rice plots after the first day of transplanting of the Young rice after 18 to 20 days in the breeding plot	When the first time irrigation water is supplied into a rice field after transplanting?
The last time of irrigation supply	day	It is defined as the last time of supplying irrigation water to the rice plots or cut-off period which is measured in the number of days before harvesting time	When the last time irrigation water is supplied into a rice field during rice growing seasons?
Irrigation water standing in the rice fields	cm	It is defined as the variation in irrigation water depth practices in the rice plots following to the rice age in days which measured from the first day after transplanting till last time of irrigation supply	How is the practice of irigation water depth variation in the field following the rice growth stages?
Duration between two irrigation turns	day	It is defined as the interval of supplying irrigation water in the rice plots	How many days interval of supplying irrigation water to the rice fields is practiced following to the rice growth stages?
Harvest yield	kg/ha	It is defined as the amount of grain rice yield for each of planting season	How much rice yield was obtained for a single growing seasons for the last three consecutive seasons in a row?

Determination of representative farmer's plots

In this study, the sampling process was divided into two phases:

The first phase of sampling process

The tertiary site was structured into upstream (u/s), middle stream (m/s) and downstream (d/s) quaternary areas along tertiary canal direction. It was identified based on quaternary boxes or quaternary canal branches in case of no field water control structure available. Then, farmer's fields for each quaternary area were grouped into three sections namely head, middle and tail according to the distance from off-take structure (Zardari & Cordery, 2009). Moreover, each of section was again divided into nine blocks in approximately areas which a block has a number of farmer's plots.

The second phase of sampling process

The samples size selected for the survey was limited a rice grower for each of block due to time and budget constraints which is randomly selected around at the middle of block (Haining, 2003). The representative farmers were randomly selected by WUA during field sampling process. The farmer's samples were recorded in terms of name, address and sample location for interviews purposes. The farmer is referred to the actual holder of the land, who cultivates and nurtures the crops and use the water for irrigation (Moustafa, 2004). In the present sampling process, a total of 27 farmers (nine farmers in a quaternary area) were selected for samples stady purpose.

Survey data collection

In this study, the interviews were conducted in relatively informal and relaxed discussions, based around a predetermined topic (García-Vila *et al.*, 2008). In this method, all interviewed farmers were asked directly the same questions in the same order. It was done in the participant's home or at any other suitable places. The selected parameters comprise basic field irrigation practices data such as irrigation water standing in the rice fields, water scheduling and productivity. The samples of question parameters in the questionnaires form were in the open ended format for the face to face interviews purposes with representative farmers are presented in Table 1.

Measured irrigation water practices

In this test, three consecutive randomly farmer's plots were selected for each of quaternary area which consists of three measurement points for each of plot a long distance apart. The water level variation in a rice plot was recorded in accordance to the measurement by scale method (IRRI, 1987). Ideally, the measurements were conducted on the daily basis at the time of water application. In this study, since the data were used for water depth validation only and due to the time constraint, the water variation in the rice filed was recorded two times per week. In this site, farmers commonly irrigated their farm at the morning or afternoon depending on their free times. Therefore, the measurements were recorded two times per week at 9 a.m or 5 p.m using a stainless steel scale bar of 40 cm in length. The measurements were taken at about 25 cm from the plot bund at an average location after water level become constant. In order to avoid reading error during measurement process, a scale bar was inserted carefully into the ponding water and the reading was taken just when the bottom of a scale bar reached the surface of puddle soil. The water depth data for selected rice plots was found by averaging three points data.

Data analysis

In this study, the rice growth seasons are early growth (EG) or early primordial with rice ages from 1 to 15 day after transplanting (DAT), growth stage 1 (G1) or primordial from 16 to 39 DAT, growth stage 2 (G2) or primordial to 10% flowering from 40 to 68 DAT and growth stage 3 (G3) or 10% flowering to fully flowering from 69 to 88 DAT. The completed interviews data were prepared and calculated in the spreadsheets tables from Microsoft Excel. The cumulative or total irrigation water use was calculated by summing up the total of irrigation water depth in accordance to a number of irrigation cycles from 1 to 88

DAT out off 105 to 110 days of a total rice age. The measured data ware use to evaluate the validity of declared water standing from interview survey.

Results and Discussion

Compared of measured and declared water depth in the rice fields are given in Table 2. Results show that the ratio of measured to the declared water depth varied between growth stages. The ratio was in the rage of 1.06 to 1.85. At EG and G1 growth stages, results show that the declared data were comparable with measured values. However, at G2 and G3, the measured water depth was about 40% lower than declared data. In this study, it is mostly unknown that whether data were measured before or after application irrigation water. Thus, this amount of variation does not explain insufficient of declared irrigation water depth data.

Table 2. Ratio of declared to recorded of irrigation water depths in the rice plots

Rice growth stages by different quaternary location on the selected tertiary site	Interval (days)	Freq. (cycles)	Av. water depth (mm)		Ratio of declared to recorded of irrigation water depths in the rice plots
			declared	recorded	
EG (1 – 15 DAT)	5	3	35	33	1.06
G1 (16 – 39 DAT)	3	8	55	41	1.34
G2 (40 – 68 DAT)	6	5	72	39	1.85
G3 (69 – 88 DAT)	5	4	72	40	1.80

Table 3. Ratio of water use to suggested value and yield to the target value

Quaternary location on the selected tertiary site	Total water use (mm)	*Suggested water use (mm)	Rice yield (kg ha^{-1})	**Targed rice productivity (kg/ha)	Ratio of water use to the suggested	Ratio of yield to the target
Upstream (u/s)	1359	577	5531	7000	2.36	0.79
Middlestream (m/s)	1584	577	6241	7000	2.75	0.89
Downstream(d/s)	648	577	6855	7000	1.12	0.98
Average	1197	577	6209	7000	2.07	0.89

*Calculated based on Module proposed by Dept. of Public Work

** Following to the target value proposed by Agriculture office, Bireuen district

In Table 3, the ratio of water use to the suggested value was in the range of 1.12 to 2.75, indicating the total amount of irrigation water use considerable greater than suggested value at all tertiary area. On the other hand, the ratio of yield to the target valu ranged from 0.79 to 0.98, suggesting high water use does not contribute significantly to the yield growth. Result explains that the total amount of water use presently practice in the rice fields could be reduced without decreasing rice production.

Conclusions

In fullfiling the objective of the study, results showed that the ratio of farmer use irrigation water to the measured irrigation water depth in the rice field up to 39 days after transplanting (DAT) was in the range of 1.06 to 1.34. This finding indicates that declared data were comparable with measured values. This suggests the successful of developing method to achieve the objective of the research study. At later growth stages, this ratio was in the range of 1.80 to 1.85, indicating declared water standing in the rice field much higher than recorded value. It can be cobcluded that the hydrograph of daily water level in the rice fields during rice growth stages is needed for validation of farmers declared water practices. Besides, the recorded water depth in the rice plots should be measured soon after application irrigation water.

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Utilizing Cacao Crust as the Bio Adsorbent of Manganese (Mn) in water

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Abstract

Producing charcoal active from cocoa crust as bio adsorbent has been done in this study. It was done traditionally by using pyrolysis reaction in a reactor that consisted of the mixture of aluminum and zinc for 3-4 hours. Chemical activation was done by aeration processes of charcoal cocoa crust using 4N H2SO4 solution for 24 hours. The quality and characteristics of the activated charcoal cocoa crust refers to the SNI 06-3730-1995. This research aimed to know the performance of bio adsorbent from activated charcoal cocoa crust in adsorbing Mn in water based on the efficiency of Mn removal processes and the constant of isotherm adsorption. The results of Mn removal efficiency from various concentrations of Mn (20, 40, 60, 80 and 100 ppm) with particle size (20, 40 mesh) for 5 and 10 grams, within 90 minutes contact was 73.25 to 90.09%, and the best result was from adsorbent 40mesh and 10 gr. The various variable of adsorption isotherms showed that this study followed the Freundlich isotherm's model with adsorption constants k = 2.7102 L / kg; n = 0.3643 (20 mesh particle size) and k = 3.0061 L / kg; n = 0.362 (40 mesh particle size). It can be concluded that bio adsorbent from cocoa crust has a heterogeneous surface and each molecule has different adsorption potential.

Key words: Activated charcoal, adsorption isotherm, bioadsorbent, cocoa crust, efficieny of Mn removal

Introduction

Water is a vital need for life. Ideal healthy water that covers the hygiene condition should be clear, colorless, tasteless and also odorless. One of the clean water used by humans is groundwater (Chandra, 2007), which is mostly from rainwater and absorbed into the soil. Before reaching a ground layer, rain water will go through several layers of soil and cause water hardness. Because of this process water

contains mineral substances in high concentrations such as calcium, magnesium (Mg), iron (Fe) and Manganese (Mn). As the result, the water become hard to be foamed, and its sediment will form slag.

Water with Mn contamination usually could be seen from its high color intensity which are yellow and even red-brown, and tasted bitter or sour (Vishnu, 2004). Mn concentrations in natural water systems are generally less than 0.1 mg /l. In 1961 WHO decided a maximum concentration of manganese in drinking water in Europe was 0.1 mg /l, but then it was updated to 0.05 mg / L. In the United States, EPA from the beginning had set the maximum concentration of manganese in drinking water for 0, 05 mg/l. While Japan set the total concentration of iron and manganese in drinking water maximum was 0.3 mg/l. Indonesia based on the Ministry of Health No. 907 of 2002 established the levels of iron and Manganese maximum in drinking water was 0.3 and 0.1 mg / l (Eaton Et.al, 2005).

Activated charcoal is one the alternative materials used to absorb the levels of manganese (Mn) in water. It is often also called as activated carbon which has a very large surface. It can absorb gases and certain chemical compounds or selective adsorption properties, depending on its size or the pore volume and surface area (Sembiring, 2003). One type of activated charcoal used beside the coconut shell is cocoa crust. Cocoa crust has chemical constituents that consist of cellulose, hemicellulose, and high lignin. Besides, it also potentially become as an adsorbent to adsorb the types of metals (Rajawane, 2008).

Based on research conducted by (Masitoh and Mary, 2013), charcoal cocoa crust was activated by using a chemical compound, $ZnCl_2$ 9%, and the results obtained show that activated charcoal cocoa crust can absorb metals Cd (II) in water ranges from 80% solvent. While Boediono (2012) said that the activation of coconut crust using 4 M H_3PO_4 and H_2SO_4 are used to adsorb phenol, the results showed that the best maximum adsorption capacity of activated charcoal for phenol was 27.027 mg / g by using coconut crust activated with H_3PO_4.

Activation of cocoa crust was performed by using 4 M H_3PO_4, the adsorption performance process based on the removal percentage of the best iron (Fe) samples of well water is 99.254% (Kemala sari, 2014). In this research cocoa crust become bio-absorbent after activated using 4N H_2SO_4. It is expected to adsorb i manganese (Mn) ions in water. The characteristics of activated charcoal cocoa crust refers to SNI No.63-3730-1995. This research aims to know about how the performance of bio-adsorbent cocoa crust in absorbing ability of Mn ions in the water based on the efficiency of Mn removal and adsorption isotherm constant. The adsorption isotherm can explain the concentration of adsorbate changes in the adsorption processes that take place in accordance with the mechanism of adsorption. In addition, it illustrates the amount of adsorbate adsorbed per-unit weight of adsorbent as a function of the equilibrium concentration in isothermal condition. Some models absorption isotherm commonly used are Langmuir, Freundlich and EBT isotherms.

Langmuir Isotherm

The Langmuir isotherm models using kinetic approach, that is equilibrium occurs if absorption rate same as with desorption rate. Assumptions in the Langmuir equation is occurring chemical adsorption; adsorbent has a homogeneous level energy system so that the affinity molecules adsorbed is equal in

each location; adsorbate forms a monolayer; do not have interactions between molecules adsorbed; and the adsorbed molecules on the surface of the adsorbent do not move.

Theoretically, Langmuir isotherm equation can be derived by considering the equilibrium between the molecules of the adsorbed substance on the adsorbent surface with substances molecules which are not adsorbed. Langmuir isotherm equation can be written as following:

$$S = \frac{\text{a.b.c}}{1+\text{a.c}}$$ and linier form is $$\frac{Ct}{S} = \frac{1}{a.b} + \frac{1}{b} \times .Ct$$ ..... 1)

where:

Ct = adsorbate concentration in solution.

a = constant showed the bond energy between solute and adsorbent.

b = constant shows the adsorption capacity maximum or saturated.

S = concentration of adsorbate adsorbed per gram of adsorbent.

Freundlich Isotherm

The isotherm is based on the assumption that the adsorbent have a heterogeneous surface and each molecule has the different potential absorption. This equation is most widely used today. Freundlich isotherm equation can be written as following:

$$S = k.C^{1/n}$$ and linier form is Log S = Log k + (1/n) Log C ..... 2)

where k and n is adsorption constant.

BET Isotherm

BET Isothem is based on the assumption that the adsorbent has a homogenous surface. The difference between the BET isotherm and the Langmuir is BET's assumps that the adsorbate molecules can form more than one layer of adsorbate on the surface. At this isotherm, adsorption mechanism for each adsorption processes is different. Langmuir isotherm is usually better when applied to chemical adsorption, while the BET isotherms will be better than the Langmuir isotherm when applied to physical adsorption. BET isotherm model equation is:

$$q = \frac{q_{maks}.k_{s.}\ C^{1/m}}{1+ k_s.C^{1/m}}$$, where q_{maks}, k_S and m k_S and m is BET constant, k_s is the function of temperature with the equation : $k_s = k_{s\infty} \exp[\frac{k_{s.o}}{T}]$, with $k_{s.o}$ and k is constant.

Materials and Methods

Procedure

The reseacrh was conducted several stages, started from the synthesis of activated charcoal cocoa crust, mesh size uniformity for adsorbant, test of the characteristics of activated charcoal (SNI No.06-3730-1995), prepare the solution $MnSO_4.H_2O$ as artificially sample, batch system of process adsorption and analyze concentration changes Mn using AAS method (SNI 6989.4: 2009).

Making of activated charcoal cocoa crust

Cocoa crust is cleaned and diced, dried in the sun and perform carbonization with reaction pyrolysis for 3-4 hours to form charcoal, cooled, and mashed to find charcoal size 10/20, 20/40 mesh. The amount of 500 grams of charcoal is maeserased in 1 L 4N H2SO4 for 24 hours. Afterward, filtered and washed with aquadest until neutral pH. Drying is done in 110^0C oven for 3 hours and cooled in a desiccators and balenced up to a constant.

Characteristics activated charcoal cacoa crust

Cocoa crust is cleaned and diced, dried in the sun to dry in the sun and do carbonization with reaction pyrolysis for 3-4 hours to form charcoal, cooled, and mashed to find charcoal size 10/20, 20/40 mesh. Total of 500 grams of charcoal is maeserased in 1 L H_2SO_4 4N for 24 hours. Then filtered and washed using aquadest until neutral pH. Drying is done in 110^0C oven for 3 hours and cooled in a desiccators and balenced up to a constant.

The chararacterization of activated charcoal from cacao crust was produced according SNI No.06-3730-1995 include water content, ash content, volatile matter content, bound carbón containt, adsorb of I_2. The results are presented in Table 1.

Table 1. Result of chacaracterization of activated charcoal from cacao crust

Characterizatic parameter	*Result*	*SNI Parameter*
Water content (%)	11,26%	Maksimum 15%
Ash content (%)	7,38%	Maksimum 10%
Volatile matter content (%)	23,48%	Maksimum 25%
Bound carbon content (%)	64,55%	Minimum 65%
Adsorb of I_2 (mg/g)	824,85 mg/g	Minimum 750 mg/g

Adsorption Process in Batch System

The adsorption process begin with determine of optimum time contact from adsorption process of Mn at 100 ppm for 15, 30, 45, 60, 75 and 90 minutes. As much as 100 ml of water containing 100ppm Mn was contacted with 5 grams of activated charcoal cocoa crust which size 20 mesh. The optimum time contact was obtained by the best efficiency of Mn removal.

Adsorption experiments in batch system use a shaker jar test with speed agitation at 100rpm. Into five 500 ml beakers were inserted bio-adsorbent cocoa crust as much as 5 grams of 20 mesh size, and they are contacted with Mn solution in 20, 40, 60, 80 and 100 ppm for 90 minutes. the adsorption process of Mn can be determined by efficiency calculation of Mn removal from that absorption process by using the following equation:

$$\%R_{Mn} = \frac{\text{Initially Mn Concentration} - \text{Mn Consentration at time contact}}{\text{Initially Mn Concentration}} \ldots\ldots\ldots 3)$$

The adsorption process is also done for variations size bio-adsorbent 20 mesh and 40 mesh as much as 5 and 10 grams for a contact time of 90 minutes at various Mn concentrations in 20, 40, 60, 80 and 100 ppm. Analysis of excess Mn concentration of the is done by using AAS analysis method (SNI 6989.4: 2009) at a wavelength of 248.3 nm. Determination of the isotherms and constants adsorption can be done graphically by using equations 1 and 2, as the result, the adsorption Mn ions in accordance with the Langmuir or Fruendlich isotherm models.

Results and Discussion

Results of activated charcoal characteristics of cocoa crust shown in Table 1. The results showed all the characteristics of the testing parameters satisfied the SNI No.06-3730-1995, therefore the activated charcoal cocoa crust can be used to bioadsorbent that it adsorb Mn in water. Determination of ash content aims to determine metal oxide content in the activated charcoal. Determination of volatile matter content aims to find out how much substance or compound that has not evaporated during carbonization and activation process, but will evaporate at 950°C. High levels of volatile matter will cause reduced absorption (Suryani, 2009), in this study was obtained 23.48% and it's less than 25% from SNI No.06-3730-1995 value. Determination of bound carbon content aims to determine levels of carbon content after carbonization process, and in this study is 64.55%. Iod absorption capability in this study is 824,85 mg/g that satisfied in the specified value SNI No.06-3730-1995. The greater iodine value the greater the adsorbed ability of adsorbent.

The determination of the optimum time contact

The determination of the optimum time in pra-research was conducted to determining of time required for maximum absorption from bio adsorbent on ability adsorbing of Mn as adsorbate at certain concentrations is based on the effisiensi of Mn removal that are obtained every time variations. Results obtained are shown in Figure 1.

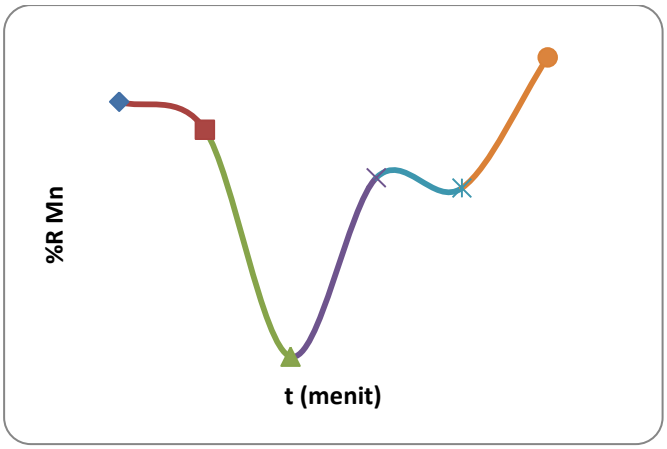

Figure 1. Determination of time contact optimum

From the graph in Figure 1 can be seen that the optimum time contact obtained in R_{Mn} 90.08% that is at 90 minutes. Therefore 90 minutes was a time contact that it can be used as main operation time on system batch's adsorption process.

Effect heavy of Bioadsorbent on efficiency of Mn removal (% R_{Mn})

To know how effect heavy of bio adsorbent on adsorption ability to remove Mn in water of various concentrations of Mn ions can be done by looking at changes in concentrations of Mn ions (calculated as% RMN) during a contact time of 90 minutes at different particle adsorbent sizes. Results obtained are shown in Figure 2.

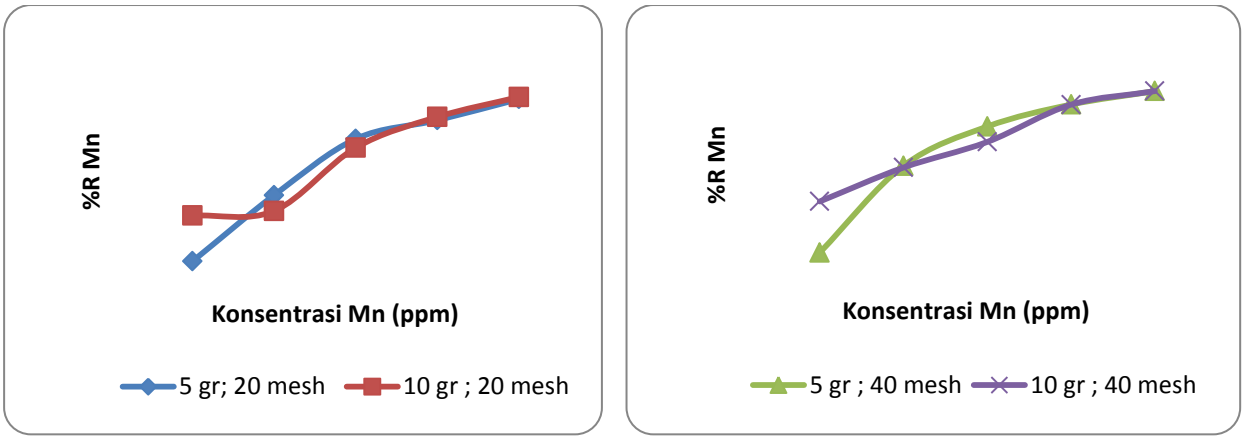

Figure 2. Effect heavy of Bioadsorbent on efficiency of Mn removal (% R_{Mn})

From the graph in Figure 2 can be seen that for all various concentration showed that heavy of bioadsorbent at 5gr and sizes particle at 20 and 40 mesh was obtain %R_{Mn} better until 20-60 ppm, while for concentrations greater than 60ppm or 80-100ppm obtained %R_{Mn} is better for 10gr weight. This showed that the greater the concentration cause the greater too of adsorbent amount that needed to increase ability adsorption. This is due much of amount of adsorbate which it was absorbed by bioadsorbant highly dependent on equilibrium bioadsorban to the existence of the adsorbate dissolved in wáter.

Effect of bioadsorbent size on the efficiency Mn removal (%R_{Mn})

To know how size bioabsorbent effect on the efficiency Mn removal in water at various of Mn concentration can be done by observing any change Mn concentrations (as %R_{Mn}) during contact in 90 minutes that is done on sizes particle of bioadsorbent different. Results of this study are shown in Fig 3.

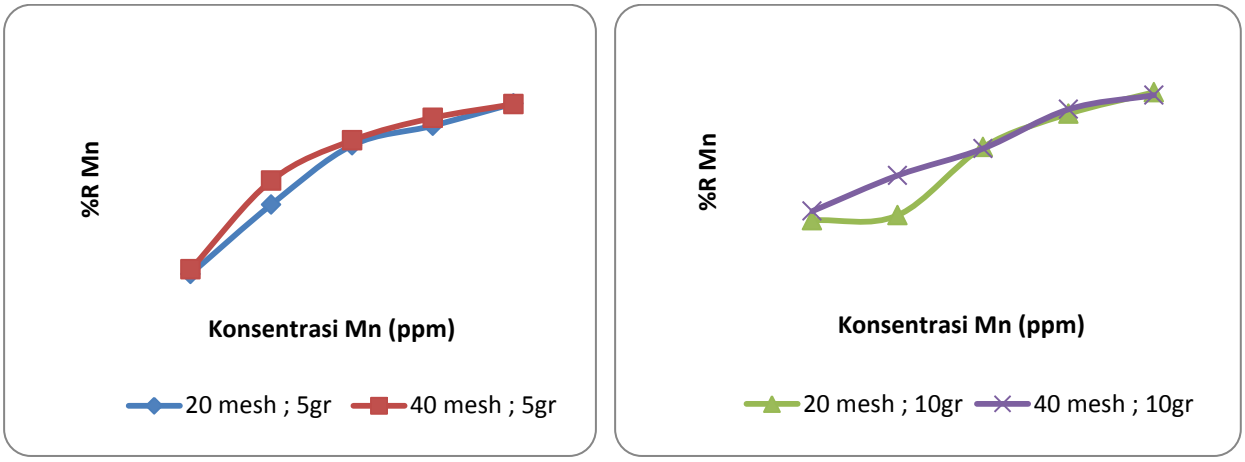

Figure 3. Effect of bioadsorbent size on the efficiency Mn removal (%R_{Mn})

From the graph in Figure 3 can be seen that for all various concentration and weight bioabsorbent shown that the smaller size particle caused the greater the efficiency of Mn removal. This is caused the smaller the bioabsorbent particle size, the greater too the surface of cantact between bioabsorbent and adsorbate so the efficiency of Mn removal was higher.

Adsorption Isotherm

Adsorption in the solid-liquid system is related to the concentration of adsorbate on surface of adsorbent. In the process of adsorption and desorption take place continuously. At first the rate of adsorption is higher than desorption. On the equilibrium conditions is reached nothing changes in concentration that can be observed because the rate of adsorption and desorption was equal. One of the illustrated will explain amount of adsorbate that was adsorbed heavy unity of adsorbent as a function of equilibrium concentration at a constant temperature that can be determined by adsorption isotherm. The adsorption isotherm models which the chosen in this study are Langmuir and Freundlich isotherm. The results of this study is shown graphically in Figure 4.

From the graph in Figure 4 can be seen that for various of any particle size (20 and 40 mesh) showed that the heavy of bioadsorbent that more demonstrating to adsorption isotherm models is 5gr. Based on correlation factor (R2) that obtained in linier equation, so model was isotherm Freundlich. This explained that adsorption process of Mn in water using bioadsorbent cocoa crust occurs physically and bioadsorbent has a heterogeneous surface and each molecule has different potential absorption. Kinetic parameters isotherms Fruendlich that was obtained consist of the constant adsorption k = 2.7102 L / kg; n = 0.3643 (particle size at 20 mesh) and k = 3.0061 L / kg; n = 0.362 (particle size at 40 mesh).

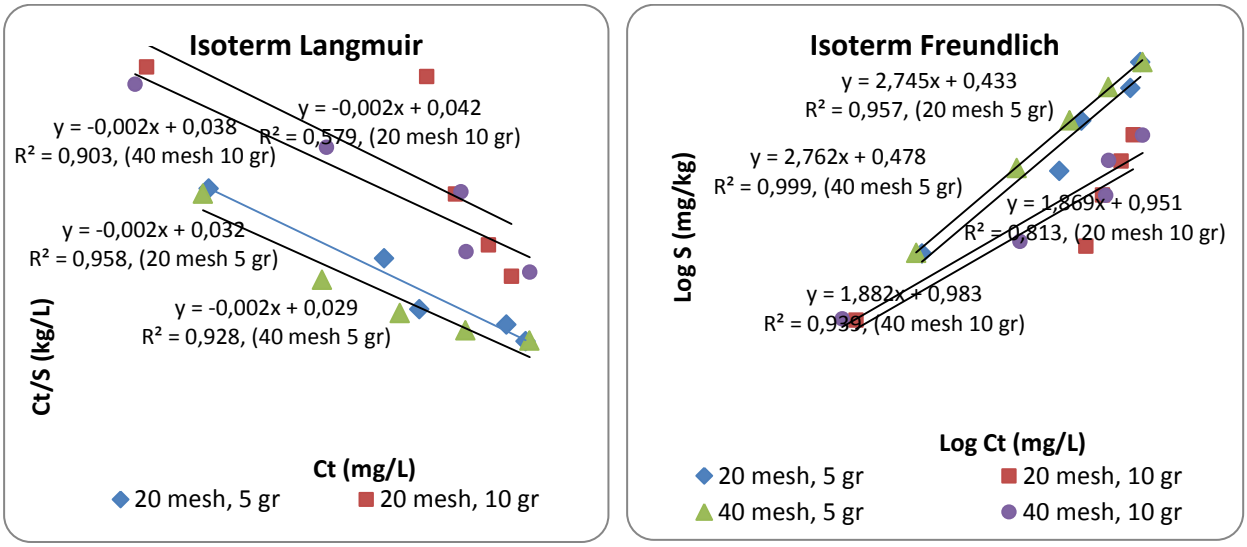

Figure 4. Graph determination of Langmuir isotherm models and Freundlich

Conclusions

Activated charcoal from cocoa crust with chemical activator H_2SO_4 4N potentially be used as bioadsorban to Manganese (Mn) in water that occurs by physically adsorption and the process was follow Fruendlich isotherm models. The adsorption ability of bioadsorbent cocoa crust in the performance to Mn removal in water is able to achieve up to 90.086% at 90 minutes and best on particle size 40 mesh. Kinetic parameters isotherm Fruendlich was the isotherm adsorption constants k = 2.7102 L / kg; n = 0.3643 (20 mesh particle size) and k = 3.0061 L / kg; n = 0.362 (40 mesh particle size).

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Advanced Improvement of Gahegi Biomass Stove for Salt Manufacture

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Abstract

Conventional wood stoves used by the farmer for producing salt is inefficient and haven't equipted by a good channel, so that produces smoke pollution which is harmful to salt farmer's health and the environment. Gahegi stove that was designed before for replacing conventional stove was realized can still be improved. The aim of this research is to improve the Gahegi stove so that it can be more efficient and eliminated more smoke pollution. The methods used to improve gahegi stove performance is by utilizing the potential heat of the exhaust gas by creating a configuration flue gases channel through the multi pot stove as a preheater. While, combustion performance and elimination of smoke pollution improved by utilizing the natural draft by adjusting the chimney height. Stove best performance was tested by the standard water boiling test for each variation of chimney height. The results showed that the optimal value of the chimney height in the advanced improved stove is at a 1.55m with a thermal efficiency of 48.6%. The thermal efficiency of this stove is 28.85% higher than Gahegi stove.

Key words: Stove, preheater, chimney height, thermal efficiency

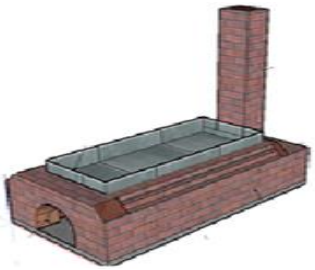
Introduction

The biomass stove which has been used by the farmers in Aceh (Indonesia) to produce salt is a very simple conventional wood stove. This stove has only one hole to feed the wood fuel into the combustion chamber without any other channel for exhaust gas. These stoves are very inefficient and produce a lot of smoke when operated. It is due to lack of sufficient air supply to the combustion chamber and this is not a good combustion process. Figure 1 (a) shows a conventional stove that is still widely used by farmers in Aceh to produce salt. The study of traditional stoves mentioned that the efficiency is about 12.9%, (Setiawan et al., 2010).

Smoke pollution from the burning of biomass is very disturbing, dangerous for health especially for pregnant women and their children who participated when their work (Kim et al., 2011 and Rahayu, 2011). Meager advantage obtained then should be spent again to pay for medical care in order to cure

the diseases caused by smoke pollution. Therefore, it should be considered a good channel to overcome the smoke pollution (Smith, 2012). Smoke pollution are disavantage to the environment.

(a)



(b)

Figure 1. (a) Conventional and (b) Gahegi stove

The Gahegi stove shown in Figure 1(b). Efficiency of the Gahegi stove is about 19.75%, (Faisal, 2015). Measurement to the temperature of exhaust gases on the Gahegi stove is about 200 ^{o}C. This exhaust gas is a potential energy to preheat the brine (raw material for making salt). Energy savings can be made by improving the efficiency of the stoves. Fuel consumed will decrease if the efficiency increased (Vaccari, 2012). Several efforts to do are to improve the efficiency of heat transfer to the pot and also efficiency of the combustion process of the fuel in the combustion chamber (Joseph, 2010).

Some of researchers have used multi-pot systems for flue gas potential utilize of biomass stove and the stoves have shown improvement and better performance (Ruiz-Mercado, 2011; Kale, 2005; and Valencia, 2004). Based on these considerations we have made some modifications to the stove unit with multi-pot configuration. Improvement has been carried out by utilizing the exhaust gas heat. Potential hot exhaust flue gases are used as a pre heater to heat the brine in the second and third pot. We named it as semi-modern salt stove.

Modification of stove models requires improvement of construction and dimensions of suitable chimney. The use of the chimney with a suitable height aims to create an appropriate natural draft that supply a sufficient amount of air into the combustion chamber for better combustion process. More air supply as an excess air is required to ensure approximated complete combustion process. However, there are nitrogen substances in the supplied air. Nitrogen can absorb the heat of combustion so that lower the combustion temperature in the combustion chamber (Hanbi, 1994). Too much excess air will lead heat loss. This is certainly harmful. Optimal height of the chimney must be determined for the stove. Based on this fact, it is necessary to do an experimental study of the chimney effects on the characteristics of combustion in semi-modern salt stove. It can be optimized in order to obtain the appropriate dimensions of chimney.

Research Methods

We used parawood as fuel in this study. Ultimate analyzes by mass percentage and stoichiometric balance combustion process calculations for 1 kg of wood have been done. Chimney fitted with a height

that can be modulated to determine the optimum height. The composition of the exhaust gases are variables that need to be observed to determine air-fuel ratio, air supply and the combustion process. The exhaust gas is sampled and its composition analyzed by gas chromatograph device.

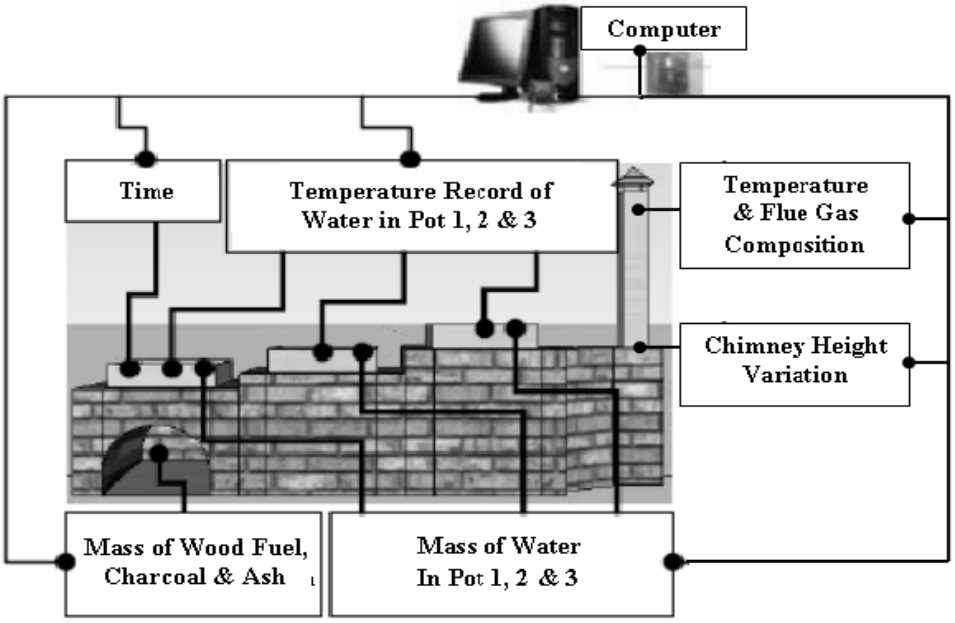


Figure 2 Schematic of measurement for data retrieval in semi modern stove

Thermal efficiency of the stove was calculated using the standard water boiling test (Bailis, 2007). The water boiling test for improved and conventional stoves was conducted in field. Water boiling test is performed for the cold start, hot start and simmer phase operating conditions. The test is performed 3 times for each conditions, each stage involves a number of measurements and calculations. The data obtained then being analyzed to find out the achievement of the stove. Figure 2 show the schematic of measurement for data retrieval in the stove. Analysis has performed. The results obtained were then compared to the conventional stove achievement.

Result and Discussion

Based on the results obtained by the analysis, air fuel ratio (A/F) is approximately 2.97. The air-fuel ratio value indicates that for 1 kg of wood fuel requires 2.97 kg of air for complete combustion process stoichiometrically. Stoichiometric equilibrium is an ideal state to the perfect combustion process that is different from the real conditions. So that the real condition needs excess air.

The results of the testing process of combustion in the stove showed that 33.8 kg wood burned with an average time of 7.05 hours. Based on the air fuel ratio, 33.8 kg wood required 100.5 kg air, so the rate of the air mass becomes 0.004 kg/sec. Air Density is 1.2 kg/m^3, so the value of the exhaust gas volumetric rate is 0.0047 m^3/s.

Based on data from the smoke gas and environment temperature, the value of the volumetric rate of the exhaust gas can be used to determined chimney height that produces a natural draft sufficient to meet the minimum air requirements for the stoichiometric combustion process. The minimum height of the

chimney is 0.24 m. Chimney height of 0.8 m will produces 8.5% excess air beyond the needs of stoichiometric combustion process, while for other heights can be seen completely in Figure 3. The changes in height of the chimney are gradually increasing the rate of the air draft and excess air. The results for recording temperature average every five minutes for each chimney height was shown in Figure 3. The temperature in the chimney increases with increasing height of the chimney.

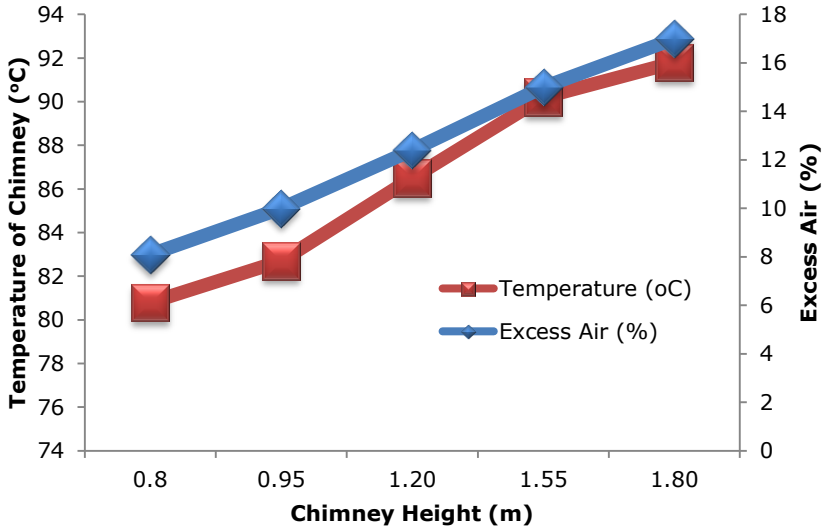


Figure 3. Graph of average temperatures and % of excess air to the chimney height variation.

Figure 4 shows the graph of the amount of wood fuel, charcoal and ash mass to the chimney height variation. The trend of fuel consumption initially declined with the rising height of the chimney. The turning point came after a height of 1.55 m. Fuel consumption is increased again after that height. Mass of charcoals mass and ash also decreased with increasing height of the chimney and the minimum point reach 1.55 m. After reaching the minimum point, they tend to increase again.

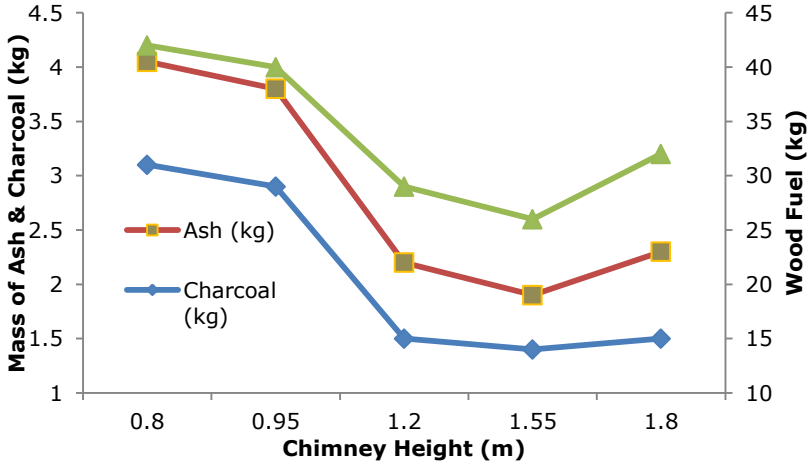
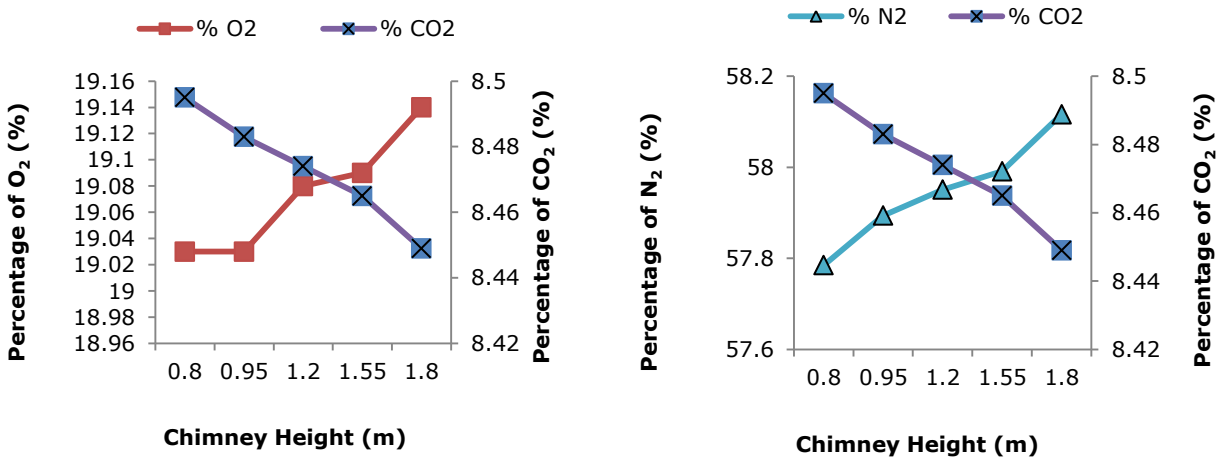


Figure 4. Graph of amounts of wood fuel, charcoal and ash mass to the chimney height variation.

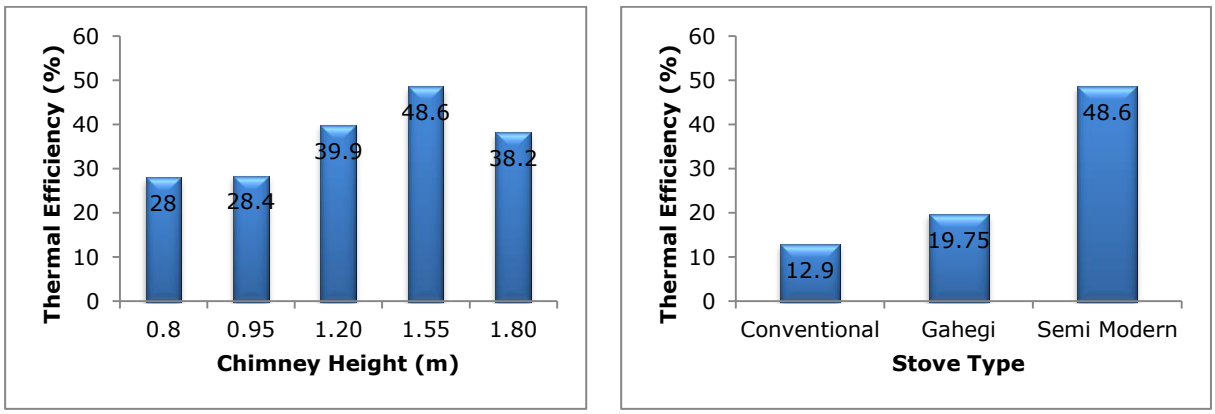
Figure 5 shows the graph of exhaust gas composition (O_2, CO_2 and N_2) to the chimney height variation. The concentration of O_2 and N_2 gases in the exhaust gas that flows through the chimney tends to increase with increasing height of the chimney while the composition of the CO_2 in the flue gas tends to decrease with increasing height of the chimney. The graph shows that the optimum value of the stove chimney height for best combustion process occurs between 1.2 and 1.5 m.



(a) (b)

Figure 5. Graph of flue gas composition of (a) CO_2 & O_2 and (b) N_2 to the chimney height variation

Figure 6 (a) shows a graph of thermal efficiency of the stove to the chimney height variation. It is seen that the thermal efficiency of the stove increased with increasing the chimney height. The peaks is at the 1.55m with the efficiency about 48.6%, and then the efficiency decreased after the height. Thermal efficiency of semi modern stove is higher then conventional and Gahegi stove, as shown in Figure 6 (b).



(a) (b)

Figure 6. Graph of stove thermal efficiency (a) to the chimney height & (b) to stove types

Conclusions

Based on the results of the data analysis and discussion, it can be concluded that:

1. Utilization of the flue gas heat potential as a brine pre heater greatly affects to increase stove efficiency that can be used in salt manufacture.
2. The height of the chimney on the biomass stove greatly affect the temperature in the chimney, excess air, the amount of wood fuel consumption, charcoal and ash formation and the flue gas composition. Based on these combustion characteristics, we can determine the optimum chimney height.
3. Based on the experimental results of this improved stove, the optimum height of the chimney for semi-modern salt stove is 1.55 m height with 48.6% thermal efficiency. The thermal efficiency of this stove is 28.85% higher than Gahegi stove.

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Effect of Heating Time and Concentration Enzyme Papain from Papaya Latex Friut as Coaglant in Tofu Production

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Abstract

Tofu is a food product derived from soybeans. To produce tofu is used coagulant, it is known as enzyme. Papain enzyme is one coagulant material in the manufacturing process tofu. Papain enzyme produced from papaya latex fruit. The enzyme papain is obtained as crude papain which is processed from the latex of papaya fruit with sodium bisulfite. Tofu was produced from soy milk at a temperature of 60 °C at heating time and the concentration of the enzyme papain varied. The result was obtained from research that the higher the enzyme papain, the higher the yield. In this study, the concentration of 0.4% produces about 11:26% yield, while the heating time for 25 minutes. The best levels of the protein during the warm-up time of 50 minutes. Analysis organoleptic like aroma and color do not affect in making tofu while the taste and texture affect tofu production by the addition of the enzyme papain from papaya latex. On the other hand, the level of preference does not significantly affect tofu.

Key words: Enzyme, papain, latex, time, concentration, tofu

Introduction

Papaya latex is one of the largest potential enzyme papain. According to Winarno (1995), the latex of papaya contains 10 % papain, 45% kimopapain and 20% losozim. Papaya latex containing 10% of enzyme papain, enzyme papain is one of enzyme proteolitik classified as protease enzyme sulfhydryl (Muchtadi et al, 1992). Protease enzyme protein functions as an enzyme breaker which has the properties of the materials to attack the protein that is in the foods that contain protein. Enzyme papain will cut peptide bond from protein to be asam amino. Where these proteins will be broken down into peptides and then will form amino acids. The enzyme papain as coagulant in making tofu. From the above hypothesis the researchers concluded that the enzyme papain derived from papaya latex fruit as coagulant can be used as material in the manufacturing process tofu. Papaya latex fruit will be isolated by using sodium bisulfit, it is called crude papain. Crude papan can be used to making tofu as coagulant. Tofu is a food product derived from soybeans. Soy beans contain about 35-45% protein. To

break the biological protein in the soybean in the process of making tofu necessary knows coagulant materials. Coagulant substances used in this study is papain enzyme derived from the papaya latex fruit. The use of the enzyme papain as a coagulant has been studied by Egrina et. al (2010) where the enzyme papain derived from papaya fruit crude extract used as a coagulant in the process of cheese making cottega. With a concentration of 520 ppm enzyme papain from papaya latex extract rough is the best result as a coagulant in cheese making cottega. Otherwise Irmawati (2014) using the enzyme papain as an ingredient in the manufacture curd, the results obtained showed the best results is the concentration of the enzyme papain at a concentration of 0.8% w/v. On the other hand, Rita puspita et. al (2013) has conducted research that the enzyme papain can be applied in the manufacture of heating the curd with a time of 30 minutes.

The aim of this study is to see the effect of heating time and the concentration of the enzyme papain from papaya latex fruit in tofu production as coagulant. Expected later this research can provide information about the use of the enzyme papain from papaya latex as a coagulant in the process of making out and getting the heating time and the best concentration of the enzyme papain in the process of making tofu from soybeans.

Materials and Methods

Materials

The material of research was used papaya latex fruit, sodium bisulfite, buffer solution, distilled water, soy beans and the equitment of the research is the scales, hot plates, stirrers, erlenmeyer, measuring cups, measuring pipette.

Methods

Papaya Latex Production

Scratch young papaya fruit still hanging on the tree and the latex is collected in a container. Papaya fruit does not need to be removed so it can be left to ripen on the tree. Intake of latex can be done several times during the fruit is still young and contains a lot of latex. The collected latex is placed in an aluminum container or other container-shaped tray. Drying or dried in an oven at a temperature of 40-50 °C. During drying or drying environmental hygiene must be maintained. Once dried, then crushed and filtered in order to get refined flour such as rice or wheat flour.

Enyme papain as crude papain from papaya latex fruit

125 grams of papaya latex mixed with sulfite 0.7% (by 3.5 g sodium sulfite dissolved in 500 ml of distilled water), then stirred for 1 hour (homogeneous). Papaya latex mixture dried at refrigerator temperature for 9 days. Cured papain dried crushed after it was packaged and stored in the refrigerator.

Making Tofu

Soy beans that have been soaked for 1 night, then blended into soy milk. Soy milk is then heated at a temperature of 60 ^{0}C with a heating process (25, 50, 75 and 100 minutes) and added enzyme papain with

a particular concentration in accordance with the variable (0.1%, 0.2%, 0.3% and 0.4 % w / v). Soy milk is stirred and then printed and analyzed texture, protein content and yield.

Determination of Protein Content

Protein content determination was be done at Balai Riset dan Standarisasi Industri (Baristand) Banda Aceh. Protein containt was analyzed by khedal analysis.

Test Appearance

Organoleptic test will be tested for flavor, color, texture, aroma, and the level of preference. This test will be tested based on the total score of the whole test and the variables contained in the form organoleptic (Sri Lestari, 2011 and Umbang AR, 2011).

1. Sense
   Assessment of the taste of tofu.
   Scale: Ordinal
2. Color
   Assessment of the color of tofu that is white or not white
   Scale: Ordinal
3. Texture
   Assessment of the tofu texture ranging from soft to hard
   Scale: Ordinal
4. Smell
   Assessment of the smell of tofu that smells soy beans or not smells soya beans
   Scale: Ordinal
5. The level of fondness
   A judgment against the tofu of likes and dislikes
   Scale: Ordinal

The method used is covered by the questionnaire method instrument list form checklist form organoleptic test. Organoleptic test at somewhat trained testers (15 people each tester will receive the 4 samples with heating time and the concentration of enzyme papain varied.

Data analysis

Univariate analysis: This analysis is done on each of the variables of the research in order to know the frequency of the variables to study the addition of the enzyme papain organoleptic quality and acceptability of tofu.

Bivariate analysis: used to look at the effect of adding the enzyme papain to the organoleptic quality and acceptability of tofu.

Ho: There is no effect of the enzyme papain to flavor, color, texture, aroma and fondness for tofu.

Ha: There is the effect of adding additional enzyme papain to flavor, color, texture, aroma and fondness for tofu

Statistic test

The method used is the Q test Cochdiran. This test is used if three or more of the set of scores (the proportion or frequency) pairwise significant benefit. The scale used is the ordinal scale.

Formula :

$$Q = \frac{(k-1)\left(\left[k\sum_{j=i}^{k} ci2 - \left(\sum_{j=i}^{k} ci\right)2\right]\right.}{k\sum_{i=1}^{n} Li - \sum_{i=1}^{n} Li2}$$

Q approaching X^2 with db = k-1

Rule test: Reject H0 if $Q \geq X^2$

K = a lot of samples (treatment)

n = number of replicates

Ci = the amount of success in each treatment (1 to k)

Li = the amount of success in each repeat (1 to n)

If the count ≥ Q value of Chie squared value at significance level of 5%, then Ho is rejected and Ha accepted. Conversely, if the Q value calculated from values ≤ chi squared at significance level of 5% so Ho accepted and Ha rejected.

Results and Discussion

Effect of Heating Time and Concentration Enzyme Papain for Yield tofu

Research has been carried out the process of making tofu with soy beans weighing 500 gr. Soybeans soaked for 1 night and in a blender to produce soya milk with soya beans and water ratio is 1: 5. 500 ml soy milk was used to making tofu. The heating process is carried out at 60 ° C with a warm-up time varied from 25, 50, 75, and 100 minutes. While the concentration of the enzyme papain from papaya latex was 0.1, 0.2, 0.3 and 0.4% w/v, they were added in soy milk. From the picture below can be seen that the enzyme papain from papaya latex can be used as a coagulant in the process of making tofu from soybeans. The images portray that the higher the concentration of the enzyme papain, the yield of the resulting higher as well. However, the heating time does not affect the results yield know. A good time to produce a high yield at 25 minutes. This is because the longer the time the heating process, the power clotting enzyme decreases.

Figure 1 can be seen that the enzyme papain at a concentration of 0.4% w / v at 25-minute warm-up time produce a higher yield. This is caused because the concentration increases, the enzymatic reaction rate will go up to a certain point and finally the constant (Winarno, 1982). From this research with variable concentrations of the enzyme can be concluded that the optimal enzyme concentration in the process of making tofu by using the enzyme papain from papaya latex was 0.4% w / v with 25 minutes of heating time. If the amount is less than the enzyme papain enzyme activity less for the clotting reaction of proteins, enzymes conversely if too much is added, the possibility of media available is not adequate to the needs of existing enzyme activity. Besides the addition of enzymes that too much will lead to flavor are less preferred by consumers (bitter).

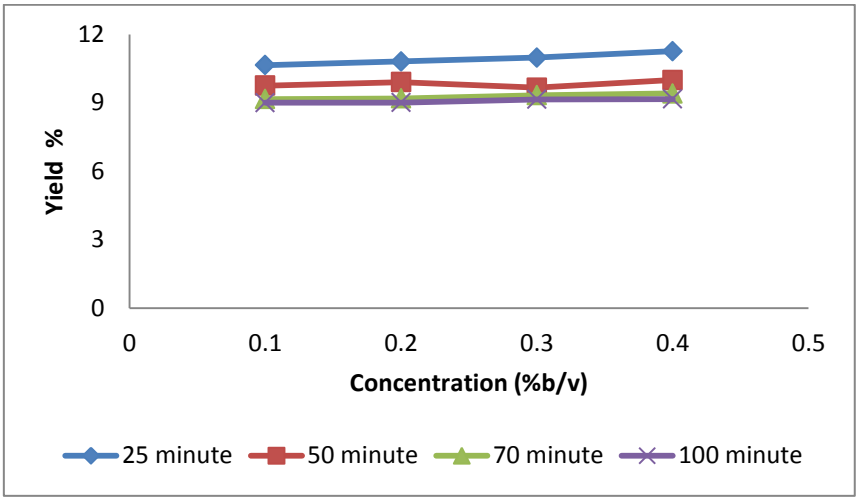

Figure 1. Chart of the effect of heating time and concentration of enzyme papain from papay latek in making tofu for yield tofu production.

Effect of Heating Time for Protein Content of Tofu

Tofu produced from soy milk with the addition of the enzyme papain 0.4% w / v with an operating temperature of 60 ° C. The protein concentration was generated using Kjeldahl methods conducted in the Balai Riset dan Standarisasi Industri Banda Aceh. From figure 2, it can be seen that the heating time can affect the concentration of the protein produced.

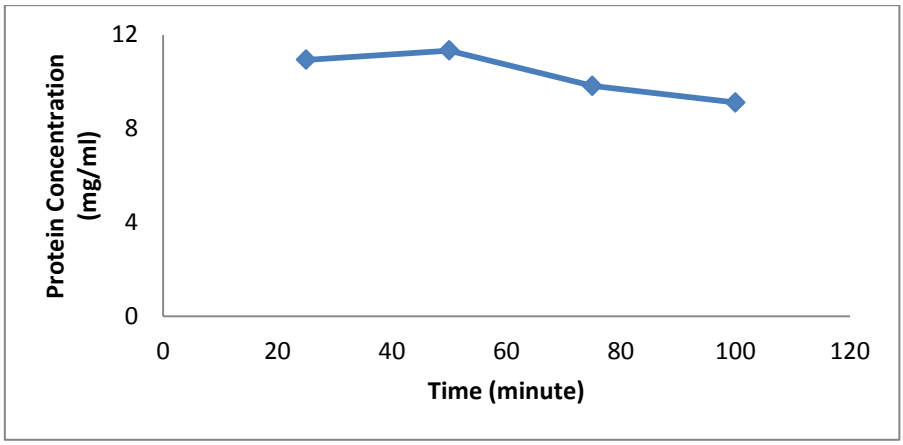

Figure 2. Chart of effect of heating time for protein content for tofu with adding 0.4 % w/v of enzym papain.

The heating time greatly affects the protein content in the tofu. It can be seen from Figure 2 that a high concentration of protein contained in the warm-up time of 50 minutes around 11.33 mg / ml. Meanwhile, the longer the heating time is 100 minutes of diminishing the concentration of protein in tofu produced is 9.11 mg / ml. This is because the longer the heating time, the diminishing their power to coagulate protein enzyme papain. It can also be seen that the longer the heating time resulting tofu weight decreases. The coagulation process carried out by the enzyme papain is influenced by the heating time. The length of

time the heating causes diminishing enzymes work to break the peptide bonds of proteins to clot. **Resulting in reduced protein concentration**

The protein content in the range of tofu products around 320,7- 439.9 mg/ml, but the levels of protein produced in the manufacture of tofu with using enzyme papain obtained lower. This occurs because the long soaking soybean predicted effect on all parameters observed. The longer the soaking time the protein level decreases, it is due to the release of the bond structures that protein so that the components of protein soluble in water. Low levels of the protein result in less flavor and aroma not typical. The protein content is too high also result in the flavors and aromas that are less favored because of the emergence of unpleasant odor.

Test Appearance

Organoleptic tofu produced from 500 ml of soy milk with the addition of the enzyme papain from papaya latex fruit can be seen in Table 1. Organoleptic test conducted by using the test as many as 15 people were poorly trained. This is done by giving questionnaires to testers. Samples were tested organoleptic four (4) samples and 5 (five) variables: taste, color, aroma, texture and level of preference. Then the results of the organoleptic test data performed statistical analysis using the equation Cochran. This organoleptic test will be calculated using the formula Cochran. Where will be calculated chi quadrat tables and Q count will be calculated with the percent error of 5%.

Table 1. Calculation of organoleptic test with using the equation of Cochran

Uji organoleptik	Chie kuadrat tabel	Q hitung
Rasa	3	5.76
Warna	6.46	1.32
Aroma	5.33	0.2
Teksture	3.86	7.89
Tingkat kesukaan	6.06	6.55

Sense

From the research that has been conducted organoleptic test on tofu by using the enzyme papain from papaya latex. Here it can be seen that the taste of tofu produced is influenced by the addition of the enzyme papain. Where the original taste Tofu is a typical soybeans and tasteless, but with the addition of the enzyme papain from papaya fruit sap that serves as a coagulant causes the taste of tofu produced a slightly bitter taste. With the addition of the enzyme papain from papaya fruit sap on soy milk at a temperature of 60 °C will occur clots in soymilk. These clots form clumps of protein contained in soy milk. Many testers assess a bitter taste in the addition of the enzyme papain from papaya fruit sap of 0.1, 0.2, 0.3 and 0.4% w / v The results of organoleptic test is supported by Cohcran Q = 5.76, while the value of chi square table 3. In this case 5.76> 3 then Ho is rejected and Ha accepted. So in conclusion the addition of the enzyme papain from papaya latex fruit affects flavor for ofu production.

Color

Tofu has a white color, but there is also yellow tofu, because tofu is added dye processes such as turmeric and others. Tofu color produced by the addition of the enzyme papain from papaya latex has the color of white. Many testers assess white on the enzyme papain with adding around 0.1, 0.2, 0, 3 and 0.4% w / v. Organoleptic test results are supported by test Cohcran Q = 1.32, while chi squared table 6.46. Based on the calculation above 0.5 <5.99 then Ho accepted and Ha rejected. In conclusion there is no effect of the enzyme papain from papaya latex fruit gum to color tofu.

Smell

Tofu is a genuine smell the distinctive aroma of soy, many testers rate the smell of soy on the addition of the enzyme papain from papaya fruit sap is not affected to the aroma produced tofu. Organoleptic test results are supported by test Cohcran Q = 0.2 5:33 while the chi square table, based on the above calculation 0.2 <5:33 so Ho accepted and Ha rejected. In conclusion there is no effect of the enzyme papain from papaya latex to the smell of tofu produced.

Texture

Tofu texture is dense and soft, while the texture enzyme papain from the sap of papaya fruit which has been isolated by sodium bisulfite when dissolved in the form of a coarse powder translucent color. Tofu many testers assess soft texture like silk tofu with the addition of the enzyme papain from papaya fruit sap that has been isolated by sodium bisulfite. Organoleptic test results are supported by test Cohcran Q chi squared = 7.89, while table 3.86. Based on the above calculation 3.86> 7.89 then Ho is rejected and Ha accepted. In conclusion there is the effect of adding the enzyme papain from papaya fruit gums in the process of making tofu to tofu texture.

The Fondness Levels

After conducting organoleptic test for flavor, color, aroma and texture A level test is then performed the fondness levels. Organoleptic tests supported by the test results obtained Cohcran Q = 6.55 while the chi squared value is 6.06. In this case 6.55> 6.06 so Ho accepted and Ha rejected. In conclusion there is the effect of adding the enzyme papain from papaya latex fruit to the level of preference. The influence given is not too significant.

Conclusions

The conclusion of this study is more concentration of the enzyme papain is used with no warm-up time of about 25 minutes too long produce more yield and higher protein produced in the warm-up time of 50 minutes at a concentration of 0.4% papain enzyme. From the organoleptic test found that the addition of the enzyme papain is not affected to color and flavor while the taste and texture of the resulting tofu influence, while the level of preference but not significant influence.

Acknowledgements

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Effect of Machining Parameters on Surface Roughness in Turning Operation

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Abstract

This research reports the significance of influence of speed, feed and depth of cut on surface roughness while working with tool made of ceramic with an Al2O3+TiC matrix (KY1615) and the work material of AISI 1050 steel (hardness of 484 HV). Experiments were conducted using Johnford TC35 Industrial type of CNC lathe. Taguchi method (L27 design with 3 levels and 3 factors) was used for the experiments. Analysis of variance with adjusted approach has been adopted. The results have indicated that it is feed rate which has significant influence on surface roughness. Depth of cut has an insignificant influence on surface roughness. The interaction of feed and depth of cut and the interaction of all the three cutting parameters have no significant influence on the surface roughness produced. If power consumption minimization is to be achieved for the best possible surface finish, the most recommended combination of feed rate and depth of cut is also determined.

Key words: ANOVA, surface roughness, interaction effect

Introduction

Turning operation using a single point cutting tool has been one of the oldest and popular methods of metal cutting. It has even replaced grinding in several applications with reduced lead time without affecting the surface quality, see Hodgson *et al.* (1981). In this connection, two important aspects which are widely studied in turning operations are cutting forces and surface roughness of the work-piece. Process parameter optimization is of great significance while looking into the process capability of any machining operation. Shaw (1984) has emphasized the importance of studying cutting forces in turning operations as a number of factors are influenced by it, namely, surface accuracy, tool wear, tool breakage, cutting temperature, self-excited and forced vibrations, etc. Ozel and Karpat (2005) have found

that machining parameters (Feed rate, Cutting Speed, Depth of Cut, tool geometry and material properties of tool) directly influence the surface finish of machined components. However, among the cutting force, thrust force, and f feed force, the former prominently influences power consumption and this work considers only cutting force as one of the endogenous factors.

Surface roughness is also a vital measure as it may influence frictional resistance, fatigue strength or creep life of machined components. As far as turned components are concerned, better surface finish (low surface roughness) is important as it can reduce or even completely eliminate the need of further machining. Many researchers have found that surface roughness has bearing on heat transmission, ability to hold lubricant, surface friction, wearing etc. Despite the fact that surface roughness plays a very important role in the utility and life of a machined component due to its dependence on several process parameters and numerous uncontrollable factors machining process has no complete control over surface finish obtained. So, the venture of controlling process parameters so as to produce best surface finish is an on-going process varying from various material to tool combinations and the machining conditions. The present work is aimed at studying the influence of the three major process parameters in a turning operation, namely, speed, feed and depth of cut on surface roughness for a predefined combination of material and tool under the given set of machining conditions.

The surface finish of any given part is measured in terms of average heights and depths of peaks and valleys on the surface of the work piece, see Shaw (1984). But there are basically two streams of arguments on the influencing factors of surface roughness. The first defines surface roughness as the ratio of f^2 to 32r, where f is the feed (mm/rev) and r is cutter nose radius (mm), see Shaw (1984), Groover (1996), Kalpakjian and Schmid (2008). According to the second equation surface roughness is a function of speed (mm/min) and feed (mm/rev), see Aruna (2010). Surface roughness is not an easy parameter to quantify as it depends on several process parameters including speed, feed, and depth of cut for different combinations of tool and work material.

Materials and Methods

The research is basically a hypotheses testing research making use of design of experiments based on Taguchi method. Following hypotheses have been constituted for testing the main effect of the cutting parameters based on the literature review.

H1a: Speed has significant influence on surface roughness of the work-piece in turning operation.
H1o: Speed has no significant influence on surface roughness of the work-piece in turning operation.
H2a: Feed rate has significant influence on surface roughness of the work-piece in turning operation.
H2o: Feed rate has no significant influence on surface roughness of the work-piece in turning operation.
H3a: Depth of cut has significant influence on surface roughness of the work-piece in turning operation.
H3o: Depth of cut has no significant influence on surface roughness of the work-piece in turning operation.

Machine and the materials

The turning operation was conducted using Johnford TC35 Industrial type of CNC lathe machine with a range of spindle speed from 50 rpm to 3500 rpm, and a 10 KW motor drive. The cutting tool was a mixed ceramic with an Al2O3+TiC matrix, which is designated by KY1615. The insert type was TNGA 160408-KY1615 and TNGA 160408-KY4400. The material used was a hardened AISI 1050 steel (hardness of 484 HV). These bars (40 mm in diameter and 300 mm in length) were machined under dry condition. The work material bars were trued, centred and cleaned by removing a 1 mm depth of cut from the outside surface, prior to the actual machining tests.

The instrument used to measure surface roughness was Surtronics 3+. For a probe movement of 4mm, surface roughness readings were recorded at three locations on the work piece and the average value was used for analysis.

Specifications of Surtronics 3+:

- Gauge Range: ±150um
- Probe Movement (max): 25.4mm
- Traverse speed: 1mm/s

Cutting conditions and experimental procedure

Among the speed, feed rate, and depth of cut combinations available on the Lathe, three levels of cutting parameters were selected based on similar earlier studies (Table 1).

Table 1. Factors and their Levels

Factor	Level 1	Level 2	Level 3
A: Speed (m/min)	50	75	95
B: Feed (mm/rev)	0.05	0.10	0.15
C: Depth of Cut (mm)	0.25	0.50	0.75

Taguchi design L-27 for three levels and three factors (3k) yielded 27 experiments. The standard order, run order, cutting parameters and responses in the design of experiments are given table - 2.

Table 2. Design matrix with responses

Standard order	Run Order	Speed (m/min.)	Feed (mm/rev)	DOC (mm)	Ra (μm)
39	1	75	0.05	0.75	5.95
5	2	50	0.10	0.50	7.34
45	3	75	0.15	0.75	7.49
26	4	95	0.15	0.50	8.73
36	5	50	0.15	0.75	6.75
3	6	50	0.05	0.75	4.45
19	7	95	0.05	0.25	5.61

27	8	95	0.15	0.75	9.67
53	9	95	0.15	0.50	8.20
52	10	95	0.15	0.25	8.53
23	11	95	0.10	0.50	7.01
44	12	75	0.15	0.50	10.20
31	13	50	0.10	0.25	7.86
8	14	50	0.15	0.50	10.00
20	15	95	0.05	0.50	6.01
49	16	95	0.10	0.25	7.77
7	17	50	0.15	0.25	9.60
38	18	75	0.05	0.50	5.66
47	19	95	0.05	0.50	8.66
14	20	75	0.10	0.50	6.32
22	21	95	0.10	0.25	6.91
2	22	50	0.05	0.50	3.96
21	23	95	0.05	0.75	7.36
41	24	75	0.10	0.50	8.53
33	25	50	0.10	0.75	8.35
16	26	75	0.15	0.25	10.60
25	27	95	0.15	0.25	9.21
12	28	75	0.05	0.75	7.93
10	29	75	0.05	0.25	4.02
42	30	75	0.10	0.75	8.06
40	31	75	0.10	0.25	5.25
54	32	95	0.15	0.75	11.07
28	33	50	0.05	0.25	4.28
6	34	50	0.10	0.75	6.53
9	35	50	0.15	0.75	8.93
43	36	75	0.15	0.75	10.93
32	37	50	0.10	0.25	8.90
30	38	50	0.05	0.50	4.92
1	39	50	0.05	0.75	4.20
13	40	75	0.10	0.25	7.60
48	41	95	0.05	0.75	7.86
17	42	75	0.15	0.50	9.53
4	43	50	0.10	0.25	9.20
18	44	75	0.15	0.75	9.80
51	45	95	0.10	0.75	6.93
15	46	75	0.10	0.75	9.00

34	47	50	0.15	0.25	9.61
24	48	95	0.10	0.75	7.59
50	49	95	0.10	0.50	6.26
46	50	95	0.05	0.25	6.66
37	51	75	0.05	0.25	6.73
29	52	50	0.05	0.50	5.65
35	53	50	0.15	0.50	10.01
11	54	75	0.05	0.50	6.86

Results and Discussion

The surface roughness analysis of variance (Table 3; figure 1) indicates that the hypothesis H2 stands supported which claims that feed rate has significant influence on surface roughness. Further, among the interaction effects, interaction between speed and feed has significant influence on surface finish (figure 2). R-square of 84.25% indicates a good model fit, but R-square adjusted of 60.09% is slightly on the lower side of goodness of fit, but in the acceptable limit (figure 3).

Table 3. ANOVA for Surface Roughness

Source	DF	Seq SS	Adj SS	Adj MS	F	P	Hypothesis
Speed	2	3.50	3.50	1.75	1.63	0.215	--
Feed	2	107.30	107.30	53.65	49.88	0.000*	Supported
DOC	2	0.52	0.52	0.26	0.24	0.79	--
Speed*Feed	4	19.17	19.17	4.79	4.46	0.01*	Supported
Speed*DOC	4	7.23	7.23	1.81	1.68	0.18	--
Feed*DOC	4	6.27	6.27	1.57	1.46	0.24	--
Speed*Feed*DOC	8	11.37	11.37	1.42	1.32	0.28	--
Error	27	29.04	29.04	1.08	--	--	
Total	53	184.40	--	--	--	--	
S = 1.037	**R-Sq = 84.25%**		**R-Sq(adj) = 69.09%**				

*Significant influence (α = 0.05).

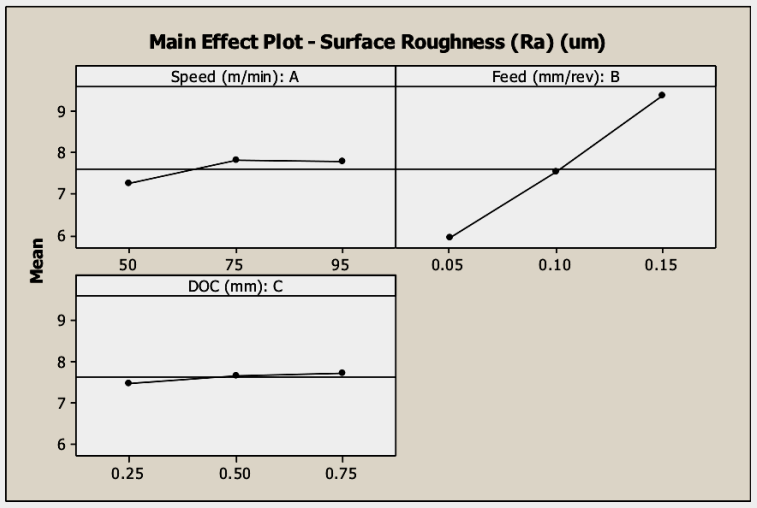

Figure 1. Main Effects Plot for Surface Roughness Ra (μm)

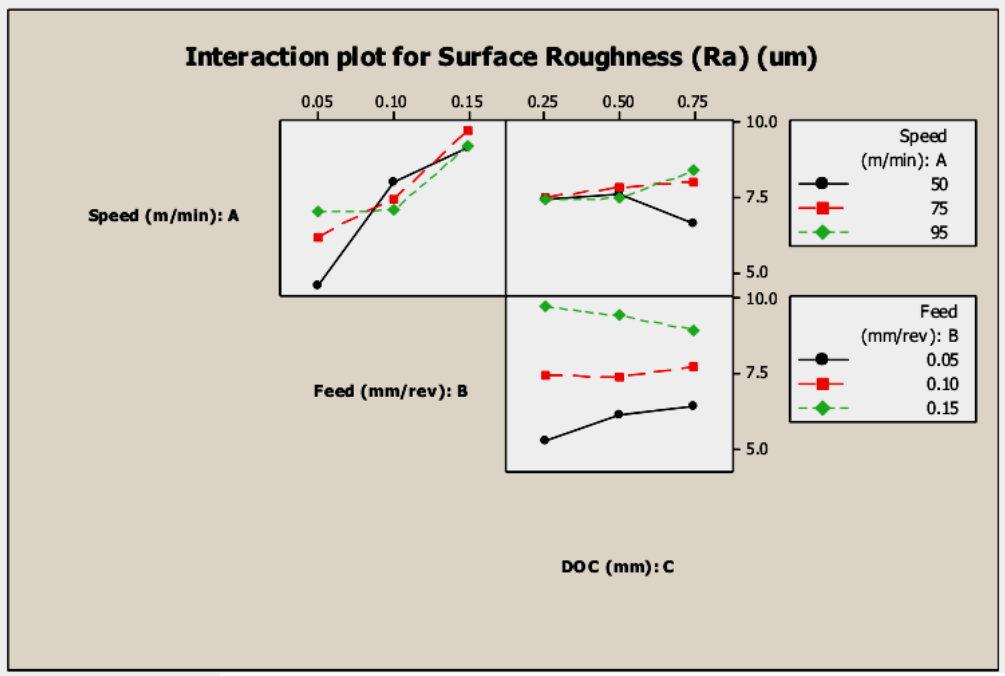

Figure 2. Interaction Plot for Surface Roughness Ra(μm)

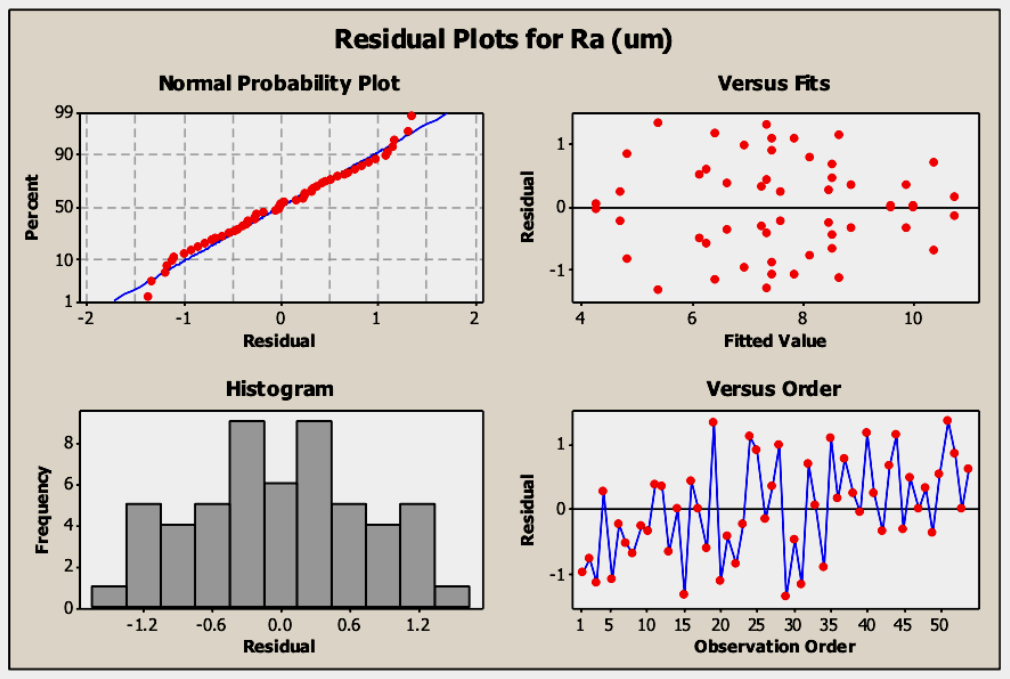

Figure 3. Residual Plot for Surface Roughness Ra (μm)

The regression analysis was carried out to study the influence of cutting parameters on surface roughness and develop the regression model with interaction effects (Table 4). The model is adequately a good fit (R-square = 79.4%; R-square adjusted = 76.3%). The regression equation is as follows. It is

interesting to note that all the cutting parameters as well as the interaction effects as indicated in the table 6 seem to be significantly influencing the surface roughness. Ra (μm) = - 1.86 + 0.0743 *Speed + 110 *Feed + 5.48* depth of cut - 0.116* speed*feed - 60.1* feed*depth of cut + 0.0930* speed*feed*depth of cut +/-€

Table 4. Factors and their Levels

Predictor	Coef	SE Coef	T	P
Constant	-1.86	1.89	-0.98	0.33
Speed	0.074	0.03	2.83	0.01
Feed	110.42	19.49	5.66	0.00
DOC	5.48	2.39	2.29	0.026
Speed*Feed	-0.12	0.04	-3.32	0.002
Feed*DOC	-60.14	19.28	-3.12	0.003
Speed*Feed*DOC	0.09	0.04	2.21	0.032
S = 2.98097	**R-Sq = 79.4%**	**R-Sq(adj) = 76.3%**		

Conclusions

The feed rate has significant influence on surface roughness. Cutting Speed has no significant effect on the surface roughness. Depth of cut has an insignificant influence on surface roughness. The interaction of feed and depth of cut and the interaction of all the three cutting parameters have no significant influence on the surface roughness produced.

The regression model with the P values indicated that the three cutting parameters and the two level interaction of speed & feed and feed & depth of cut, as well as the third level interaction of all the three have significant influence on surface roughness. The most significant among all these is obviously the feed rate which is very much in agreement with the analysis of variance.

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Preparation and Characterization of Zeolite MFI Membrane For Biofuels Purification Application

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Abstract

The most common renewable biofuel today is bioethanol, which can be blended with petrol or used as neat alcohol in dedicated engines taking advantage of the higher octane number and higher heat of vaporization. In the process of ethanol fermentation production, ethanol dehydration has been proved to be a difficult task due to formation of ethanol/water azeotrope. Pervaporation process with a distinct advantages including low energy cost, environment friendly and unrestraint of vapor liquid equilibrium, is considered as a promising alternative for bioethanol purification. The Zeolite MFI membrane have been sinthesized on asymetri pore structure alpha alumina support with pore diameter of top layer being about 0,1 µm. In this experiment, the method performed was a hydrothermal process being done at temperature 313 K by using Silica colloidal with the composition of 30 % SiO_2, 0.04 % Al_2O_3, 0.4 % Na_2O and NaOH 4 N. The Membranes produced were characterized by scanning electron microscope (SEM), X-ray diffraction (XRD) and gas permeation. Based on the SEM observation, the top layer of MFI zeolite membrane produced was about 20 µm. From the gas permeation test, the permeance of nitrogen increased while the temperature encreased. This membrane has a good stability at high temperature, in organic solvent and was able to increase the concentration of bioethanol from technical grade (90%) to fuel grade (99.4%).

Key words: Biofuels, Fuel grade, Membrane, Pervaporation, Zeolite MFI.

Introduction

Biofuel is defined as liquid, solid, or gaseous fuel derived from renewable biological sources for transport purpose. Biomass can be burned directly for thermal energy or converted to other high-value energy sources including ethanol, biodiesel, methanol, hydrogen, or methane. Currently, bioethanol from sugarcane, tapioca, corn grain, shorgum, algae and biodiesel from rapeseed, CPO, castor oil, cooking oil waste are produced in some countries on an industrial scale (Chew, and Bhatia, 2009).

The increasing interest for biofuels production is due to the depletion of fossil fuel. Plant oils have attracted attention of researchers to develop an environmentally friendly and high quality fuel, which is free of nitrogen and sulfur (Dodic, et al., 2009).

Ethanol has a higher octane rating than gasoline i.e. about 113-116 compared to 95 for gasolina (Ahmed, et al., 1989). The higher octane rating will give the better fuel is at preventing engine "knocking" caused by inefficient fuel combustion. In other words, the higher-octane fuel provides better performance because it is used more efficiently to generate power rather than heat. If engines were optimized to take advantage of the higher octane rating of ethanol, they could achieve fuel economy more similar to that of gasoline engines.

In the process of ethanol fermentation production, ethanol dehydration has been proved to be a difficult task due to formation of ethanol/water azeotrope. The conventional distillation can purify the ethanol maximum until 95%. The prevailing industrial technologies such as azeotropic distillation and extractive distillation suffer from high-energy consumption and need for an auxiliary agent. Membrane pervaporation technology is considered as a promising alternative, due to its distinct advantages including the ability to purify ethanol more than 99% with low-energy cost, environment-friendly and unrestraint of vapor–liquid equilibrium (Mulder, et al., 1983 and Wee, et al., 2008).

Synthetic membranes can be produced from organic materials such as polymers and liquids, as well as inorganic materials such as zeolite, ceramic, metal, glass, etc. Most pervaporation membranes that are used in industrial applications are of polymeric type. Polymeric membranes are attractive because they are relatively economical to fabricate. However, a major drawback of these polymeric membranes is their limited solvent and temperature stability. Swelling that occur in polymeric membranes also tends to alter the membrane properties and generally leads to higher permeability and lower selectivity. Inorganic membranes, also called as ceramic membranes made from silica, alumina or zeolite are of high solvent-resistant properties, high temperature stability and free of swelling (Nishiyama, et al., 1996 and Saputra and Rosyidi, 2004). Therefore, these membranes can be used for broad range of applications and at the same time have both high selectivity and permeability. The industrial use of ceramic membranes could lead to a higher product quality and broaden the application range of pervaporation. In particular, porous inorganic membranes exhibit high permeabilities relative to dense membranes and high thermal stability relative to organic membranes (Dyer, 1988).

In this research, a zeolite MFI membrane was developed for increasing the purification of bioethanol from technical grade about 90% to fuel grade (more than 99%). The morphology and mass transfer in the membrane were also studied.

Materials and Methods

Procedure

Membrane Preparation

Zeolite MFI membrane was prepared on asymmetry alpha alumina support with the smallest top pore size 100 nm by hydrothermal method. Membrane was formed on the surface of the support by direct crystallization. The membrane was synthesized by using colloidal silica with the composition in weight percentage 30% SiO_2, 0,04% Al_2O_3, 0,4% Na_2O and NaOH. Cation tetrapropylammonium (TPA) was used as organic template. The synthesis process block diagram of zeolite MFI membrane is shown in Figure 1.

The parent solution was obtained from the mixture of colloidal silica, tetrapropylammonium hydroxide (TPAOH) and 4N NaOH. All the materials was stirred 200 rpm at 313 K for 2 hr. Then alpha alumina support immersed in the parent solution for 1 hour at 313 K. Then carefully the solution and alpha alumina support inserted into Teflon chamber in stainless steel autoclave then sealed. The crystallization process was conducted at 453 K for 24 hours in autoclave without stirring. After crystallization process completed, then as-synthesized membrane was washed using distilled water, followed by drying to remove water content from membrane. Finally, the organic template was removed from the membrane by calcination process at 773 K for 5 hours with the increasing temperature 1 °C/min.

Characterization

Membrane structure was identified by using X-ray diffraction (XRD) using Cu K α radiation (Philips X's Pert-MRD). The morphology was observed by Scanning Electron Microscope (SEM). Mass transfer in the membrane was studied by gas permeability. Gas permeation test was conducted using some pure gas such as helium, nitrogen, methane and i-butane.

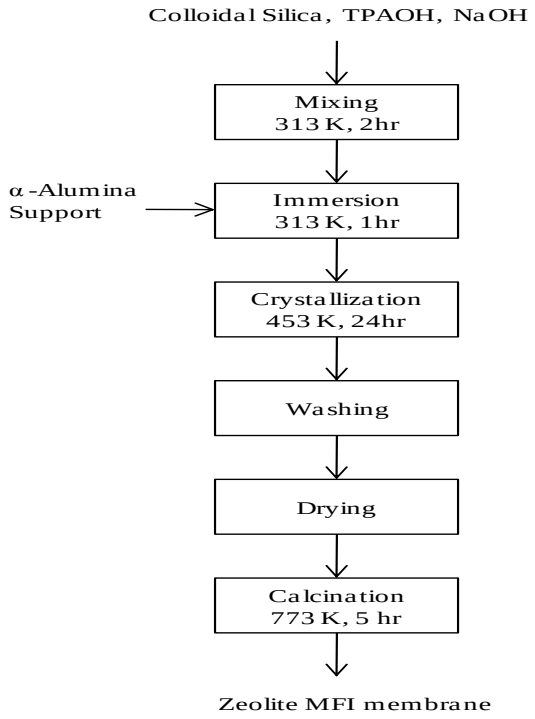


Figure 1. Block diagram process of zeolite MFI membrane preparation.

Pervaporation

The pervaporation test of as-synthesized zeolite MFI membrane for purification of bioethanol was carried out at room temperature. The schematic pervaporation test setup is shown in Figure 2. Technical grade bioethanol (90%) was used as the feed.

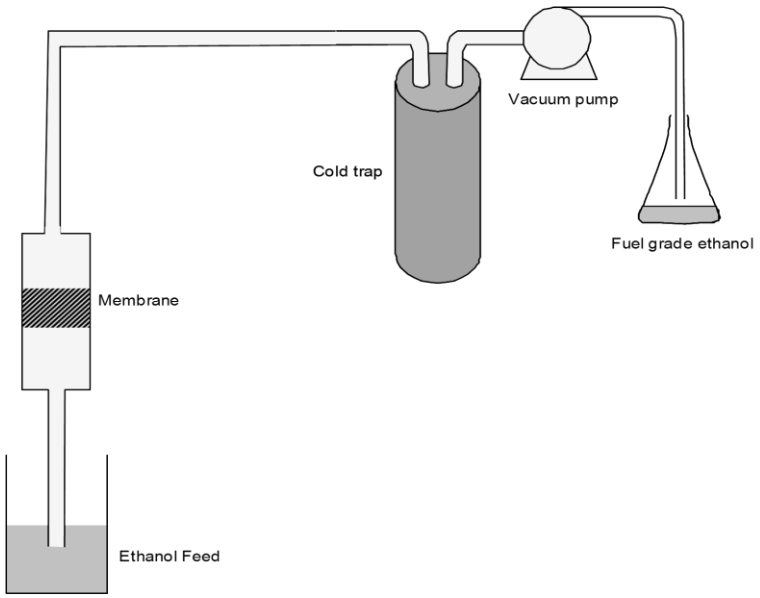


Figure 2. Schematic diagram of membrane pervaporation system

Results and Discussion

Figure 3 shows the X-ray diffraction (XRD) pattern of as-synthesized membrane. The XRD patterns of the sample showed peaks corresponding to MFI-type zeolite. In the structure of the MFI-type zeolite, continuous chains of five-member rings are connected by the four- and six-member rings. The pores and channel system of zeolite MFI materials is as shown in Figure 4 (Burggraaf and Cot, 1996, and Xu, et al., 2007).

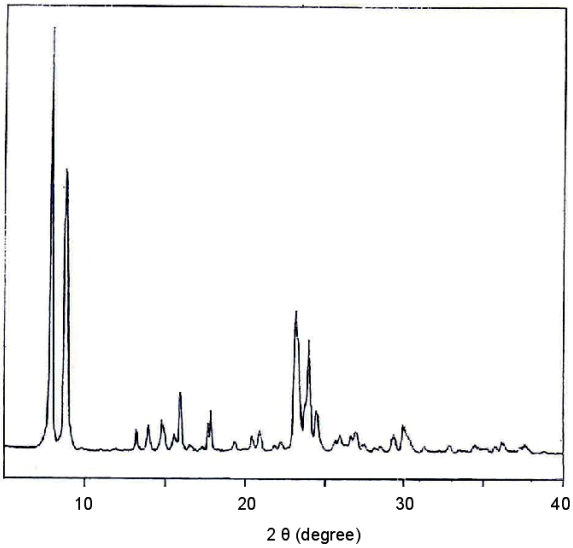
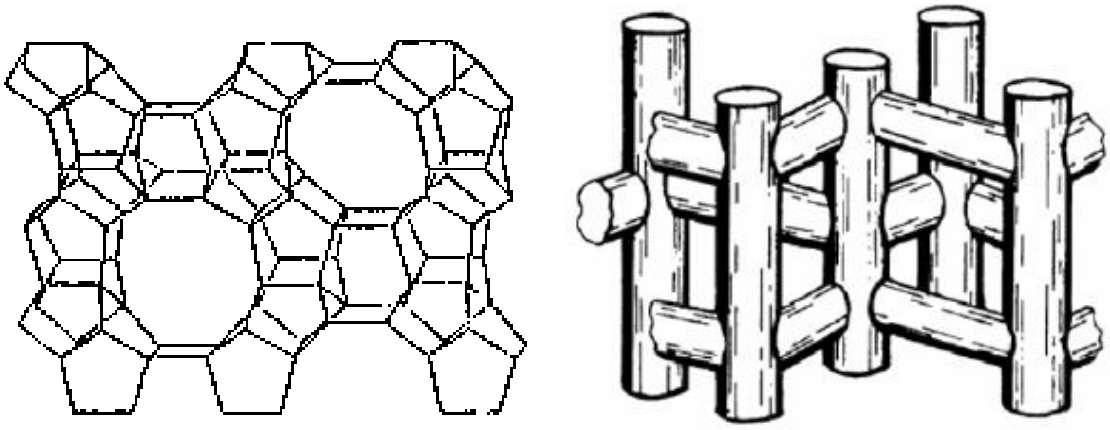


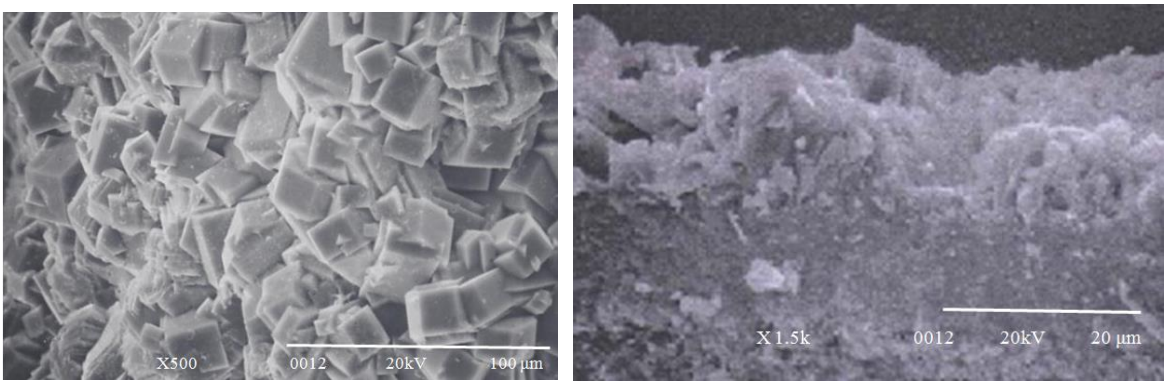
Figure 3. XRD Pattern of as-synthesized zeolite MFI membrane



(a) (b)

Figure 4. MFI pores and channel system : a) porous sheet parallel to the (100) plane, b) channel structure

The SEM micrograph of top surface and cross section as-synthesized zeolite MFI membrane is shown in Figure 5. Zeolite MFI structure observed clearly on the top surface of alpha alumina support. According to SEM observation the thickness of membrane was about 20 μm.



(a) (b)

Figure 5. SEM image of as-synthesized zeolite MFI membrane ; (a) top surface, (b) cross section

The fluid flow properties of porous media are extremely sensitive functions of the pore size distribution and additional pore structural characteristics (shape, connectivity). By dynamic technique, the useful data concerning the structure of membrane can be provided and evaluate their overall quality simultaneously. We may note that open pores can be either conductive of blind (dead-end). Both open pore types contribute to adsorption, while permeation occurs through conducting pores only. The study of the transport of gaseous species through the pore space of porous membranes, analysis and understanding of the mechanisms that are involved in this process are very important.

The results of gas permeation test using as-synthesize Zr-MCM-41 membranes at room temperature, transmembrane pressure of 300 kPa, shows that before calcined membranes were impermeable to N_2 gas. It is considered that Zeolite MFI particles were densely packed in the pores of support. The permeance of some pure gases through zeolite MFI membrane is shown in Figure 6. According to the permeability results indicated that permeability of the gases decreased with the increasing of kinetic diameter. Gas permeation in zeolite MFI membrane followed the molecular diffusion mechanism.

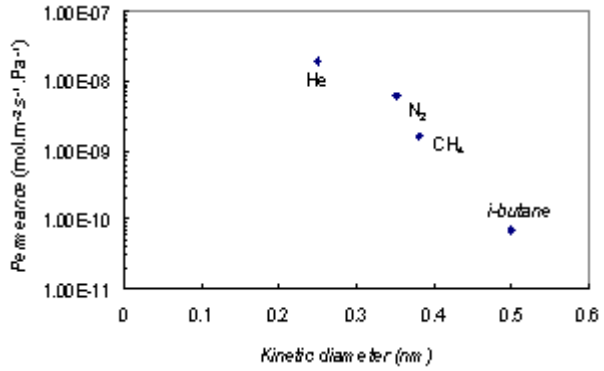


Figure 6. Permeability of some pure gases through zeolite MFI membrane

The pervaporation test of bioethanol was carried out using technical grade at 90% ethanol at room temperature. The separation factor was ca.18 delivered the concentration of bioethanol at permeate was 99.4%. According to ASTM D4806 Standard of ethanol fuel grade, zeolite MFI membrane is able to enhance the concentration of bioethanol from technical grade (90%) to fuel grade (99.4%).

Conclusions

Zeolite MFI membrane has been synthesized on alpha alumina support by hydrothermal method. The thickness of membrane was ca. 20 μm. Structure of Zeolite MFI has a good thermal stability and organic solvent resistant. Permeability of some pure gases were following the molecular diffusion mechanism. Zeolite MFI membrane is able to enhance the purification of bioethanol from technical grade (30%) to fuel grade (99.4%) with separation factor about 18.

Acknowledgements

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Hardness Properties, Microstructure and X-ray diffraction of *Hydroxyapatite-Glass Ionomer Cement Biocomposites*

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Abstract

Development of bioactive materials for the replacement or repair of body tissue is being rapidly developed today. This research aims to develop material of biocomposite hydroxyapatite (HAp) - glass ionomer cement (GIC) for hard tissue restoration. Glass ionomer cement is biocompatibility in nature, that it shows good biological effect on the structure of hard tissues (bones and teeth). Another advantage of this material is that glass ionomer cement is anti-bacterial. In this study, specimens prepared by mixing hydroxyapatite (HAp-200) with glass ionomer cement of GC Fuji IX with composition of 10% of HAp: 90% of GIC, 20% of HAp: 80% of GIC, and 30% of HAp: 70% of GIC, all in% of weight. Hydroxyapatite was mixed with glass ionomer cement (GIC) for approximately 60 minutes to obtain a homogeneous powder mixture. To cause bonding between the particles, the catalyst of GC Fuji IX was added in the amount of 70% wt and stirred thoroughly. The growth of apatite can be seen from the SEM test at 30% of weight of HA200-70% of weight of GIC after soaking in SBF for 28 days. The results showed that the highest hardness value was of 20% of HAp- 80% of GIC, which was 45 VHN.

Keywords: Hydroxyapatite, glass ionomer cement, catalyst, SBF, VHN

Introduction

The need of rehabilitation material is huge so that much effort has been made to find alternative rehabilitation materials which are good, affordable and can replace the damaged tissue structure with the

ability to adapt well to the body's tissues. Development of synthetic biomaterials as the material rehabilitation of the hard tissues of the body that are bones and teeth are expected to be able to replace the role of the tissues replaced. Synthetic biomaterial that is being developed is bioceramic. Bioceramic is known to have bioactive material - material that can provide specific biological response at the encounter of the material with the tissue that will lead to the process of bone formation (osteogenesis) between the material and the tissue [Hench, 1991]. Bioceramic material that is often used in the field of tissue rehabilitation is synthetic hydroxyapatite [HAp, CA10 (PO 4) 6 (OH) 2]. Hydroxyapatite contains Ca2 + ion and when it reacts with body fluids, it can bind to specific ions to form bone like apatite interphase. Besides, it also has very good biocompatibility and bioactivity (Suzuki, *et al,.* 2003). HAp material has characteristics that resemble HAp of bone and teeth tissues. To develop HAp which has characteristics similar to the bone and teeth tissues, the glass ionomer cement chosen as the matrix material.

In this study, hydroxyapatite was mixed with glass ionomer cement to replace the role of the matrix. Glass ionomer cement is a material that can be chemically bonded to the hard tissue. Glass ionomer cement is also adhesive, not irritating, has low solubility, and heat insulator.

Literature Review

Some previous researchers have developed hydroxyapatite biocomposite as hard tissue rehabilitation material. Na-Young *et al.,* (2003) investigated HAp-Ag and HAp-ZrO2 biocomposites and acquired fracture toughness was slightly increased with the addition of Ag content of 5% of volume on HAp matrix. Ang *et al*., (2002) developed chitosan and hydroxyapatite biocomposites for hard tissue rehabilitation candidates. Basically, it is hydroxyapatite powder dispersed into chitosan. The study of the literature shows that this biocomposite has good biocompatibility properties of the cell growth. Kishi *et al*., (2004) investigated hydroxyapatite - alumina-zirconia biocomposite and it was obtained that by the addition of alumina-zirconia (Al2O3-ZrO2), 20% by weight, may increase the value of the material hardness. While addition of hydroxyapatite concentration will lower the hardness value. Nugroho *et al*., (2007) synthesized HA of calcite and produced HA biphasic material and calcite which can be developed as a bone substitute material. The Hydroxyapatite was then made hydroxyapatite-gelatin bicomposite and macro porosity between 80-400μm and micro porosity between 0,5-10μm were generated which are suitable for the growth of osteoblast cells. The biggest compression strength was obtained at composition of 50% of weight, in the amount of 7-8 MPa..

Materials and Methods

The materials used in this research were commercial Hydroxyapatite (HA200, Taihei Co. Ltd., Tokyo, Japan), Glass ionomer cement powder of GC Fuji IX and GC Fuji IX catalyst, Tokyo, Japan. The size of particles ranging from 15-50μm, stirring time of 25-30 seconds, maximum working time was 120 seconds and setting time of 150 seconds. Simulated Body Fluid (SBF) used was made by Basic Dentistry Laboratory of Gajah Mada University referred to Kokubo and Takadama journals [2004]. Table 1 shows the composition of glass ionomer cement.

Preparation of Hydroxyapatite-Glass Ionomer Cement Biocomposite. Weighing hydroxyapatite powder and glass ionomer cement in several composition variations (10% of HAp: 90%of GIC, 20% of HAp: 80%

of GIC, and 30% of HAp: 70% of GIC) weight (in grams) sequentially = 0.045; 0.09; 0.135 for Hydroxyapatite and 1.035; 0.92 and 0.80 for glassionomer cement. All the test specimens were soaked and not soaked in SBF for 28 days hydroxyapatite and glass ionomer cement powder was mixed and 0.67 grams of catalyst was added to cause a hardening reaction. The mixture was put in a mold and left to harden at room temperature.

Table 1. Composition of GIC

Composition	(%)
Silica	41,4
Alumina	28,6
Aluminium Florite	1,6
Calsium Florite	15,7
Sodium Florite	9,3
Aluminium Fosfat	3,8

Hardness test. The hardness test used was Vickers test, JIS Z 2251 standard, using a diamond pyramid indenter with a face angle of 136°. Former stamping of diamond pyramid indenter was then measured for its average diagonal to calculate the hardness value of the tested material on a load of 100 grams (0.1 kg). Before testing the hardness, firstly, specimen surface was sanded until it is shiny. Vickers hardness testing variables shown in **Table 2** and Scheme of Vickers indenter can be seen in **Fig. 1.**

Tabel 2. Variable *Vickershardness* spesimen with and without treatment *SBF*.

Materials	Composition (%wt)	Load (gr)	Specimen
GIC	100%	100	2
HAp/ GIC	10%/ 90%	100	2
	20%/ 80%	100	2
	30%/ 70%	100	2
HA_{200}/ GIC	10%/ 90%	100	2
	20%/ 80%	100	2
	30%/ 70%	100	2

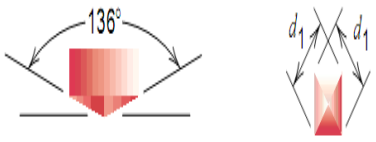

Figure 1. Indentor *Vickers*

Vickers hardness value can be calculated using the formula:

$$VHN = 1{,}8544\frac{P}{d^2}$$

VHN = Vickers hardness (kg / mm2)

P = load suppression (kg)

d = diagonal suppression results (mm)

$$d = \frac{d_1 + d_2}{2} = \text{diagonal load (mm)}$$

Results and Discussion

Hardness Testing. It can be obtained from hardness test that the material hardness value of GIC without HAp showed the average strength value of 87.5 HVN while at the compositions of 10% of HAp,20% of and 30% of HAp, the Vickers hardness obtained were 38; 45 and 42.5 HVN. It shows a decrease in inter-particle bonding of GIC by the presence of HAp particle resulting in the decrease of hardness value. However, with the addition of HAp particles in GIC, it is expected that it will be able to support the growth of living cells of hard tissues (bones and teeth) because of the nature of the biocompatible hydroxyapatite and its morphology that resembles hard tissues (bones and teeth). Figure of hardness test results can be seen in **Figure 2.**

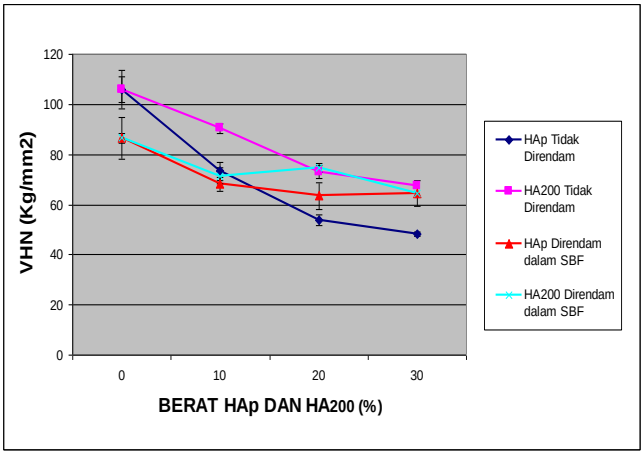

Figure 2. *Vickers Hardness*

X-Ray Diffraction of Hydroxyapatite Powder. X-ray diffraction patterns of HAp synthesized from calcite is shown in **Figure 3** which shows the peaks that resemble the peaks of hydroxyapatite HA200 and KPHAp. HAp showed several peaks that have very strong intensity on the angle between 25º≤2θ≤26º that form the crystal field of 002 and the angle between 31,8º≤2θ≤34º that form the crystal field of 211, 112 and 300. Based on the results of testing for HAp (prior to the development of composites), it is known that the synthesis of HAp has successfully transformed calcite into HAp which characterized by X-ray diffraction pattern at about 25,5θº and 32,5θº corresponding well with the database of HAp on XRD machine, there

were also peaks of X-ray diffraction as a marker of calcite, at about 29.5θo. A diffraction pattern on HAp as the synthesis result of calcite was almost the same as that carried out by Morales et al. (2001), that the X-ray diffraction pattern of HAp showed strong intensity on 25,839θº (002), 31,859θº (211), 33,039θº (112) and 34,099θº which is a reflection of the crystal field of 300. X-ray diffraction (HA_{200} Jepang) can be seen in **Figure 4.**

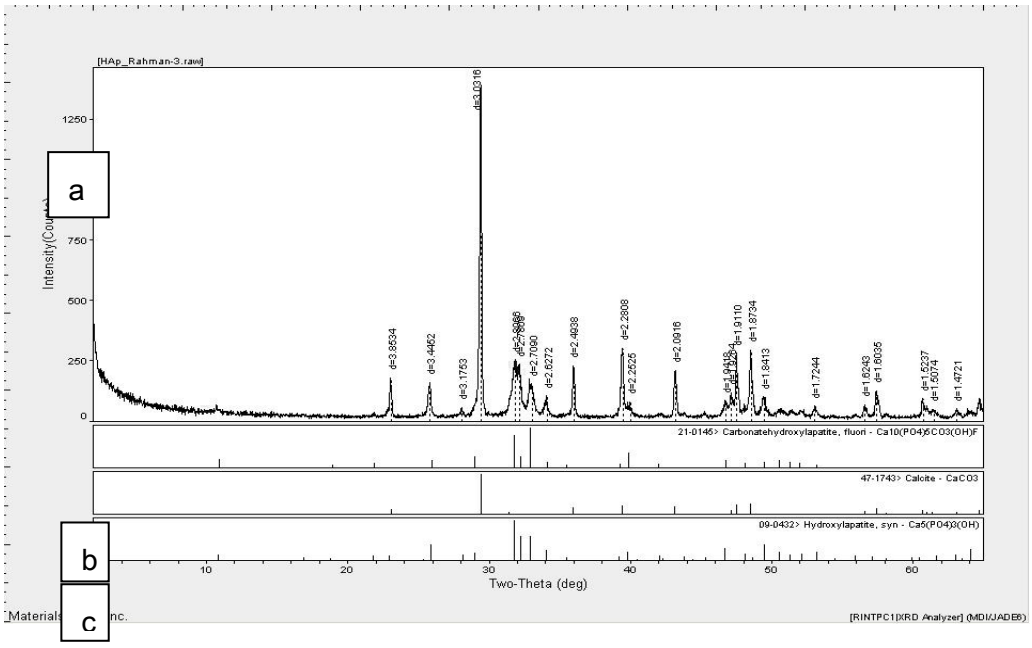

Figure 3. X-Ray Diffraction (a) hydroxyapatite synthesized from calcite (HAp), (b) Basic data of calcite on *XRD machine*, dan (c) Basic data HA on *XRD* machine

Microstructure of Hydroxyapatite-Glass Ionomercement. SEM Test conducted on specimens with a composition of 100% of GIC weight, 30% of weight of HAp-70% of weight of SIK and 30% 0f weight of HA200-70% of weight of GIC with different treatments which were to be soaked and not soaked in SBF for 28 days. SEM Testing was done with the power of 20kV with a magnification of 10,000 times. The test was carried out on the fracture surface of specimens. Before the test, specimens were put into cup and first specimens were coated (gold coating) using sputtering to determine the microstructure of the test specimens.

Results of SEM test performed on specimens with a composition of100% of weight of GIC, 30% of weight of HAp-70% of weight of GIC and 30% of weight of HA 200-70% of weight of GIC with different treatments which were to be soaked and not soaked in SBF. SEM testing results conducted with 20kV power with10,000 times magnification are presented in **Figure 5-10**.

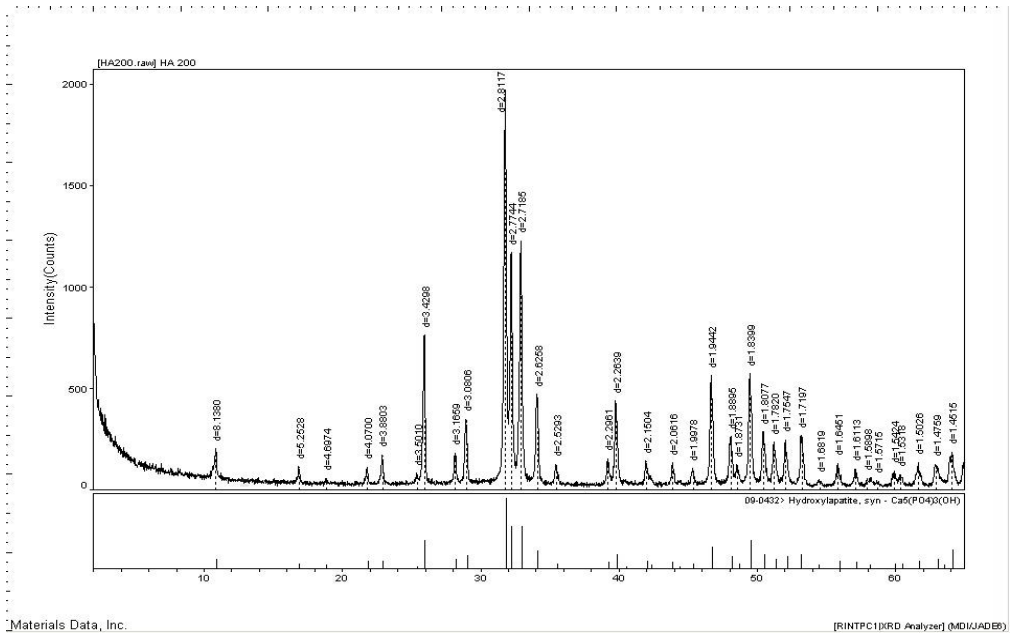

Figure 4. X-ray diffraction (HA_{200} Jepang)

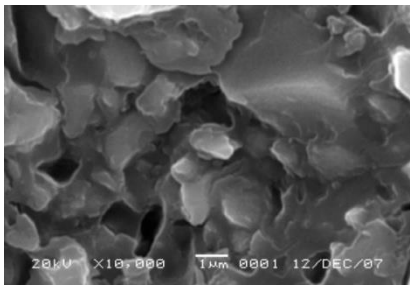

Figure 5. GIC 100% without treatment, 10.000x

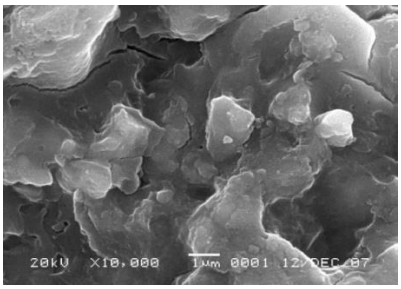

Figure 6. GIC 100% with treatment *SBF*, 10.000x

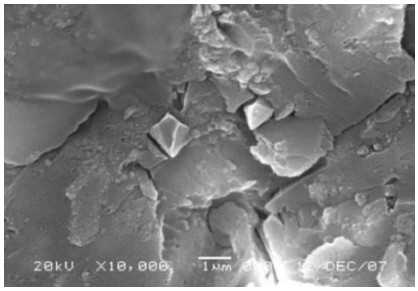

Figure 7. Biocomposites 30% HA_{200}-70% GIC without treatment, 10.000x

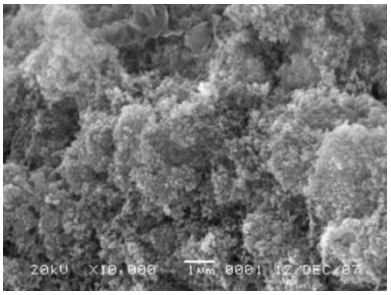

Figure 8. Biocomposites 30% HA_{200}-70% GIC with treatment *SBF*, 10.000x

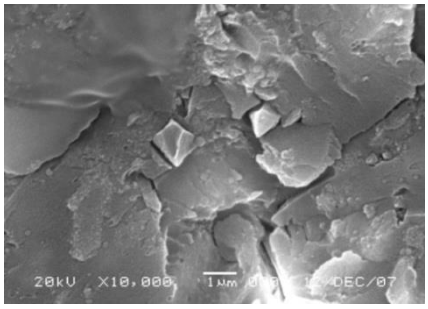

Figure 9. Biocomposite 30% HAp-70% GIC without treatment 10.000x

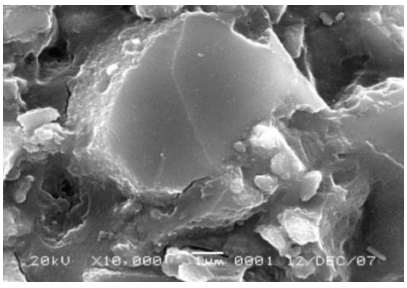

Figure 10. Biocomposite 30% HAp-70% GIC without treatment *SBF*, 10.000x

Conclusion

The graph shows that the hardness value of GIC decreased on the three compositions of 10%, 20% and 30%, but their hardness levels were not different significantly and the highest hardness value was obtained in composition of 20%. The synthesis of HAp has successfully transformed calcite into HAp which characterized by X-ray diffraction pattern at about 25,5θ° and 32,5θ° corresponding well with the database of HAp on XRD machine, there were also peaks of X-ray diffraction as a marker of calcite, at about 29.5θ°. Apatite growth can be seen from the SEM on specimens with a composition of 30%wt of GIC $_{HA200\text{-}700\%}$ after immersion in SBF for 28 Days.

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Fasilities Relayout by Using Conventional Method based on 5S (Seiri, Seiton, Seiso, Seiketsu and Shitsuke)

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Abstract

Production facilities design is one of many factors that influence company performance. This was caused by inefective facilities layout which make material flow poor, and the movement of material, product, information, equipment and labor cost is relatively high, that caused delay in finishing the product and of course adding the cost of production. Layout design in manufacturing industry is the first step in organizing production facilities layout and to have benefit of the area as much as possible. This was made to create smooth condition in materials flow, so that later can achieve material flow which is efficient and working conditions that are orderly. The layout factory problems that cannot be avoided by companies is in its operation. The distance of material movement from one department to other will create influence on increasing productivity and profitability. With high total material movement/year, it can make material handling costs will be high too. The research purpose is to know minimum material handling total, so that later on the best of final layout and can minimize cost of material handling. The Results of facilities relayout drinking water in PT Ima Montaz Sejahtera consists of some department must be added which in the beginning there are 7 (seven) department and after the design become 12 area Therefore the additional department don't need additional area. This can be done by relayout and give the region or area for the part that there was not exist before. This research use method 5S in drawing up the facilities relayout in PT Ima Montaz Sejahtera to obtain layout that is more efficient, which is The Seiri and Seiton in mechanical warehouse, Seiso in production warehouse and all department, Seiketsu and Shitsuke in all departments.

Key words: *Factory Relayout, 5S, conventional method, facilities design*

Introduction

Production facility design is one of the factors that is very influential in a company performance.This was caused by not good layout facilities, that will cause not so good pattern material flow and movement material, product, information, equipment and labor is relatively high that cause a delay settlement

products and add production costs. The plant layout can be defined as how to setting these facilities factory will support the process of production (Yamit, 1998). Settings will use area to place machine or supporting facilities, smooth motion another production moves good material is schedule as well as permanent, personal workers and others. In the layout factory there are 2 (two) thing that must be noted that is a setting of machine and setting of department in the factory. With good factory layout plan, then the back tracking, the distance of transfer material and material handling can be minimized. Kaizen was the instrument to unify philosophy, the system and a tool to solve the problems that developed in Japan for 30 years in a company to do better. Kaizen can begin to realize that each company has a problem. Kaizen solve the problem by establishing a corporate culture in which everyone can apply the problem freely (Imai, 1998). A large Definition of 5S was to use the workplace (which includes equipment, documents, the building and the space) to train habit of workers in an effort to increase work discipline that begins with Division (Seiri), arrangement (Seiton), cleansing (Seiso), Fortifying (Seiketsu), Discipline (Shitsuke) or has participated fully in the development customs work according to the rules set (Imai, 1998).

PT. Ima Montaz Sejahtera is one of the companies which is located on the way in to Public Port Krueng Geukueh, Blang Naleung Mameh, Muara satu Lhokseumawe city. This industry is moved in production bottled water (bottled mineral water). Products that are produced by consists of 4 (four) categories which are the aqua cup 220 ml, aqua medium 550 ml, aqua large 1,500 ml and aqua gallon 5 liters. The marketing region include Lhokseumawe city and north Aceh Regency in particular and the whole Aceh in general. Some problems which have the companies are a number of areas accumulations of finished goods in some places that located not uniform means that their proliferation was located where there is a place that is empty. This is the work of fork lift led to widespread; where fork lifts moving erratically follow their proliferation. In addition, this company is also not hold the standard parking lot vehicles, it meant that there were some areas empty that were made to the parking lot and mechanical equipment that fall to pieces in the work station, so the employees requires a long period of time when improving machine that were damaged, because they have to look for equipment that is needed, And in the company also there had not been musalla a standard and the rest are qualified. Working condition at PT Ima montaz sejahtera requires a number of efforts improve layout facilities by applying methods 5S. This Research purpose is to relayout facilities factory by using implementation methods 5S

Research problem is not well of organizining factory layout, the distance between one department to the other have back tracking between labor, so it need facilities layout improvement in conventional method based on 5S (seiri, seiton, seiso, seiketsu and shisuke). The purpose that want to be achieved in this research is to design relayout /new facility layout, saving the area for production, warehouse and service, get the solution and new alternative to the issues in a company, which are related to the layout factory that effective and efficient.

Methods

The method used is conventional design method by using 5S application, that is Seiri (selection) is applied to the mechanical room that is putting the equipment in place and separate unnecessary so it

does not take a long time to finish the work, Seiton (arrangement) that the goods have through the seiri process followed arrangement of equipment that have been mentioned, Seiso (cleaning) is cleaning on the production floor and equipment needed in the production process such as machines and others, Seiketsu (strengthening) is the stabilization of the methods of 5S has been applied, and Shitsuke (habituation) of this section is more focused on how to accustom them selves to the application of this 5S method.

Results and Discussion

Operations Process chart

Production process bottled mineral water 220 ml (cup) to start from material in the raw materials warehouse. Materials being transported and brought to production area. Glass cup material unpacking to then flowed through conveyor to cup wash station. After washing cup is completed, then is flowed into the filling water (filler). From filler, cup that are filled with water and then flowed through conveyor is closed with plastic as a label. Plastic label has been written expired date before by using inject print. After an operator paste label, then cup will pass shrink tunnel that produce heat and function to paste back the cup. And then, Cup goes through conveyor for packaging by using carton sealer. Finished goods are transported by using fork truck and stored in warehouse. The process of production description is described in the form Operation process chart that can be seen in the Figure 1.

Before drafting the layout plants, it is done descriptions for factory layout planning phase, first phase is planning Activity Relationship Chart (ARC) with result 12 departments, there are: Raw materials Warehouse, production department, a reservoir of water, Toilet, finish goods warehouse, office, genset warehouse, parking, mechanic warehouse, Rest room, Mushalla and Canteen.

From the ARC planning and design, then followed work sheet, block templates, Activity Relationship diagram, calculating production space requirement sheet, plant service area planning sheet, the total space requirement sheet, area template, space relationship diagram and the last is Final layout. Final layout desing from the research can be seen in the Figure 2.

5S Methods

The 5S application methods employed at PT Ima Montaz Sejahtera is as follows:

Seiri (election), method seiri be applied to the warehouse mechanics because in this department many mechanical equipment strewn on the floor. Equipment not required at this mechanic warehouse. It's make the floor becomes full. So that a worker doing repairs to damaged engine becomes narrower.Looking at the situation so needed applied seiri methods. Seiri placing equipment in their place and removing unnecessary so that workers do not need a long time to finish the job.

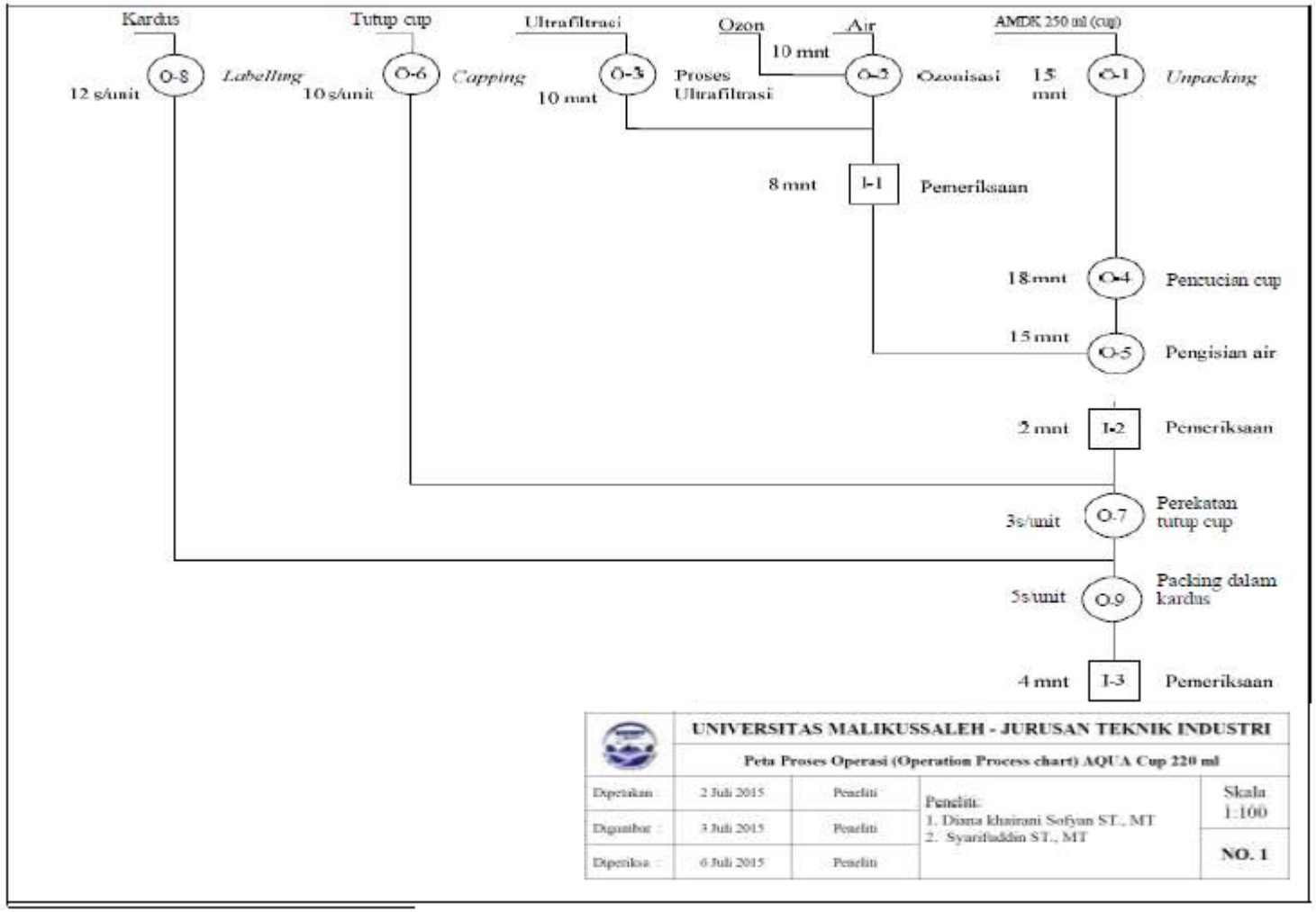

Figure1. Operation process chart of AQUA Cup 220 ml

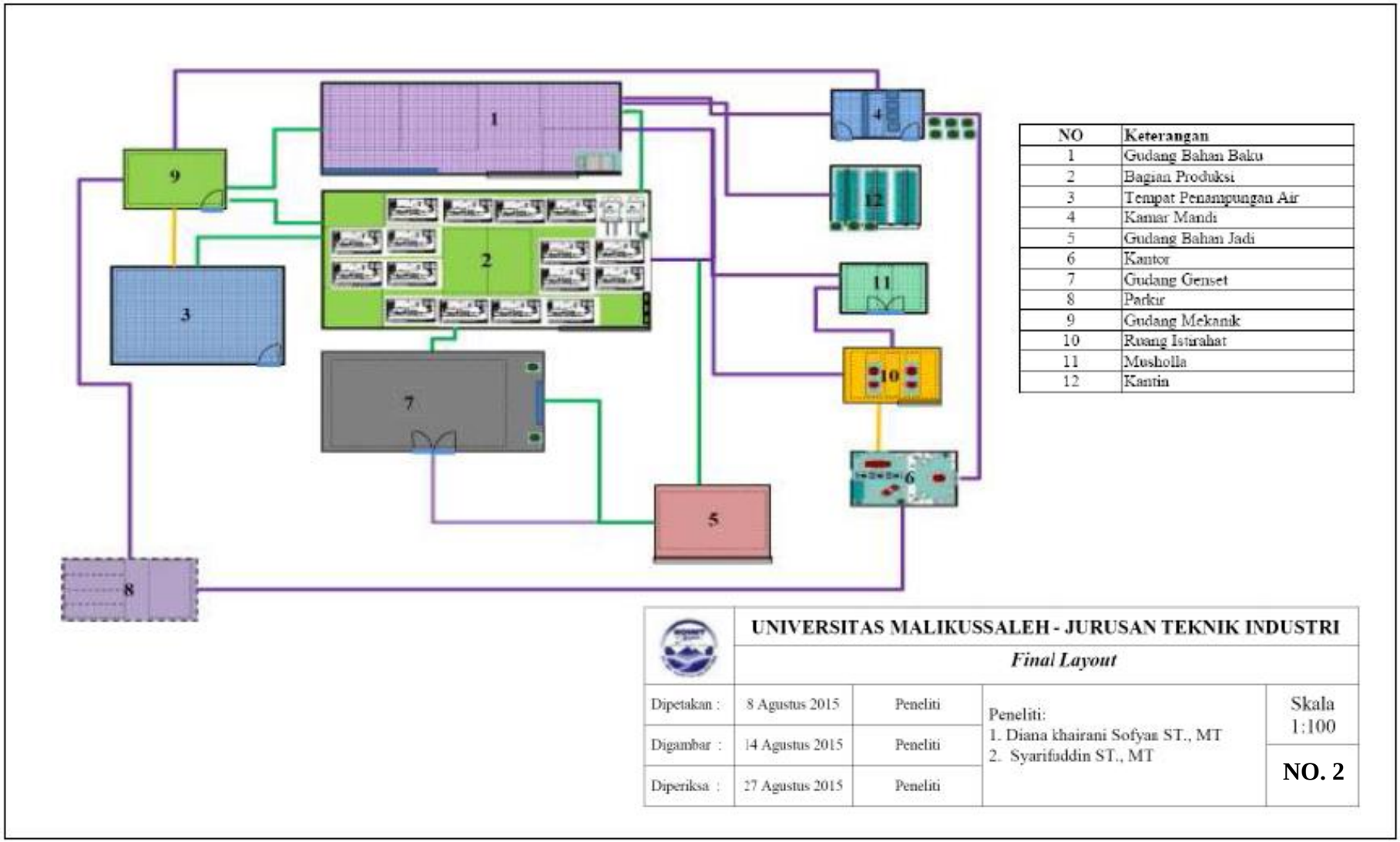

Figure 2. Final layout of PT Ima Montaz Peace

Seiton method is the continuation of seiri, where the division that has been done will be followed by ordering process equipment that has been sorted. In this equipment that is in warehouse mechanics are arranged neatly are placed in a rack mechanical equipment that is made of planks and put the names of the work for example screwdriver, hammer, bolts and so on, so that workers are easier to take and use it, do not need a long period of time when they were looking for equipment that is needed because there are already name and sets be disintegrated area, where mechanical area is no longer a room with production area, so neat mechanical equipment can be in the room and the workers is more broadly based move, not hindered by mechanical equipment that are scattered on the floor production.

Seiso, At this stage it is done is a cleansing process. The cleaning done is dust and debris spred on production and equipment that is used for the process of production, equipment which are clean up is production machines. Floor factory had been cleaned up from garbage, the dust and the oil, that they are attached to the floor, because if floor slippery and dirty can make workers stumble and fall, so that this situation is very dangerous for the labors. Disk Cleanup floor production is aimed at for the safety and comfort workers at the time his work. While for the purification equipment work was done with the aim to treatment equipment. Seiso is applied to all departments at PT Ima Montaz Sejahtera

Seiketsu, at this stage which lead to the establishment of methods to 5S that had been implemented. This stage conducted an effort how the application that has been done on continuous not for a while it's just a way of making label working areas such as the raw material, finish goods area, warehouse mechanics and other departments. In addition, is also conducted by making line area that was intended to work more organized arrangement equipment with good. With the line-making working areas can make employees know where the placement equipment and know border areas had been damaged, so that the application can take place continuously.

Shitsuke, this step is part of the latest 5S method. In this section which focuses on how to get used to it in the implementation this method, so needed awareness of the workers work pattern to have a method in accordance with 5S in comfort and safety in work. Remember that human nature is different, it is necessary to a man who could control it. in this case the role the leadership is needed to care about and able to control workers to keep working environment based on 5S method that had been implemented.

Conclusions

The conclusion from the research has been done is:

1. Relayout facilities in PT. Ima Montaz Sejahtera consists of some part and department which should be supplemented and corrected from only 7 (seven) to 12 areas, adding this department does not necessarily need additional area, this can be done by relayout and give the region or area for the part that is not yet available.
2. This research method 5S in drawing up the layout facilities in PT. Ima Montaz Sejahtera to obtain layout that is more efficient, that is Seiri and Seiton in mechanical warehouse, Seiso in warehouse production and all the department, Seiketsu and Shitsuke in all departments.

Acknowledgements

Thanks to higher Education and LPPM-UNIMAL and Mr. H. Fathani that has facilitated the activity research.

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Improvement of Working Methods on Production Department by Using Man and Machine Chart

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Abstract

Working method is procedure technical work to improve working system for the company especially manufacturing companies. Various working methods, from the research in primary operator to directly selected by certain criteria in a factory. PT Ima Montaz Sejahtera which is one of the drinking water companies in packmaging that is located in Lhokseumawe where the companies in production are always trying to meet consumer demand, with a wide marketing area is Lhokseumawe and surrounding areas until a few areas such as Banda Aceh to Medan. The company has a problem that is not able to meet consumer demand for products, where the company is only able to effectively produce as much as 420 cardboard with effective working hours is 6 hours 42 minutes (6.7 hours) for aqua cup 220 ml, so that consumers have turned to buy the product from other companies. Results of the study showed that improvements can be done by working method improvement by using man and machine chart where total number of total production, increase to 215.16 unit/day, repair work is also can be done by improving working time effective from 402 minutes to 435 minutes per day until the increase total production to 230.55 unit/day. In addition, repair work is also can be done by improving procedure of workers work. So that can minimize working time in every operation process. Last, can be done is to improve SOP (standard operating procedure) in a company, which during this is not yet available.

Key words: *working method, working procedures, man and machine chat*

Introduction

Working chart is a tool that describes the work activities in a systematic and clear. Through these charts we can see all the steps or events experienced by a workpiece from start to enter the factory (in the form of raw materials), and then describe all the steps that happened, such as: transportation, machine operation, inspection and assembly, until it becomes the finished product, either a complete product or as part of a complete product (Sutalaksana, 2006). There are also other working chart definition is a picture

of a systematic and logical in analyzing the work process from the beginning to the end. With this chart also obtained information necessary to improve the working methods, as a workpiece to be made, the operation to complete the work, the capacity of the machine or other working capacity, and the sequence of work procedures experienced by a workpiece (Aiello, 2007).

Water is the most important requirement for life. All living things in the world is always in need of water. Without water will not last the life of the well. To get qualified water to drink is not easy, for it PT. Ima Montaz Sejahtera engaged in the production of bottled water with brand Mount Aqua, always strive to produce water according to the water quality standards.

PT. Ima Montaz Sejahtera is a company that has been trusted by the community. The company produces products with three product categories that is products in gallon size is 19 liters, Large 1500 ml, 550 ml of medium and 220 ml cup. The biggest problem the company is a company not being able to meet consumer demand for its products, which the company is only able to effectively produce as much as 420 cardboard with effective working hours 6 hours 35 minutes. For superior products aqua 220 ml cup making it very difficult for companies to be able to distribute the product.

To Improve production system of companies to be able to meet consumers demand capacity it needs in a research about improve working methods. Where it will be examined and repaired methods employee work so that there has been delayed production, so that the relationship of workers and machinery will be able to work in an optimal manner, and will be achieved special targets companies that can start on time in accordance with the number of and production capacity that is expected.

The problem of research is unfulfilled consumer demand for products produced by the company in other words the company's production targets have not been met. In this case there are limitations and assumptions made, which limits the study include: The data are taken only on the production for 220 ml cup aqua products at PT Ima Montaz Sejahtera. The method used in this research is the working improvement by using man and machine chart, followed by analysis of fish bone diagram. Assuming that the activities undertaken during the research went smoothly, the company's condition has not changed during the research and the production process runs normally.

The objectives to be achieved in this research is In order for the company is able to produce just in time to meet consumer demand for products aqua cup 220 ml and To find out how improved methods of optimal working on the production, as the application and dedication to the development of science, science and technology.

Materials and Methods

Improvement working methods of Man and Machine Chart is one the methods to improve working can be applied in the company, be related among the operators and work balancing. In the repair is working method will be renovated that leads to the safety unemployed both operators and machines. So that it will be working method, improve a balanced among the operators and machine that would be disastrous effect on the production capacity in the company.

Results and Discussion

Operations Process chart

Production process bottled mineral water 220 ml (cup) to start from material in the raw materials warehouse. Material being transported and brought to production area. Glass cup material unpacking to then flowed through conveyor to cup wash station. After washing cup is completed, then is flowed into the filling water (filler). From filler, cup that are filled with water and then flowed through conveyor is closed with plastic as a label. Plastic label has been written expired date before by using inject print. After an operator paste label, then cup will pass shrink tunnel that produce heat and function to paste back the cup. And then, Cup goes through conveyor for packaging by using carton sealer. Finished goods are transported by using fork truck and stored in warehouse. The process of production description is described in the form Operation process chart that can be seen in the figure 1.

Man and machine chart prelude

Sequence of Man and machine chart prelude can be seen in the Table 1.

Table 1. Man and machine chart early for aqua Cup 220 ml

Man and machine chart -prelude Aqua cup 220 ml packing process					
maker: researcher			checker : researcher		
date : June 26, 2015			Location: PT Ima Montaz Sejahtera		
Machine activity	Duration (minute)	Symbol	Symbol	Duration (minute)	Man Activity
Stop	10			5	Prepare cup
				5	Turn on the water filling machine
Water filling machine start	2			2	Delay
Fill the water to aqua cup	10			10	Checking cup condition
Deliver aqua cup out of room	5			3	Delay
				2	Taking cardboard
Aqua cup filled with water deliver out of water filling room by using conveyor	28			5	Enfold cardboard
				13	take aqua cup and arrange it in the cardboard
				4	Close cardboard
				4	put cardboard to gluing station
				2	Lift cardboard
tape/gluing process	2			5	Arrange cardboard at the pallet
stop	3				
	60			60	

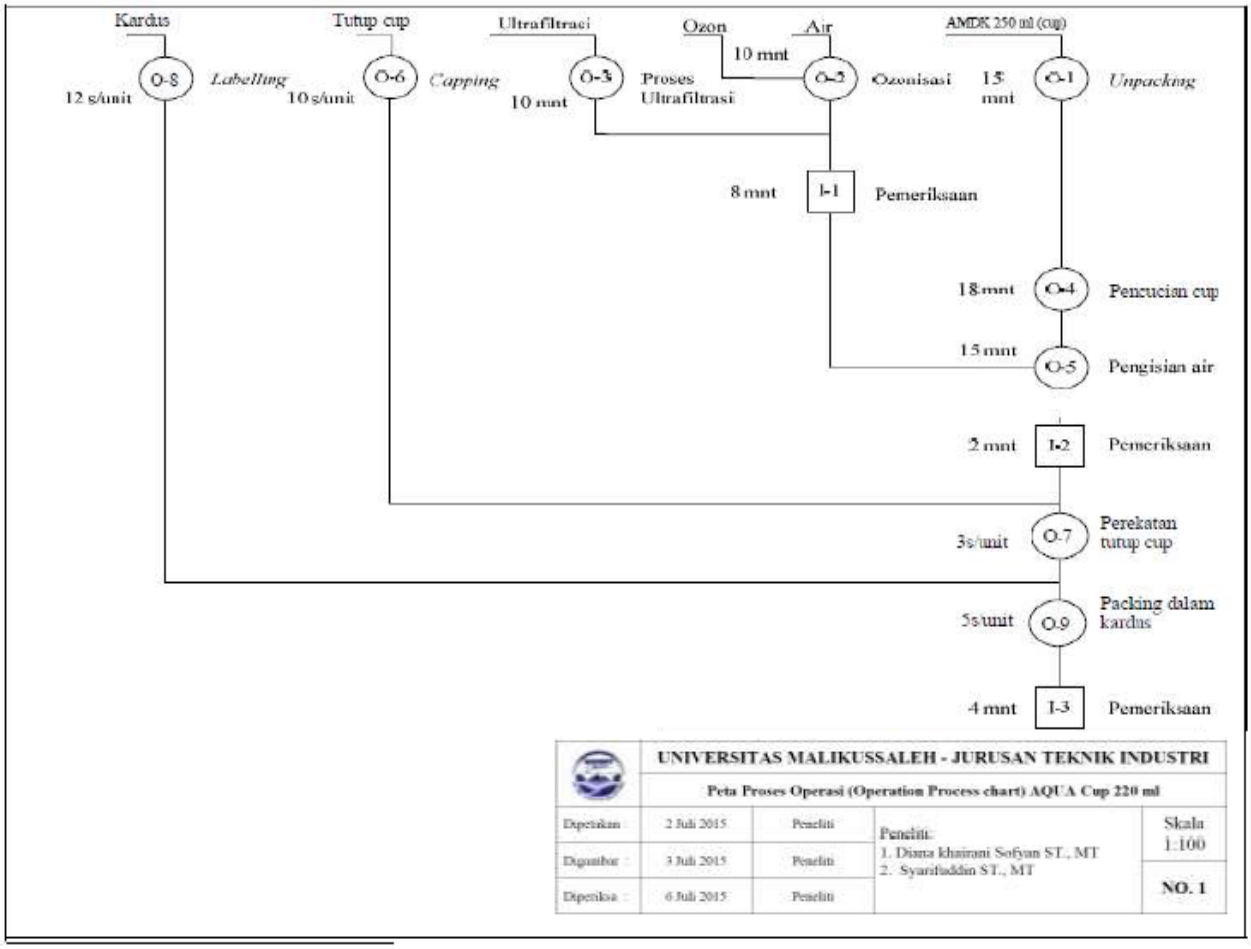

Figure1. Operation process chart of AQUA Cup 220 ml

Analyzing the calculation of production time before revition

Total production time 402 minutes per day with a total production of 420 Aqua 220 ml cup. Effective work time starts at 09:00 pm until 16:00 pm, a half hour break. So 1 minute produce 1.05 units. this unit calculation only to compare the time before and after improvement of working methods.

Revision of Man and machine chart

Revision of Man and machine chart can be seen in the Table 2.

Analyzing the calculation of production time after revision

If the effective time of the working hours that have been there are 6.7 hours or 402 minutes, then the production of aqua cup after repair work method into 60 x 1.05 = 63 units / hour, after repairs to 60 / 40x1,05 = 1, 58 units / min or 94.8 units / hour. Bringing the total production to 6.7 hours is 635.16 units Aqua 220 ml cup. Effective working hours starting at 09:00 pm until 16:00 pm, 1/2 hour rest period. If the effective working hours begin at 08.15 with a break ½ hours then obtained the total effective working time 435 minutes, the total production by using the current working methods is 456.75 units and 687.3 units for the working methods repair.

Table 2. Revision of Man and machine chart

Revision of Man and machine chart aqua Cup 220 ml packing process					
Maker : Researcher			Checker : Researcher		
Date : August 25, 2015			Location: PT Ima Montaz Sejahtera		
Machine activity	Duration (Minute)	Simbol	Symbol	Duration (minute)	Man activity
Stop	5			3	Prepare cup
				2	Turn on the water filling machine
Water filling machine start	1			1	Delay
Fill the water to aqua cup	9			9	Checking cup condition
Deliver aqua cup out of room	3			1	Delay
				2	Taking cardboard
Aqua cup filled with water deliver out of water filling room by using conveyor	20			3	Enfold cardboard
				11	take aqua cup and arrange it in the cardboard
				2	Close cardboard
				2	put cardboard to gluing station
				2	Lift cardboard
tape/gluing process	1			2	Arrange cardboard at the pallet
Stop	1				
	40			40	

Description:

Symbol	Description
	Man *activity*
	Machine *activity*
	Delay

Based on the analysis conducted there are some improvements that can be made are:

1. Improvements can be made by using improved methods of working using man and machine chart with the total number of total production has risen be 215.16 units / day.

2. Improvements can be made to improve the effective working time of 402 minutes to 435 minutes per day so that the total increases in production to 230.55 units / day.
3. Improvements can also be done by improving the working procedures that workers can minimize the work time on each operation process.
4. Improvements can be made to improve the SOP (standard operating procedure) in the company that is not yet there. SOP proposals can be seen in Table 3 below.

Table 3. Standard Operating Procedure production department of Aqua Cup 220 ml

Start date : August 20, 2015		Standard Operating Procedure	PT.IMA
proposed research	: Beginners lecturer		MONTAZ SEJAHTERA
approved	: production manager	Production department	
Page	: 1 from 1 page	Aqua Cup 220 ml	

1. Purpose : Standardize the way employees work on the production aqua 220 ml cup.
2. Coverage : Employees
3. Method administration: Training

No.	Activity	Description
1.	Prepare the cup	Prepare and check the cup
2.	Turning on the water filling machine	*On* , *off*
3.	Taking cardboard	Aqua cardboard cup
4.	Checking and folding cardboard	Fold into a box shape without glue
5.	Taking aqua and arrange in a cardboard cup	Develop until full compliance rules until a full compilation
6.	closing cardboard	closing cardboard
7.	Putting cardboard in the glueing	Push to the glueing
8.	lifting cardboard	Lifting cardboard boxes already in the glue
9.	Arrange cardboard on pallets	Lift and draw up cardboard
	finished	finished
		Lhokseumawe, August 20, 2015
		researcher

Conclusions

The conclusion from the research has been done is:

1. Improvements can be done by using improve working method using man and machine chart with the number of total production total experienced an increase to 215.16 unit/day.

2. Improvements can be done by improving working time effective from 402 minutes to 435 minutes per day until the increase total production to 230.55 unit/day.
3. Repair work is also can be done by improving procedure workers work so that they can minimize working time in every operation process to make SOP (standard operating procedure) in a company, which during this is not yet available.

Acknowledgements

Thanks to higher Education and LPPM-UNIMAL and Mr. H. Fathani that has facilitated the activity research.

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The Structural Trans *formation between Thin Film Phase and Bulk Phase of Pentacene Films Grown on Different Substrates

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Abstract

The phase transition of thin film phase and bulk phase of vacuum deposition pentacene films was investigated using out-plane and in-plane X-ray diffraction. Pentacenes were deposited on slide glass, *3-(2-aminoethyl aminopropyl trimethoxysilane)* (AEPTS) treated glass, naturally oxidized silicon wafers, 30 nm SiO_2 on Si wafers, Pt/glass and Au/Si wafer substrates by thermal evaporation on pressure of $3x10^{-4}$ Pa. The thin film phase prior grows on the glass substrate and then transform into bulk phase at a critical thickness of 58 nm. The pentacene crystallinity is better on the natural oxidized silicon wafer which contributed to vertical direction grain formation. On hydrophilic substrate (AEPTS on glass), crystallinity of pentacene declines as a result of disorder orientation of pentacene molecules shown by the decrease of peak intensity. For the 100 nm pentacene grown on metal substrates such as Au and Pt, the crystallinities of both thin film phase and bulk phase are powder-like.

Key words: Thin film growth, pentacene, different substrates, phase transition.

Introduction

Pentacene is one of the well-known organic materials for Organic Thin Film Transistor (OTFT) and Organic Field Effect Transistor (OFET) devices which are popular due its higher mobility (Dimitrakopoulos *et al.,* 2002; Bao *et al.*, 2007). There are two main pentacene polymorphs found in the thermally sublimated pentacene thin films, namely, a bulk phase with an inter-planar spacing, d ~ 14.5 Å and a thin film phase with d ~ 15.4 Å (Dimitrakopoulos *et al.,* 2002). Both bulk and thin film phases arranged in herringbone configurations (Mannfeld *et al., 2009*) with different molecule orientation angles, where on glass substrate, the molecular axis of bulk phase tilts around 25° and thin film phase tilts around 15° from the surface normal.

For the applications of OTFT and OFET devices, the different electronic transportation property of thin film phase and bulk phase is important. Both phases are quite similar in band-gap (Kitamura *et al.*, 2008), but possess drastic different effective masses of the carriers (Kitamura *et al.*, 2008) which gives rise to a much better conductivity for the thin film phase. The energy difference between these two phases is only 6.5 meV (Nabok *et al.,* 2007).The bulk phase is a more stable phase. This smaller energy difference results in phase transition during the various thin film growth conditions, which also gives rise to different electron transportation properties. The formation of different polymorphs depends on various factors such as the nature of the substrate surface (Ruiz *et al.,* 2004), the substrate temperature during growth (Yano *et.al.,* 2011), the deposition rate (Yoshikawa *et al.*, 2006) the thin film thickness (Kakudate *et al.,* 2007; Clough, 2011), and the annealing temperature of films (Kakudate *et al.,* 2007; Fukuda *et al.*, 2009). Polymorphs could also be induced by oxidation process (Lee *et al.,* 2009) or IR annealing (Wang *et al.,* 2009) after deposition. Coexistence of pentacene polymorphs in the thin film occurs frequently due to their small energy difference. Therefore, a detailed study on the phase transition between these two phases is needed. Therefore, a detailed study on the phase transition between these two phases is needed.

In this work, the transition between these two phases, especially, samples grown on different substrates, with hydrophilic substrate treatment, and after post-annealing has been studied. In addition, gamma ray irradiation was found to have a significant contribution on the transition between thin film phase and bulk phase.

Materials and Methods

Procedure

The pentacene powder (99%, Aldrich) was thermally evaporated from an alumina crucible and deposited on various substrates at a base pressure of $3x10^{-4}$ Pa and the deposition rate was 0.3Å/s. During the deposition the crucible was heated to 280℃ and the substrates were kept at room temperature. The pentacene film thickness was varied from 35 nm to 144 nm by changing the deposition time. Several substrates were studied, such as slide glass, *3-(2-aminoethyl aminopropyl trimethoxysilane)* (AEPTS) treated glass, naturally oxidized silicon wafers, 30 nm SiO_2 on Si wafers, Pt/glass and Au/Si wafer substrates.

The pentacene films on different substrates, with different thickness were investigated by X-ray diffraction (XRD), X-ray Reflectivity (XRR) and grazing incidence X-ray diffraction (GIXD) at beam-line 17B (Tsang *et al.,* 1995) of National Synchrotron Radiation Research Center (NSRRC), Taiwan, to investigate phase change of pentacene thin films.

Results and Discussion

The plane-normal θ-2θ XRD data of pentacene film deposited on glass substrate at different thickness are shown in the Figure 1. The peaks are labeled according to the lattice plane of the crystal. Since the deposition rate in this work is high, it favors the formation of thin film phase with the molecular axis 25°

titled from the perpendicular to the surface (Zheng *et al.,* 2007), the dominated peaks are denoted as $[00l]_T$ for the thin film phase. The bulk phase, denoted as $[00l]_B$ peaks, can be found growing on the top of the thin film phase at the thickness of 58 nm and the diffraction intensity of the bulk phase starts to increase as the film thickness increases. The rocking curve widths for the $[002]_T$ and $[002]_B$ at sample of 58 nm are 0.34° and 1.36°, respectively, which reveals that the crystalline order the bulk phase is inferior to the thin film one. The thickness where bulk phase starts to grow is considered as the critical thickness. Our result is similar to the work reported by Kakudate *et al.* (2007) of 50 nm pentacene film deposited on 300 nm SiO_2 at substrate temperature of 20°C.

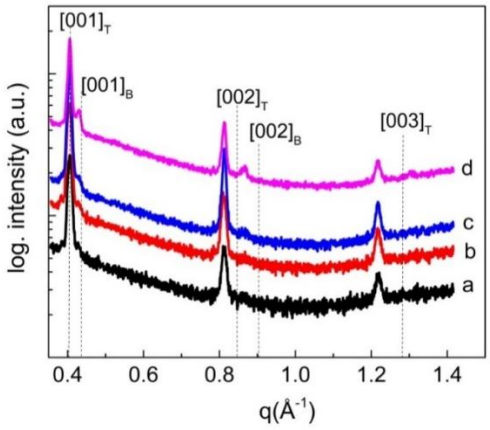

Figure 1. XRD spectra of pentacene film on the glass substrates with thickness of (a) 35 nm, (b) 58 nm, (c) 98 nm, (d) 144 nm.

Figure 2 shows the plane-normal XRD spectra of 98 nm thick pentacene deposited on a hydrophilic treated glass substrate. As revealed in the Figure 2, the angle of [00*l*] peak of treated and non-treated glass remains basically unchanged. This result suggests that the hydrophilic surface which refers to high surface energy has no strong effect on the lattice spacing and molecular orientation of pentacene thin film. On the other hand, the crystallinity of pentacene declines on the treated glass as a result of disorder orientation of pentacene molecules shown by the decrease of peak intensity. In this case, the first few layers of thin film would determine the continuity growth of the next layer of pentacene molecules. With the hydrophilic AETP surface, on the high surface energy, the first monolayer of pentacene molecule lies down on the surface, which reduces the nucleation density (Al-Mahboob *et al.*, 2013) while the growth of the next layer will follow the previous nucleation sites resulting more disordering molecules stacking at thick pentacene film compared to the untreated substrate at the same thickness.

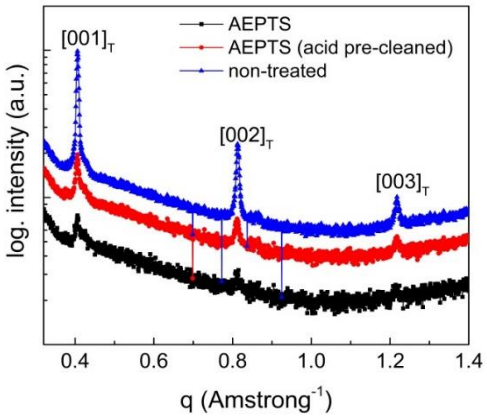

Figure 2. XRD spectra of 98 nm pentacene on hydrophilic treated and non-treated glass substrates.

For the comparison of the effect of surface morphology, pentacene was deposited on the slide glass and on naturally oxidized silicon substrate with the same thickness and conditions, as shown in Figure 3. The tilt angle on natural oxidized wafer is slightly larger than that on glass substrate. This trend of the lower surface energy results in higher tilt angle can also be found on the NaCl and Kapton substrates (Kitamura *et al.*, 2008). In addition, the diffraction peak intensity of thin film phase grown on natural oxidation wafer is higher than that on the glass substrate, which indicates that the pentacene crystallinity is better on the natural oxidized silicon wafer. By the XRR measurement of the substrates itself, we found the root-mean-squared roughness of glass is around 1 nm while for the silicon wafer, the surface roughness is less than 0.3 nm. It implies that the ordering of pentacene layers stacking vertically is better for a flat surface. On the contrary, from the 2θ width of XRD (Figure 3), pentacene film grown on the glass has a larger grain size (88.8 nm) compared to the one grown on natural oxidized Si wafer (73.7 nm) in vertical direction. On the glass substrate, the surface energy is higher, thus the interaction between pentacene and substrate is stronger, which may lead to a formation of larger grain size due to higher film coverage at first few layers (Ruiz *et al.,* 2004). The larger grain size and lower intensity of diffraction peak on the rough glass substrate might be due to the number of large grain is smaller than that on the oxidized silicon wafer. The rough surface gives rise to many disorder grains, while grains with larger size are also developed.

For the pentacene grown on the metal surface, the first few layers is highly influenced by the substrate surface energy resulting in molecules lying down on the substrate (Beernink *et al.,* 2004; Donald *et al.,* 2006). It is quite obvious that the interaction between the π bond of pentacene with the *d* or *f* orbital of metal forms a barrier for pentacene molecules to pack perpendicular to the surface. However, the interaction of non-polar molecules and metal surface usually is a physisorption system through van der Waals force (Lee *et al.,* 2010). For well covered above the first monolayer, the pentacene molecules re-orient from an initially interface-controlled structure towards a bulk-like structure. For example, Satta *et al.* (Satta *et al.*, 2007) summarized the recent results of re-orientation of few monolayers of pentacene grown on metal substrate. Similar result can also be found in the system of pentacene on Co/Cr substrate under ultra-high vacuum environment (Hsu *et al.,* 2011). As the thin film grows up to 100 nm, the films grows

into the thin film phase or bulk phase without interaction from the substrate. Figure 4(a) shows the pentacene grown on Au and Pt substrates. Both pentacene grown on Au and Pt substrates tend to have the same molecular orientation. The tilt angle is almost the same as pentacene grown on glass and silicon substrate in this work. It indicates that the long molecular axis orientation is independent of the substrate after certain thickness. However, due to the first few layers of pentacene molecules tilted far away from the perpendicular direction, the sequential growth pentacene layers are more randomly orientated resulting in a powder-like structure for both thin film and bulk phases, which can be indicated by the almost flat rocking curve scan shown in Figure 4(b).

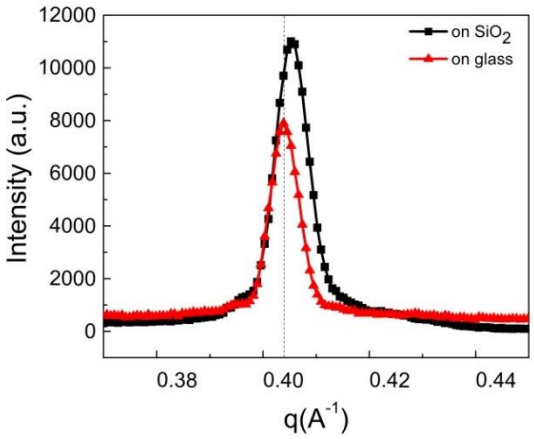

Figure 3. Pentacene deposited on glass and natural oxidized Si wafer with thickness of about 100 nm.

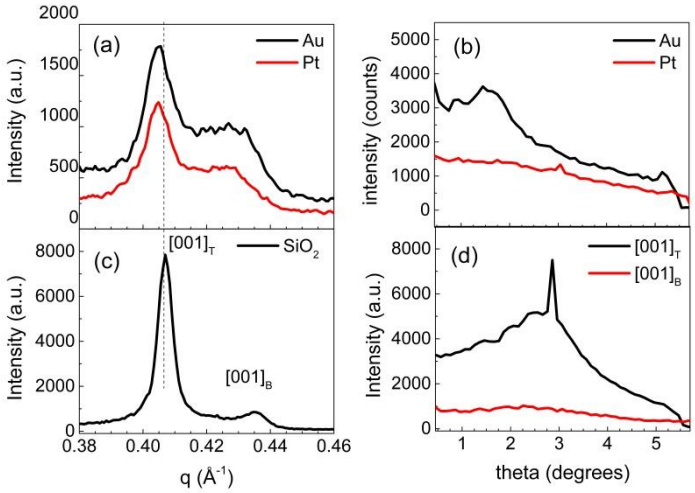

Figure 4. (a) Plane-normal θ-2θ scan XRD spectra (b) rocking scan of $[001]_T$ of pentacene on Au and Pt, (c) plane-normal θ-2θ scan XRD spectra and (d) rocking scan of $[001]_T$ of pentacene on SiO_2 /Si wafer.

To illustrate this point clearly, the 2θ scan and the rocking curve scan for the pentacene grown on SiO_2/Si wafer were also shown in Figure 4(c) and 4(d) for comparison. The rocking curve of thin film and bulk

phase shown in Figure 4 (d), suggests that the thin film phase grown in a well order orientation while the bulk phase grown more randomly to different orientations on SiO_2/Si substrate. More randomly growth orientation of bulk phase indicates that bulk phase is more powder-like. For the Figure 4(b) and 4(d), the rocking curve at lower angle side shows a higher intensity than that of high angle side. It is due to the geometrical factor. The illuminating X-ray foot print on the shallow angle side is larger than the other side.

Conclusions

The phase transition of pentacene film was investigated on different substrates with different thickness, and surface treatment. The critical thickness where the bulk phase arises is around 58 nm and the ordering of the thin film phase strongly depends on both the surface morphology. On the thick pentacene films grown on Au and Pt substrates, the crystalline of these two phases are all in powder-like structures, which indicates that the initial few monolayers of pentacene lying down in the plane affect the sequential growing orientations of thin film phases profoundly.

Acknowledgement

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Disaster Forecasting Approach In Indonesia: A Fuzzy Time Series - Markov Chain Model

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Abstract

The concept of Fuzzy Time Series to predict things that will happen based on the data in the past, while Markov Chain assist in estimating the changes that may occur in the future. With methods are used to predict the incidence of natural disasters in the future. From the research that has been done, it appears the change, an increase of each disaster, like a tornado reaches 3%, floods reaches 16%, landslides reaches 7%, transport accidents reached 25% and volcanic eruptions as high as 50%.

Key words: Fuzzy Time Series, Markov Chain, Forcasting, Disaster.

Introduction

Various kinds of natural disasters still occur in Indonesia. The disastrous events make people uneasy and lead to a health crisis. The availability of information on the past is not just a mere documentation, but can be used as a reference for predicting future events. The concept of Fuzzy Time Series to predict things that will happen based on the data in the past, to learn how the variables change at any time. While the Markov Chain assist in estimating the changes that may occur in the future. Previous research conducted by Ruey-Chyn Tsaur that using fuzzy time series and Markov chain to predict currency of Taiwan with the US dollar (Ruey, 2012). Using the concept of fuzzy time series and Markov chain, the researchers predicted the occurrence of natural disasters that occur in the future with quantitative forecasting techniques where such techniques use existing data in the past are taken directly from the national disaster management agency.

Materials and Methods

The measures undertaken in this study are:

Fuzzy Time Series

Step - 1 : for the set of the universe U = (D_{min}, D_{max}) be the same number of odd intervals ($u_1, u_2, \ldots u_n$).

Table 1. Table base interval

Interval	Bases
0.1 – 1.0	0.1
1.1 - 10	1
11 – 100	10
101 - 1000	100

Step - 2 : Make (A_1, A_2, ... A_k) be a fuzzy set that is where the linguistic determined in accordance with the state of the universe.

$$A_1 = k_{11}/u_1 + k_{12}/u_2 + ... + k_{1m}/u_m$$

$$A_2 = k_{21}/u_1 + k_{22}/u_2 + ... + k_{2m}/u_m$$

$$A_n = k_{n1}/u_1 + k_{n2}/u_2 + ... + k_{nm}/u_m$$

Step - 3 : Forming fuzzy logical relationship

Step - 4 : Set weight fluctuation

Step - 5 : Calculating the value of linguistic distribution center

Step - 6 : Defuzzification process, with both vectors are multiplied to obtain initial estimates.

$$\text{Forecast}_{t+1} = v_t\, w_t \quad t = 1,....,n$$

Where :

Forecast_{t+1} = Forcast to Time t + 1

V_t = vector line (1 x k) to Time t

W_t = vector colum (k x 1) to Time t

Markov Chain

Step - 1 : Create a probability matrix of disasters

$$P = \begin{bmatrix} p00 & p01 & p02 & .. \\ p10 & p11 & p12 & .. \\ .. & .. & .. & .. \\ pi0 & pi1 & pi2 & .. \end{bmatrix}$$

Step - 2 : Adjusting the inclination value

$$\pi(1) = \pi(0).P$$

Step - 3 : Determine the results of forecasting

Results and Discussion

Description Data

Data obtained from natural disaster relief agencies are taken in the period from July to September 2015.

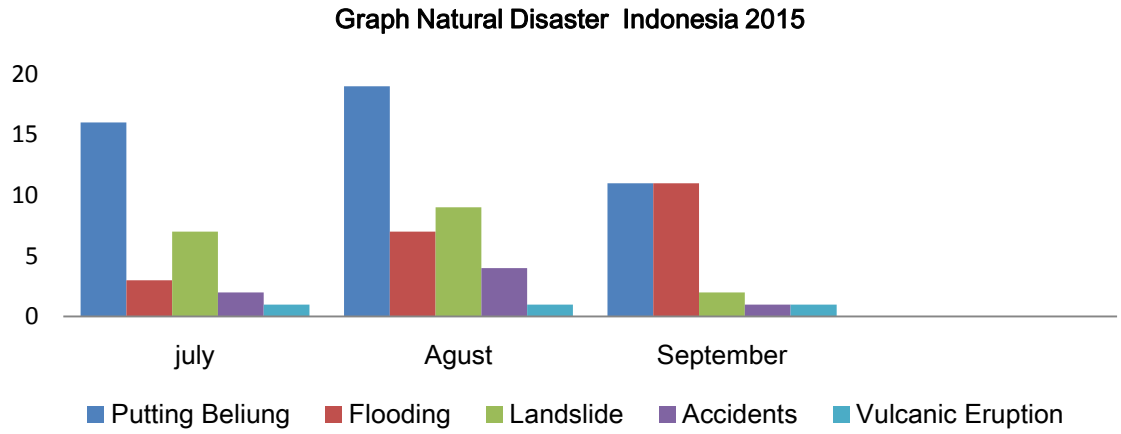

Figure 1. Graph Natural Disaster Indonesia 2015

Based on the graph Indonesian natural disasters that occurred from the month of July until September 2015 that as many as 46 events tornado, flood as many as 21 events, landslides total of 18 events, transportation accidents as much as 7 events, and volcanic eruptions as many as three events.

Table 2. Data Disaster in september 2015

No	Province	District	Type Disaster	Date/Year
1	Jawa Tengah	Pati	Puting Beliung	22/9/2015
2	Bangka Belitung	Bangka	Puting Beliung	21/9/2015
3	Jawa Timur	Situbondo	Puting Beliung	21/9/2015
4	Pemerintah Aceh	Kota Subulussalam	Banjir	20/9/2015
5	Jawa Barat	Sukabumi	Tanah Longsor	18/9/2015
6	Sumatera Utara	Nias Barat	Banjir	15/9/2015
7	Jawa Timur	Pamekasan	Puting Beliung	15/9/2015
8	Pemerintah Aceh	Aceh Barat	Banjir	14/9/2015
9	Sumatera Utara	Simalungun	Puting Beliung	14/9/2015
10	Riau	Kampar	Puting Beliung	14/9/2015
11	Riau	Kota Pekanbaru	Puting Beliung	14/9/2015
12	Pemerintah Aceh	Aceh Barat Daya	Banjir	13/9/2015
13	Pemerintah Aceh	Nagan Raya	Banjir	13/9/2015
14	Pemerintah Aceh	Bener Meriah	Banjir	13/9/2015
15	Pemerintah Aceh	Simeulue	Banjir	12/9/2015
16	Pemerintah Aceh	Aceh Utara	Banjir	12/9/2015
17	Sumatera Utara	Kota Medan	Banjir	12/9/2015
18	Sumatera Utara	Kota Binjai	Banjir	12/9/2015

19	Pemerintah Aceh	Aceh Utara	Banjir	11/9/2015
20	Sumatera Utara	Serdang Bedagai	Puting Beliung	11/9/2015
21	Jawa Timur	Tuban	Kecelakaan Transportasi	11/9/2015
22	Jawa Timur	Bojonegoro	Puting Beliung	10/9/2015
23	Kepulauan Riau	Bintan	Puting Beliung	9/9/2015
24	Maluku Utara	Kota Ternate	Letusan Gunung Api	8/9/2015
25	Jawa Barat	Kota Bogor	Tanah Longsor	7/9/2015
26	Kalimantan Timur	Kota Bontang	Puting Beliung	5/9/2015

Analysis Fuzzy Time Series

From the data obtained in the specified set of rules U = (D_{min}, D_{max}) be the same number of odd intervals ($u_1, u_2, ... u_n$). Where the number of intervals is 7. From the data obtai ned history D_{min} = 1, D_{max} = 19.

7 interval in the universe U is:

U_1 = (11, 19) U_5 = (1, 7)

U_2 = (11, 16) U_6 = (2, 4)

U_3 = (3, 7) U_7 = (1, 2)

U_4 = (2, 9)

Based on the results of the universe U can be determined fuzzy linguistic namely:

$A_1 = 1/u_1 + 0{,}5/u_2 + 0/u_3 + 0/u_4 + 0/u_5 + 0/u_6 + 0/u_7$

$A_2 = 0{,}5/u_1 + 1/u_2 + 0{,}5/u_3 + 0/u_4 + 0/u_5 + 0/u_6 + 0/u_7$

$A_3 = 0/u_1 + 0{,}5/u_2 + 1/u_3 + 0{,}5/u_4 + 0/u_5 + 0/u_6 + 0/u_7$

$A_4 = 0{,}5/u_1 + 1/u_2 + 0/u_3 + 0/u_4 + 0/u_5 + 0/u_6 + 0{,}5/u_7$

$A_5 = 0/u_1 + 0{,}5/u_2 + 0/u_3 + 1/u_4 + 0/u_5 + 0/u_6 + 0/u_7$

$A_6 = 0/u_1 + 0/u_2 + 0/u_3 + 0{,}5/u_4 + 1/u_5 + 0/u_6 + 0/u_7$

$A_7 = 1/u_1 + 0/u_2 + 0/u_3 + 0/u_4 + 0{,}5/u_5 + 0/u_6 + 1/u_7$

The next stage of the process is done by natural disasters defuzzification based on data from the month of July to September 2015. Based on the results of the set U, the universe can be generated from the data fuzzyfikasi natural disasters which can be seen in the table fuzzyfikasi following:

Table 3. Table defuzzyfikasi

Month	Case	Data	Fuzzyfikasi
July	Puting Beliung	16	A_2
	Flooding	3	A_3
	Landslide	7	A_3
	Accidents Transportation	2	A_6
	Vulcanic Eruption	1	A_7
Agust	Puting Beliung	19	A_1
	Flooding	7	A_3
	Landslide	9	A_4
	Accidents Transportation	4	A_6
	Vulcanic Eruption	1	A_7
September	Puting Beliung	11	A_1
	Flooding	11	A_1
	Landslide	2	A_7
	Accidents Transportation	1	A_5
	Vulcanic Eruption	1	A_5

For example, the data in July with tornado occurrence is 16. Because 16 including U2 interval then difuzzyfikasinya to A2.

Markov Chain

Based on the data table natural disasters can be created matrix as follows:

$$P = \begin{bmatrix} 3,2 & 0,6 & 1,4 & 0,4 & 0,2 \\ 3,8 & 1,4 & 1,8 & 0,8 & 0,2 \\ 2,2 & 2,2 & 0,4 & 0,2 & 0,2 \end{bmatrix}$$

$$\pi(1) = \pi(0).P$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \end{bmatrix} x \begin{bmatrix} 3,2 & 0,6 & 1,4 & 0,4 & 0,2 \\ 3,8 & 1,4 & 1,8 & 0,8 & 0,2 \\ 2,2 & 2,2 & 0,4 & 0,2 & 0,2 \end{bmatrix}$$

$$= \begin{bmatrix} 3,2 & 0,6 & 1,4 & 0,4 & 0,2 \end{bmatrix}$$

For forecasting results in the next year, the tornado reached 3%, reaching 16% of flood, landslides reaches 7%, reaching 25% of transportation accidents and volcanic eruptions as high as 50%.

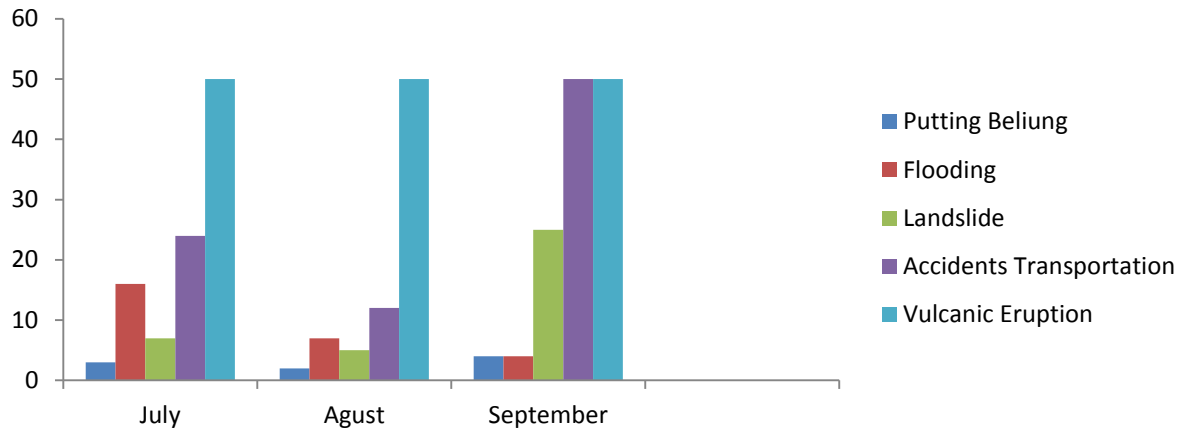

Figure 2. Graph the results forecast in the next year

Conclusions

Based on research that has been done, using fuzzy time series and Markov chain, the prediction of natural disasters following year for tornado reached 3%, floods reaches 16%, landslides reaches 7%, transport accidents reached 25% and a volcanic eruption reaches 50% , By combining fuzzy time series with Markov chain, better accuracy rate than the usual fuzzy time series.

Acknowledgements

The advice given by the author is to experiment with larger data using fuzzy time series and Markov chain.

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Tourism Information System Analysis Using End User Computing Satisfaction (EUCS)

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Abstract

Bontang one city in East Kalimantan province, it is located about 120 kilometers from the city of Samarinda, directly adjacent to the East Kutai district in the north and west, Kutai regency in the south and the Makassar Strait in the east. Geographical location 0.137 ° N and 117.5 ° East. This city stands at three major companies in different fields, Badak NGL (natural gas), East Kalimantan fertilizer (manure and ammonia) and Indominco Mandiri (coal) and has a petrochemical industrial area named Kaltim Industrial Estate. Bontang city itself is a city that is oriented in the fields of industry, services and trade. Bontang besides famous because there are three companies that, also because of the presence of the football team, FC (formerly Bontang PKT) is playing in the Superliga, Marching Band PKT Bontang, East Kalimantan built Fertilizers and Marching Band Eroh Dahana built Badak NGL Patra. Meanwhile, local television broadcast studios, LNGTV and PKTV also located in Bontang. Sightseeing in Bontang very diverse, the following is a list of attractions in Bontang: Pulau Beras Basah Island Segajah, Bontang Kuala, Padang Golf Bukit Sintuk, Kutai National Park, Park Cibodas, Cafe Singapore, the island-Tihi Tihi, Selangan island, traditional house Kutai Guntung, Lembah Hijau Lestari, Lake PKT Walnuts Water Park, Mangrove Tourism Kedindingan, are many other attractions in addition to those mentioned, such as shopping and dining (especially seafood). Therefore needed information systems analysis methods EUCS order to determine the level of satisfaction of visitors to the city of Bontang.

Key words: eucs, information system, web, culture, tourism

Introduction

In the course of history, Bontang previously only a village located in the watershed, then experienced a change of status, thus becoming a city. This is a demand of the region's diverse and growing. Bontang city itself is a city that is oriented in the fields of industry, services and trade. Bontang besides famous because there are three companies that, also because of the presence of the football team, FC (formerly

Bontang PKT) is playing in the Superliga, Marching Band PKT Bontang, East Kalimantan built Fertilizers and Marching Band Eroh Dahana built Badak NGL Patra. Meanwhile, local television broadcast studios, LNGTV and PKTV also located in Bontang. Sightseeing in Bontang very diverse, the following is a list of attractions in Bontang: Pulau Beras Basah Island Segajah, Bontang Kuala, Padang Golf Bukit Sintuk, Kutai National Park, Park Cibodas, Cafe Singapore, the island-Tihi Tihi, Selangan island, traditional house Kutai Guntung, Lembah Hijau Lestari, Lake PKT Walnuts Water Park, Mangrove Tourism Kedindingan, are many other attractions in addition to those mentioned, such as shopping and dining.

Bontang city located 150 km to the north of Samarinda. With a relatively small area compared to other districts in East Kalimantan (406.70 km²), Bontang holds an important role in the development of Kaltim and nationally. Because in a town of about 110,000 inhabitants, there are two international giant companies namely PT Badak NGL in Bontang South and PT Kaltim fertilizer in North Bontang. Bontang administratively developed as the City Autonomous Region since 1999, having previously been in the administration area Kutai Kertanegara. It is located strategically classified, on the shaft of the Trans-Borneo and Makassar Strait shipping route traversed so beneficial in supporting regional interaction with the outside area Bontang Bontang. Overall, the vast Bontang reach 49752.56 ha, of which the majority a large area of water, while the land area of about 29% or 14,870 Ha. From the diagram above, in particular the type of land use for the land area of the City Bontang shows the distribution of land use which generally consists of 3 type of use: Protected Forests and Agriculture, Industrial and Areal Urban awakened. As for the land use land area which covers an area of Bontang covering an area of 147.80 km² consists of: Forest Protected Areas / TNK: 9,025 ha (11.96%), PT Badak NGL.Co Area: 1,527 ha (3.15%), Kaltim PT.Pupuk Area: 2,010 ha (4, 04%), the effective area for development: 1,950 ha (10.56%).

There are several factors that support the development of tourism in tourist destinations such places and attractions, Tourism Infrastructure, Tourism facility, Procedure (services, safety, and comfort) and the public or the environment. Travel Attractions can be defined as anything that has a uniqueness, beauty and value in diversity of natural resources, culture, and the results were subjected to man-made or destination of tourists visit. If an area has a tourist attraction that the region could become a tourist destination, also called tourism destination which means the geographic region that are within one or more administrative regions in which there are tourist attraction, public facilities, tourism facilities, accessibility, and community interrelated and complementary realization of tourism.

Internet (interconnection-networking) is a global system of interconnected computer networks connect with each other around the world by using the standard Internet Protocol Suite. Through the Internet make it easier to obtain information, faster and cheaper with global reach. In the field of tourism, the Internet is a highly effective publicity media because the Internet is a source of information for tourists tourist destination. One of the publications that use the internet tourism information system.

Tourism Information System is a system that provides information about an attraction, tourist areas or rides in a tourist attraction. The system is also present on some information that support tourism activities such as accommodation, transportation, tickets, hotels. Tourism information system is a media

publication effective and efficient for tourism because of the cost of making the system inexpensive and very broad scope could be up to the world.

In Bontang already has a tourism information system and the system has been running around for 5 years. But from year to year, yet the development and evaluation of existing tourism information system so that there is no better system improvements. With the good tourism information system is expected to attract tourists and give effect to the development of tourism in Bontang.

To measure the success of and optimization through analysis of tourism information systems so they can know the advantages and disadvantages of the system and can be improved and the development of a better system. A good information system should be able to provide information that is complete, accurate, timely and satisfactory user. User satisfaction can be used as a benchmark for the success of tourism information systems. From the description, the researchers will analyze the information system of tourism in Bontang to satisfaction of using End User Computing Satisfaction (EUCS). This analysis model developed by Doll & Torkzadeh (2004) with more emphasis satisfaction (satisfaction) end users of the technology, to assess the content, accuracy, format, ease of use, timeliness of the system, the truth of information and interfaces.

Basis Theory

1. Tourism

According to the Law of Tourism, tourism is travel activities carried out by a person or group of people to visit certain places for recreational purposes of personal development, or to learn the uniqueness of the visited tourist attraction in a temporary period. While tourism is a wide range of tourist activities and supported a wide range of facilities and services provided by the public, employers, the Government, and Local Government. According to the World Tourism Organization (WTO), tourism is an activity anyone traveling to or living in a place outside the usual environment within no more than one year continuously, for pleasure, business or other purposes.

A trip is considered as a tourist trip if it fulfills the three requirements necessary, ie:

a) must be temporary
b) must be voluntary in the sense that did not happen because of forced
c) It does not work that are generating wage or paid

According Pendit (1999) tours can be divided into two categories based on the types, namely:

a) Nature, which consists of natural attractions, nature reserves, hunting and the meter.
b) socio-cultural Tourism, which includes historical relics, monuments and museums.

The system according to Jordan Tourism (in Leiper, 2004: 48) is the order of the components in the tourism industry in which the respective components are interconnected and form something that is comprehensive. While Bertalanffy (in Leiper, 2004: 48) defines a system as a whole interrelated elements inside each other and with their environment. Leiper (2004) tried to explain the tourism system as a whole (whole tourism system) begins by describing the journey of a traveler. From the results of the analysis he recorded 5 as a subsystem element in any comprehensive tourism system, namely:

a) Travelers (tourist) which is the human element that people who travel.
b) The area of origin of tourists (traveler-generating regions), is a geographical element that is a place where tourists start and end his journey.
a) Line haulage (transit route) is an element of the geography of the place where the main tourist trip lasts.
b) Tourist destination region as a geographical element that is the main place visited by tourists.
c) The tourism industry as an element of an organization, which is a collection of organizations dealing with tourism business, cooperation in tourism marketing to provide goods, services and tourism facilities.

2. A Tourism Information System

Bontang tourism information system is a web-based application that is used by the Department of Culture, Tourism, Youth and Sports Bontang to publicize or promote tourism and tourism activities in Bontang. Tourism information system has been running for more than five years and during his journey information system has undergone development. Although it is already happening, but the development of the information system can't provide complete information. On the system only displays the vision and mission as well as related activities of the department of Tourism, Youth and Sports Bontang District. In such systems have not been showing the existing attractions in the Bontang in full so it is necessary to develop a better system as in Figure 1.

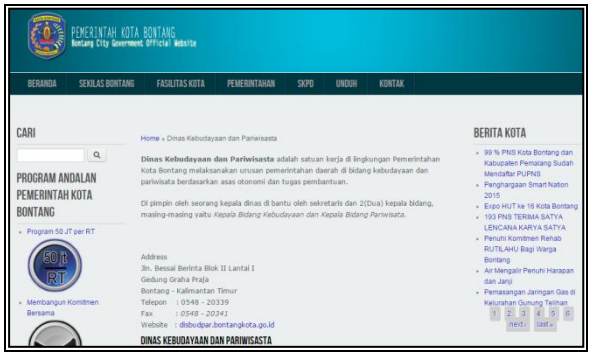

Figure 1. Interface system

3. Model EUCS Doll and Torkzadeh

Doll and Torkzadeh (1988) developed a measurement of end-user computing satisfaction because "Analysis of decision" (examination using an application specific computer in decision-making) is "generally not feasible" (p. 259), but the satisfaction is in lieu of reasonable to assess usage. Doll and Torkzadeh claims that other studies support the expectation that satisfaction leading to the use (as opposed to the cause of satisfaction). The Doll and Torkzadeh study focused on the ideas of comprehensive systems and applications (such as mini or mainframe, micro application, analysis, and application monitor). Satisfaction scale end-user computing satisfaction is a multidimensional instrument. Doll and Torkzadeh (1988) uses 40 items, and reduced to 18 items, and then reduced to 12 items. Dimension scale end-user satisfaction, namely accuracy, format, ease of use, and timeliness.

According Azleen research related to EUCS, the factors that contribute to EUCS earlier, Doll and Torkzadeh Model (1988); using five variables, namely, content, accuracy, format, ease of use, and time lines, and the model is modified by Chin and Lee (2000), by adding two variables of satisfaction with the system speed and reliability of the system (developed). Evaluation model developed by Doll & Torkzadeh (2004) emphasizes the satisfaction end users of the technology, to assess the content, accuracy (the accuracy), format, ease of use (ease of use), and time lines (punctuality system). Model Doll & Torkzadeh (2004) shown in Figure 2.

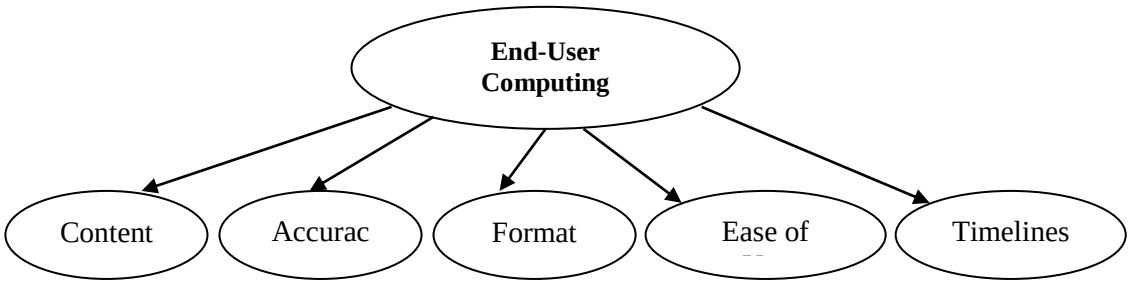

Figure 2. Model Doll & Torkzadeh

Hypothesis

In this study, using a model of End User Computing Satisfaction (EUCS) with some modifications to analyze tourism information system. A modified form of this model is to add a variable user satisfaction and interfaces. Based on the review of the literature and the theoretical basis of the above hypothesis of the overall EUCS constructed based on five factors: the content, accuracy, format, ease of use and time lines. The fifth factor is formulated to test user satisfaction and a net benefit. Picture hypothesis in this study as shown in Figure 3.

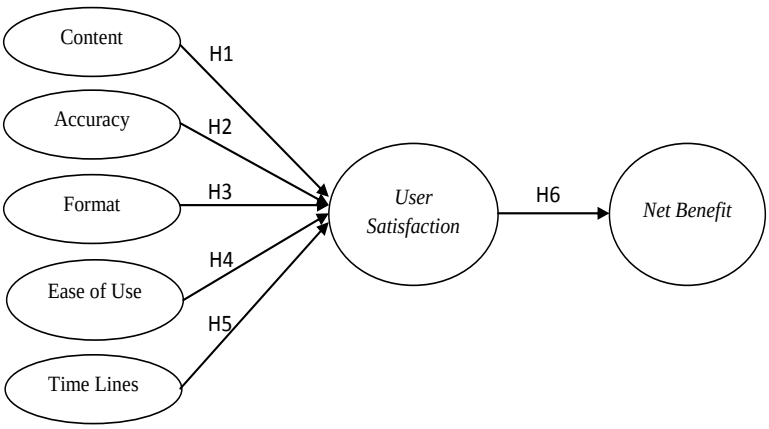

Figure 3. Model Hypothesis

H1. Fill in the information of the tourism information system positively affects user satisfaction.

H2. The accuracy of the information of the tourism information system positively affects user satisfaction.

H3. Format information of the tourism information system positively affects user satisfaction

H4. Ease of use of the tourism information system positively affects user satisfaction

H5. Timeliness of information of the information system positively affects user satisfaction

H6. User satisfaction positive effect on net benefit

Materials and Methods

Using the methods of questionnaire survey data and provide tourism information system related to the respondent. Respondents could from the Department of tourism, community, students and tourists. From the results of surveys and questionnaires conducted through software testing SmartPLS. The model used in this study is the End User Computing Satisfaction (EUCS) that has been modified is coupled with two variables. There are two variables independent variables and the dependent variable. Independent variables namely the content, accuracy, format, ease of use and time lines that will affect the dependent variable is the user satisfaction and net benefit.

a) Content,
b) Accuracy
c) Format
d) Ease of use
e) Time lines
f) User satisfaction
g) Net benefit

Model End User Computing Satisfaction in this study as shown in Figure 4.

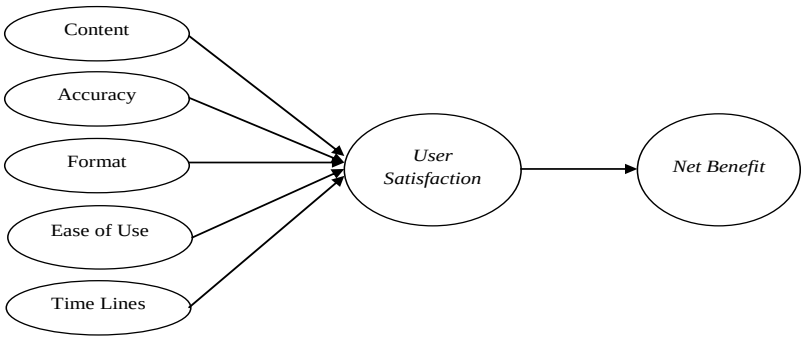

Figure 4. Model Research

Results and Discussion

Phase Problem Identification and Dissemination Questionnaire, At this stage is the stage of identifying the problem by collecting data and search for information related to the implementation of the tourism

information system in Bontang. The next stages of compiling a list of the factors that affect the tourism information system, determine research objectives to be achieved and determine the appropriate research methods are assessed using a method End User Computing Satisfaction (EUCS). Furthermore, conducting surveys and questionnaires involving end users, service users or the public, the Department of Culture, Tourism, Youth and Sports as a respondent and resources research.

Stage Processing and Data Analysis

At this stage it has obtained data from surveys and questionnaires. Processing data using models Structural Equation Modeling (SEM) with SmartPLS application.

Formulation Phase Results

At this stage it is a hypothesis testing is done by comparing the initial hypothesis of the model used by data from questionnaires that have been processed and tested using the software smartPLS.

Final stage

At this stage, drawing conclusions on the research conducted. After drawing conclusions, further expected to provide input and advice to the Department of Culture, Tourism, Youth and Sports Bontang.

Descriptive Statistics

In this section will be the tendency of respondents on each variable research, using a Likert scale assessment. The tendency of respondents can be seen from the form of descriptive statistics of each variable. Categories of respondents can be shown by the average value of the respondents' answers which categories of respondents. The answers of 80 respondents to each of the variables studied. The way the measurement data is by using a Likert scale, with 4 categories can be divided into four levels, as in the table 1.

Table 1. Scale measuring based level

No	scale	Remark
1	1,00 – 1,75	Extremely Dissatisfied
2	1,76 – 2,50	Not satisfied
3	2,51 – 3,25	Satisfied
4	3,26 – 4,00	Very Satisfied

Table 2. Mean value of satisfaction (EUCS), respondents of all variables

indicator	Mean	Remark
Contents	2,72	Satisfied
Accuracy	2,71	Satisfied
Easy to Use	2,76	Satisfied
Punctuality	2,56	Satisfied
The Mean	2,69	Satisfied

From Table 2 shows that the overall average of 2.69, so it can be said to be on a scale user satisfaction satisfied. But if we look more closely the level of satisfaction tend to approach the lower limit of the scale are satisfied, namely 2.51 primarily to the variable timing that has the lowest with a value of 2.56.

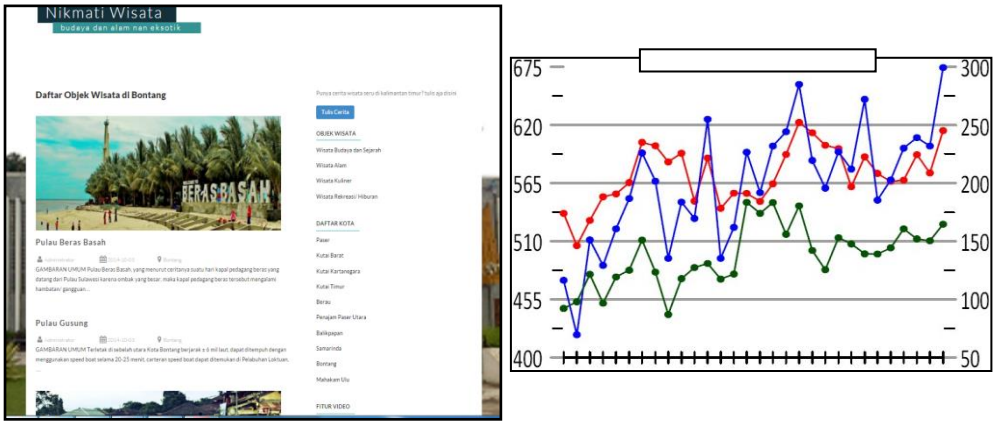

Figure 5. Increased flow of tourists the last 3 years

Conclusions

1. If an area has a tourist attraction that the region could become a tourist destination, also called tourism destination which means the geographic region that are within one or more administrative regions in which there are tourist attraction, public facilities, tourism facilities, accessibility, and community interrelated and complementary realization of tourism. based on that we need a good analysis with the aim to increase interest in tourism visits.
2. Because the existing tourism information system is not optimal, the Tourism Office Bontang still use conventional publications that utilize tourism exhibition from one region to another, making brochures, Leflet and so on. It requires a lot of cost and effort. Through a good tourism information system then it could be a means of publications and tourism information for tourists. So will be able to improve the traveler will visit attractions in Bontang.
3. Based on the average value of the variable EUCS test showed that the level of end-user satisfaction (EUCS) are in scale satisfied with an average value of 2.69. However, seeing the satisfaction level of each variable, the variable timing is the bottom with a value of 2.56. If viewed from the upper limit scale satisfied (3.25) and the lower limit of the scale satisfied (2.51), the overall average satisfaction score of each variable is approaching the lower limit. So we can say the success rate is not the maximum of information systems.

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System control on off mobile with the android application

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Abstract

Phone Cell (smart phone) is the combination of information technology and technology computing in apply in mobile manner (running) rely on efficiency, automation device, convenience, security, and austerity an electronic device. According to the development of technology, now production smart phone is thriving with different kinds of the concept and systems in wake up. Smart phone can be integrated to the production of technology other that are currently being much used as integration with arduino uno and with operating system with mobile platform that is android. The prototype from the phone of (smart phone) with client-server system based arduino uno with a user interface android which will perform data communication through a wireless (without cable). Stage the project starts by building server, build interface, and control system cell phone (smart phone). It is in server side will use programming language c and c while with user use of language programming java. On server will use a method of or protocol common gateway interface that function as a link between platform android with modules arduino uno used. On a system control and monitoring on this off, work on central control which in this system is a smartphone based android by using wireless networks. Read will burn if in gui smartphone android read lighted and read are go to die if on gui smartphone android read cut off, in this system there is a sensor LDR that serves detect a flame of read, so that user in a smartphone android can know if when ignited read out.

Keyword: S*mart Phone, Operating System, mobile platform, client-server, user interface, wireless, Common Gateway* Interface

Introduction

Phone Cell (smart phone is another name of mobile phone or cell phone. Cell phone is electronic device telecommunication which may be brought into everywhere (portable, mobile) and no need to hooked up with a network of telephone use a cable (wireless; wireless). But the ability essentially the same with a telephone conventional connected with a cable. Currently, Indonesia has two tissues a cell phone, i.e. the system GSM (global system for mobile telecommunications) and CDMA system (code division multiple access).

The phone does not can only be used to perform and received a call the phone, but also can be used to make deliveries and acceptance of short message or SMS (short message service). In accordance with technology development digital now cell phone are equipped with a choice variety features, as the ability to catch radio broadcasts and television, software audio and video player, digital camera games and services the internet.

Android is operating system based linux to mobile phone as smart phone and computer tablet. Android gives them a platform open for the developers to create their own application for use by various tool move. Originally, google inc, Buy android inc newcomers did software for cell phone. Then to develop android, formed open handsets alliance, a consortium of 34 company hardware, software, and communication including google, htc, intel, motorola, qualcomm, t-mobile, and nvidia.

By using hardware that there had been in smartphone android, it can make application by function. Others the process of making application is certainly not paid and can be done freely of open source and having the appearance of application intelligible in uses by the user.

The theory

Smartphone

A smartphone first called simon; devised by ibm in 1992 and exhibited as a product the concept of that year in comdex, a computer exhibition in las vegas nevada. A smartphone the marketed to the public in 1993 and sold by bells out. Is not only a mobile phone, a smartphone are also have a calendar; phone book, hours the world, the registry, mail, the ability transmit and receive fax and game. Telephone sophisticated was not has knobs. But users use touchscreen to select a telephone number with the fingers or make fax and memo with a stick stylus. Text inserted with the keyboard "predictions" that is unique in the screen. For the present standard, Simon is a product of low level, but its features at the moment it is very sophisticated.

Currently, the functions of the smartphone with the feature-rich communication devices. The addition of Internet access is the latest innovation in the smartphone technology. Currently, users can surf the Internet with the same ease as when using a laptop or desktop computer. At the same time, many manufacturers a line of smartphones has been working to improve the clarity and integrity of the audio signals of the basic cell phones. This helps to ensure that even with the addition of all the extra features, it is still possible to use a smartphone to make a simple phone call and expect quality sound being crisp and clear.

Development of mobile application.

The Mobile application is the process of developing applications for handheld devices such as PDAs, digital assistant or mobile phone. This application already exists on the phone during the manufacturing, or downloaded by customers of the application and of the distribution of the mobile software platform to another.

Developing a mobile application surely should have considerations in order to be used in appropriate and useful. Create mobile applications especially for smartphones would be very good if we use the native programming language. The advantages of belonging to the FIRE which is richer, more complete features, specifications and packaging system better.

Mobile Application Architecture

At the time this occurred 4 wireless 2 g digital systems in the world, i.e. TDMA, GSM, CDMA, PDC, and-One. Experts discuss the migration to formulate a "smooth" fourth system was to go to the 3rd generation technology. The old system was basically will not be removed or disposed of casually, although the development of the new system was means that infrastructure development must also be new. Migration is a "smooth" (smooth evolution) is formulated by experts as stated in recommendations Telecommunications International Mobile 2000 (IMT 2000) issued by the International Telecommunications Union (ITU). The development of 3 g technology development done by between 2.5-generation technology (2, 5 g) which is basically an introduction to the technology of data packet. Because of the difference in technology and the use of frequencies in the fourth then line to 2 g technology to generation-3 for they will be different as illustrated in Figure 1.

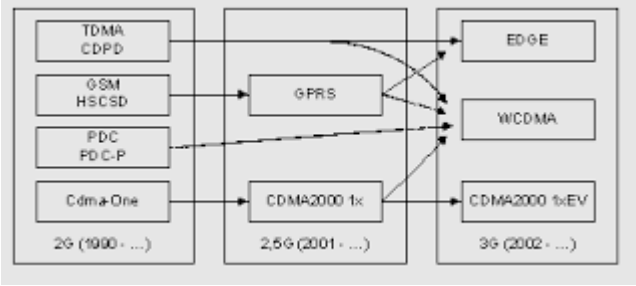

Figure 1. Migration generation-2(2G) to generation-3(3G) (the dotted line indicates the changes major changes to systems and network infrastructure)

a) 3 g System intended to provide global mobility with wider service coverage, such as telephony, paging, messaging, Internet and broadband data.
b) The International Telecommunication Union (ITU) began the process of standard 3 g system known as the International Mobile Telecommunications 2000 (IMT-2000).
c) European Telecommunications Standards Institute (ETSI) is responsible for the process of standardization of UMTS (universal mobile telecommunication systems). 1998, the Third Generation Partnership Project (3GPP) was formed to continue the work of the technical specifications for UMTS.
d) Third Generation Partnership Project 2 (3GPP2) set up to develop cdma2000 technology which is a member of the IMT-2000 family.
e) February 1992, World Radio Conference to allocate Frequencies for UMTS – 1885-2025 Mhz and 2110-2200 MHz used for IMT-2000.
f) 3 g network provides higher data transmission rate: 384 Kbps, compared to 56 Kbps GSM WCDMA using the width of 5 MHz radio signal with a chip rate of 3.84 Mcps

g) 3 times larger than the CDMA One (IS-95), which uses the width 1.25 Mhz chip rate 1.22 with Mcps.

Android

Android (operating system) – the Android OS – is a Linux-based operating system for cell phones like Smartphones and tablet computers. Android provides an open platform for developers to create their own applications to be used by a variety of mobile device.

Initially, Google Inc. bought Android Inc., a newcomer to create software for mobile phones. Then to develop Android, an Open Handset Alliance, a consortium of 34 corporations hardware, software, and telecommunications, including Google, HTC, Intel, Motorola, Qualcomm, T-Mobile, and Nvidia. At the time of the release of Prime Android, November 5, 2007, along with the Open Handset Alliance Android States support the development of open standards on a mobile device. On the other hand, Google released the code – the Android code under the Apache license, a free software license and open standard mobile device. In the world there are two types of distributors operating system Android. First got full support from Google or Google Mail Services (GMS) and the second is right – free distribution without the direct support of Google or known as the Open Handset Distribution (OHD). Android uses the interface is fun and easy to set up and manage applications on some phones the best in the world. In fact, if bringing Android phones, it's like a mini sized laptop carrying in your Pocket.

Wireless Application Architecture

Since the introduction of the technology of data packets over a wireless network (such as GPRS), providing many new opportunities to the application developer or a content developer for developing various applications of mobile communications services. For application developers, which is urgently needed now is the agreement on open architecture and the availability of Application Programming Interfaces (APIS). the 3 g technology is formulated based on the agreement of the competent experts in their field. The Organization of the International Telecommunication Union (ITU) has issued the 3 g system recommendations contained in the International Mobile Telecommunications 2000 (IMT-2000). These recommendations are:

1. Quality of Service (QoS) that can be compared to the QoS of the PSTN network
2. Development of the first phase of support data transfer rates up to 2 Mbps
3. Ability to build terminals that support a variety of systems, ranging from a 2 g system
4. up to the latest standards
5. Availability of an open architecture that allows application developers can easily build applications that are varied and rewarding

The world has got a lesson from the past by implementing technological development and application architecture that is both closed and inflexible and only allows the opportunity for the development of the technology in question. Architecture thus described vertical as illustrated in Figure 2.

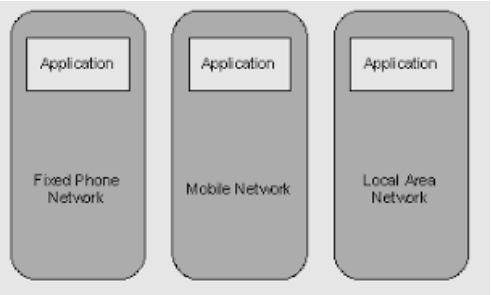

Figure 2. Technology development with the old architecture with dedicated application on the technology in question

With vertical architecture as above, technology development can only be done on the technology in question and cannot be applied (not compatible) on other technologies. This causes the growing technologies and applications are vendor-technology oriented mainly occurs in large companies that want to create their own markets against customers who need their products. For example, the in the past customers of CDMA network cannot access the SMS of GSM, CDPD packet data technology and can only be run on a network of TDMA (D-AMPS), or fixed-line phone subscribers have different answering machine with voice-mail on a cell phone. Architectural model such, third party application developers will also be very difficult to play and come into play. These limitations become more noticeably at the present moment in which the internet has developed with open architecture.

With the discovery of the world's data packet technology, nowadays the telecommunications industry is increasingly aware of the need to move the experts and application developers to quickly develop the internet move (mobile internet). From the lessons of the old architecture which is closed, then the key step to initiate the movement is the need of the development of the architecture are open and flexible operated in various technology and wireless network systems, without compromising the aspect of security and reliability of data transfer. For it is indeed required cooperation and agreement between different providers network. With its open architecture, will hopefully be developed multiplatform application, which can reach customers from a variety of existing wireless network systems.

The solution to that is a development that is both horizontal architecture with 3 mai layers, i.e. layer applications, control, and transport, as illustrated in Figure 3.

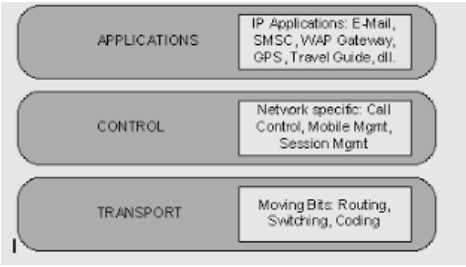

Figure 3. Technology development with new architecture that is horizontal with 3 screens

The new architecture developed with horizontal nature and consists of 3 main layers, which are:

1. Application Layer, i.e., the layer where the mobile communications applications and services developed and accessible to all the existing wireless network
2. Layer Control, i.e., the layer that handles aspects of intelligent wireless networks, such as the dial setting, tracking mobiles, billing information management, etc.
3. Transport Layer, i.e., the layer that handles data transfer where the process is happening such as routing, switching, and coding guarantees the transmission of data to the destination.

With the new architecture of the above then the understanding wireless network no longer distinguishable based on difference systems and technologies (such as GSM, CDMA, etc.) but became the basic logic is divided into functional entities. The third layer above operated above the open interface (called Application Programming Interfaces-APIS). The availability of an open FIRE to make third-party developers don't have to again think of a telecommunications protocol that will connect the application to be rebuilding, but they can concentrate more on quality, production, and distribution of the applications they build.

With the new architecture it will pop up a new business opportunity for third parties to act as an Application Service Provider (ASP). ASP operates only at the application layer with the function of providing mobile communications services and applications without having to own and operate its own network. The previous function of the application service provider with a network operator functions can only be performed by a provider network. With the growing number of sides who play in this business, then the customers on the other hand will be more felt benefited because it will be more and more applications are available with a wide variety and competitive prices.

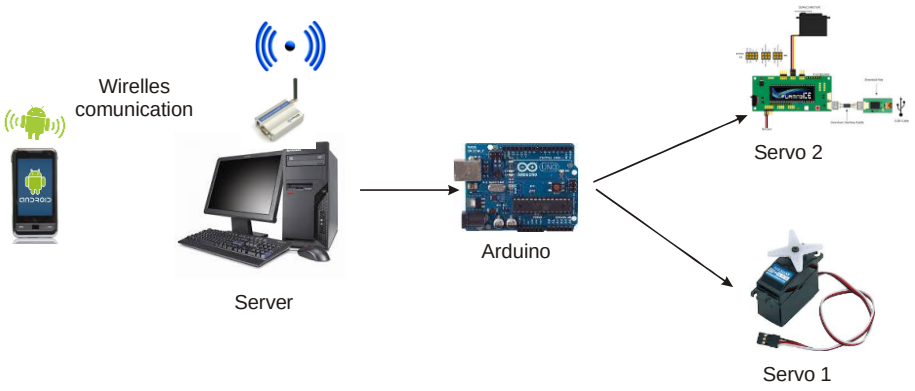

Figure 4. Implementation of designing system

Discussion

A. Supporters of The System

To complete this study used several supporting system consisting of software and hardware. Software, in making the design of android-based control. the main program of the application i.e. the IDEA of Eclipse and several ancillary programs, namely the IDEA of arduino as a tool for programming and configuration of microcontroller and wizfi, as well as a mobile phone with the operating system android 2.2 (froyo).

Hardware, other software that is used in the manufacture of this system, also used hardware to operate this system. The hardware used is a series of relay servo connected to an arduino microcontroller/and wifi.

B. Installing Applications on Device Mobile Android

This application can be installed on the system android, android application installation process control system made in the eclipse IDE through a direct installation consisting of an engineering package files and debugging, directly to your android-based smartphone device and then through the emulator or android virtual device (AVD).

Installation directly to your android device bypassing the package file by including a certificate of legality and that of objective evidence that the application was built/develope yourself. The key here is that the certificate obtained from google. The resulting file with extension UR*.apk (android package kit). The file UR*.apk that is called by the android applications, and later can install diperangkat android smartphone.

Debugging technique performed after USB debugging on your android device already active by way of connecting the device via the USB cable with the computer then on eclipse project application is compiled and executed, this process without the need for AVD again. Installing the android emulator via the aim application developers can see the results of the applications made without the need for device smartphon.

C. Testing the System.

At first the server must be enabled with the device the controllers that are connected to the server, and is connected to a voltage source. The server is already in the setting as the access point so that it can be accessed by the user via a local wireless network. Furthermore the user can control/blame and turn off the lights through programs that have been made, and which have been installed in the laptop/CPU or device in the android smartphone. After the user enters in the program that there are in computer or android smartphone. The user will be confronted directly with the main page of the application program, where on this page the user fill in the IP address and PORT once it connects via wireless.

Conclusions

a. For testing the whole system which means integrating all components in order to mutually synchronized, can be drawn that the analysis the whole system can function and integrated

with one another as well as the response of hardware and software in accordance with the input are included. This means the Smart Home systems have been built with either

b. Equipment or systems used only to turn on, turn off, and the monitor
c. This equipment can be used anywhere because the sensors in the design so as not to be affected by interference from other sources
d. Application can only be used for equipment that its mac address is already registered on the application, because these applications are auto pairing

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Molecular Dynamics on Phase Change Material Using Fokker Planck Equation

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Abstract

It has been calculated molecular dynamics equations nanofluid on Phase Change Material uses Fokker Planck equation. Particle dynamics in nanofluid usually use the equation of Brownian motion which does not describe the interactions between the particles. Fokker Planck equation are components of particle diffusion and overview of the interactions between the particles, so that got nanofluid molecular dynamics equations that can describe the physical properties of Phase Change Materials

Key words: molecular dynamics, Phase Change Materials, Fokker Plank Equation

Introduction

Phase change/transition materials (PCM), with many good thermophysical properties in thermal energy storage, have been widely investigated and applied in industrial areas for energy saving (Rao, Wang, Wu, Zhang, & Li, 2012). Energy in the form of heat can be stored in a state of sensible heat or latent heat or with a combination of both. The storage temperature depends on its use. Storage temperature can be classified as low (less than 100 ° C), medium (100 to 450 ° C) and high (higher than 450 ° C). Storage time can be classified as short duration (a few hours to several days) and long duration (a few months to a few seasons). Sensible heat storage is done by adding energy to the material to increase the temperature without changing the phase. The material used can be either liquid or solid. The most commonly used fluid is water and oil. The solid material is often used as stone, brick, concrete, iron, dry and wet soil, and many others.

According to Lane (1984), storage of latent heat energy requires a smaller volume than the sensible heat energy storage. Besides, the energy storage of latent heat can store a large amount of heat energy with small changes in temperature, however, the energy storage of latent heat still has a lot of problems about the materials used to make the process of energy storage such as high costs, low thermal conductivity and stability on thermophysics properties after processing cycles (recurrent). When the particles collide so that the particles slowed down or gets the frictional forces, hence condition Lioville equation can not be used. Instead the evolution of the distribution function is replaced by Fokker-Plank equation. Occurred as a result of collisions between the particles, the particles move randomly change. Particle called a Brownian particle has the distribution function $f(\bar{r},\bar{v},t)$ and experience the process of diffusion. Random particle motion and particle motion is not influenced by the movement of the particles beforehand.

Phase Change Materials

Sensible heat storage material must have high thermal properties, namely the specific heat Cp, density, thermal diffusivity α. Material storage should be repeated (reversible) as many cycles during hot filling (charging) and disposals/discharging. The amount of heat energy that can be stored on the state of the sensible heat can be calculated using the equation:

$$Q = \int_{T_1}^{T_2} m * C_p * dT = m * C_p * (T_2 - T_1)$$

Where "Q" is the amount of heat energy that can be stored on the state of the sensible heat (kJ), "T1" is the initial temperature (°C), "T2" is the final temperature (°C), "m" is the mass of the material that is used as a medium heat storage (kg), and "CP" is the specific heat of the material used as the heat storage medium (kJ/kg.°C). Based on this equation it is clear that the amount of heat energy that can be stored in a state of sensible heat depending on the mass, specific heat value of the material and temperature changes. It is known that water is one of the best materials that can be used to store water because the sensible heat energy available in large amounts, cheap, has a specific heat and a high density. Until now, commercial applications are still using water as thermal energy storage in liquid-based systems. Latent heat storage utilizing the latent heat contained in the material to store thermal energy. Latent heat is the amount of heat absorbed during the change in the material from one phase to another phase. There are two known types of latent heat is latent heat of fusion and the latent heat of vaporization.

Latent heat of fusion is the amount of heat absorbed when the material changes from a solid phase to a liquid phase or vice versa, then the latent heat of vaporization is the amount of heat energy absorbed when the material changes from liquid phase to vapor phase or vice versa. Indeed latent heat of vaporization is not considered to latent heat energy storage applications because of the large changes in volume is accompanied by a phase change. The amount of thermal energy storage in latent heat is determined by:

$$Q = m * LH$$

Where "Q" is the amount of heat energy stored by the latent heat (kJ), "m" is the mass of material that is used to store thermal energy (kg), and "LH" is the latent heat of fusion or vaporization (kJ / kg). Based on

the equation it is clear that the amount of heat energy that can be stored in a state of latent heat depends on the mass and the value of the latent heat of fusion or the evaporation. The material used as a store of heat energy in a state of latent heat so-called Phase Change Materials (PCM). According to Lane (1984), storage of latent heat energy requires a smaller volume than the sensible heat energy storage. Besides, the energy storage of latent heat can store a large amount of heat energy with small changes in temperature, however, the energy storage of latent heat still has a lot of problems about the materials used to make the process of energy storage such as high costs, low thermal conductivity and stability on thermophysics properties after processing cycles (recurrent). All materials are Phase Change Materials (PCM). The most important difference between this material is in the form of changes in temperature.

Each material change form (phase) at different temperatures. Besides, each material also has a different value of the latent heat and thermal conductivity. The major drawback of most of PCM is the low thermal conductivity will decrease the rate of heat transfer. The most important trait in selecting PCM is a phase change material that has a temperature which is accompanied by changes in the temperature range. Indeed, no specific material is referred to as an ideal material for use as PCM, the material has advantages and disadvantages of each.

Fokker Planck equation

Fokker-Planck equation is an equation that describes the distribution function of particles in a system that contains many particles collide (Palupi, 2010). This equation was first introduced by Fokker and Planck. Several application of the Fokker-Planck equation, among others on the erratic movement of small particles immersed in a fluid, fluctuations in the intensity of the laser beam, and the velocity distribution of fluid particles in turbulent flow. In general, the Fokker-Planck equation can be applied to the system of balance and imbalance (Frank, 2004). The initial formation of nonlinear Fokker-Planck equation is the result of collision between particles, thus changing the direction of motion at random (Brownian Motion). Particle called a Brownian particle is undergoing a process of diffusion. Random particle motion and particle motion is not affected by previous particle motion (Palupi, 2010). Fokker-Planck equation including partial differential equations (PDE) because these equations describe the rate of change of the two independent variables are time and distance (space). If seen from the equation (1), then the Fokker Planck equation is a PDE-order one of the independent variables t and a second order of the independent variables x. Fokker Planck equation is a parabolic-type PDE.

Fokker-Planck equation is an equation that describes the distribution function of particles in a system that contains many particles collide with each other. This equation contains diffusion component particles and interactions between particles (Palupi, 2010). The general form of the Fokker-Planck equation is with v the particle distribution function, A called floating coefficient (drift coefficient) and B called diffusion coefficient (Zauderer, 2006). Fokker-Planck equation including partial differential equation because it contains partial derivatives, ie derivatives with two independent variables x and t. One method to solve partial differential equation is the line method (method of lines). Line method is a specific finite difference method which produces a numerical solution to approach the actual solution. The basic idea of this method is to change the form of partial differential equations in the form of ordinary differential equations.

As a result of collision between the particles, the particles change direction at random motion. Particle called a Brownian particle distribution functions $f(\bar{r},\bar{v},t)$ and has undergone a process of diffusion. Random particle motion and particle motion is not influenced by particle motion said that before or in other words, the particles can no longer remember the previous movement (Medhi, 1982; Schuss, 1980). In other words, the particles follow a Markov process. If the shift of the particle at a time is *X (t)* and the probability distribution function is expressed in transition from the current position x_0 at s to x at the time t is s <t., Then the transition probability density or distribution function is given by

$$p(x_o,s,x,t)\,dx = Pr\{x \le X(t) < x + dx | X(t_0) = x\}$$

with

$$P(x_o,s,x,t)\,dx = Pr\{x \le X(t) < x + dx | X(t_0) = x\}$$

For a homogeneous process of transition probability density depends only on the lapse interval *(t - s)*, the transition probability density can be expressed x_0, *x,* (*t-s*) only. So that only the parameters $Pr\{x \le X(t) < x + dx | X(t_0) = x\}$ can be expressed as $p(x_o,s,x,t)\,dx$ to any t_0. Based on Chapman-Kolmogorov equation then meetings transition probabilities can written as follows :

$$p(x_o,s,x,t)\,dx = \int p(x_0,s;z,v)p(z,v,x,t)dz$$

Suppose Brownian particles in a short time interval ・ *x* ・ *t* shifted so far, the total shift in time *t* is *X (t)* after *N* steps is expressed as

$$X(t) = \sum_{i=1}^{n} Z_i$$

Z_i is a random variable that specifies the length or distance in step *i*. The time required for each step is ・ *t*, then the number of steps is *N = (t/Δt)*. Distance occur at each stage can be +・ *x* which means that the particles move forward or be ・ *x* which means particles moving backwards. Probability distance +・ *x* can be exemplified as the probability *p* and distance -・ *x* can be exemplified as *q*. Total probability of both movements thus = *p* + *q* = 1.

Fokker Planck equation that describes the evolution of distribution because of weak collisions causing minor shifts can be served in the room rate. If *f* is the distribution function does not depend on space $f(v,t)$ ・ than Fokker-Planck equation in the form (Kirk, 2002;Somov, 2003)

$$\frac{\partial p}{\partial t} = -\frac{\partial}{\partial x}(a(x,t)p) + \frac{1}{2}\frac{\partial^2}{\partial x^2}(b(x,t)p)$$

$$\left(\frac{\partial f}{\partial t}\right)_c = -\frac{\partial}{\partial v}[a_\alpha f] + \frac{\partial^2}{\partial v_\alpha \partial v_\beta}[b_{\alpha\beta} f]$$

Coefficient a is the coefficient of dynamic friction. Brownian particle gets frictional forces against the movement and the coefficient b is a diffusion coefficient that is the average change of pace. The first tribe -Planck Fokker equation is a friction that slows the beam of particles and the particles move towards zero

velocity in the phase space, while the second form of diffusion presents a beam of particles in three-dimensional space velocity.

Application Fokker Plank Equation in Molecular Dynamics PCM

Space in the PCM is composed of a fluid system. Fluid system composed of ions, which can be charged positively or negatively or positively charged and negatively so that the total charge is 0 or a neutral fluid. Because the fluid system composed of ions, the Coulomb interaction between the particles making up the fluid. Collisions in a fluid can not be determined uniquely as the neutral atoms (Bennz, 2002). Coulomb potential interactions with other particles gives the effect that the first two test particles moving in a fluid experience deviations from the original direction, which both accelerate particles terrain. The influence of the latter accounted for a loss of energy and provide frictional forces on the motion of test particles. Both of these effects depends on the ratio of the two particles. Review the fast particle beam in a fully ionized fluid thermally gets the internal magnetic field H_0. An internal magnetic field that determines the course of the particle. Suppose tesusun fluid on thermal electrons and protons that are in thermodynamic equilibrium and *v* is the particle distribution function test of the equations of motion of a particle is (Somov, 2003).

$$\frac{df}{dt} + v_\alpha \frac{\partial f}{\partial r_\alpha} + \frac{q}{m}\{\boldsymbol{v} \times \boldsymbol{H_0}\}\frac{\partial f}{\partial v_\alpha} = -\frac{\partial f}{\partial v_\alpha} J_\alpha$$

When viewed in a stationary state, and only depends on the variables of space alone or with a z-shaped field direction H_o, $f = f(z, v, \theta)$ form

$$v\cos\theta \frac{\partial f}{\partial z} = \frac{1}{v^2}\frac{\partial}{\partial v}(v^2 J_v) - \frac{1}{v\sin\theta}\frac{\partial(\sin\theta J_\theta)}{\partial\theta}$$

by equating with the Fokker-Planck equation becomes

$$x\cos\theta \frac{\partial f}{\partial \delta} = \frac{\partial F(x) f}{\partial x} + \frac{\partial^2}{\partial x^2}[D(x) f] + D_\theta(x)\Delta_\theta f$$

The first coefficient on the *F(x)* which determines the energy loss when the accelerated particles through the fluid. The second coefficient is *D(x)* describe the diffusion of energy. The third $D_\theta(x)$ coefficient associated with particle diffusion quickly on Considering the electron mass is much smaller than the mass of the electron. In this case, the coefficient on Fokker Plank equation becomes:

$$D(x) = \frac{1}{\sqrt{x}}\left(1 + \frac{m_e}{m_p}\right)$$

$$F(x) = -\frac{m}{m_e}\frac{1}{\sqrt{x}}\left(1 + \frac{m_e}{m_p}\frac{1}{x}\right)$$

$$D_\theta(x) = \frac{1}{2x\sqrt{x}}$$

The first tribe in the coefficient D (x) Brazilians donated fluid thermal collisions between electrons, while the second term is the contribution to the thermal protons. The first two show the energy coefficient of

diffusion due to collisions with electrons m_p/m_e thermal more than proton because of collisions with thermal. While the speed of diffusion angle is determined equally by the electron and proton fluid. Test particle velocity distribution in the fluid can be determined by using the Fokker Planck equation in space speed. Review the set of test particles with the same speed that is easy to move, test particle velocity distribution d approached isotropic before loosing power. If the particles are mobile field, drag on the particle slows the particles before the turn. The time between the test particles begin to change the direction of movement is generally different from the time when the particles lose power or lose momentum.

Conclusions

Fokker Planck equation is a diffusion equation that describes the distribution function of particles in a system that contains many particles collide with each other. The equation can be used in molecular dynamics recall PCM in the form of a fluid chamber, which is composed of charged particles. Particle motion and diffusion processes in the plasma can be solved by using the Fokker Plank equation in the coordinate space and in space velocity. Scattering, interaction and diffusion process occurs not only because of the interaction between the particles but also the interaction between the particles and electromagnetic.

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Effect of Plastilizer Concentration on Bioplastics Based on Mixture of Cassava Starch With Polylactic Acid

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Abstract

The applications of bioplastic base on cassava starch and polylactic acid as a potential alternative choice. Synthesis of bioplastics made from a mixture of cassava starch and polylactic acid on variation of concentration plasticizer glycerol and polylactic acid has been studied. The general aims of this research are the synthesis and characteristic of bioplastic base on casavva starch with glycerol and polylactic acid modification. The bioplastic characteristic consist of, tensile strength, elongation, spectra of molecule structure by FT-IR (Fourier Transform Infra Red) and biodegradation. The research used 5 combination of glycerol and polylactic acid. The results of this research showed that treatment by added of polylactic acid and glycerol was improved the physic and mechanical of bioplastic. The optimum tensile strength was showed at increasing plastilizer glicerol 2.00 ml and polylacted acid 5.00 ml was value 5.10 MPa and elongation 84.96% . Base on data of FTIR, the film plastic that produced did not happen change function group so we can know that interaction in film plastic thta produced just physical interaction. Cassava starch add polylacted acid based films plasticized with glycerol showed interesting mechanical properties being transparent, clear, homogeneous, flexible, and easily handled. The result of bioplastic cassava starch as raw material and treatment by added polylacted acid and glycerol would degradation in natural way.

Key words: cassava starch, biodegradable plastics, mechanical properties, plasticizer

Introduction

Over the last decades, the use of conventional plastics as food packaging material has increased considerably. Convetional plastics are widely used for packaging and other applications because of their several advantages compared to other materials. For example, plastics are inexpensive, light weight and chemically inert. Moreover, they are heat-sealable, easy to print on and offer the flexibility of fabricating into various shapes. Unfortunately, conventional plastics have their origin in petrochemical industry making them non-biodegradable and non-renewable (L. Janssen, 2009 and Q.X. Zhang, 2007). The non-biodegradable and non-renewable nature of plastics has been a serious disadvantage to their application leading to huge municipal wastes and environmental degradation.

So the use of conventional plastic as food packaging material facing various environmental problems, which cannot be recycled and cannot decompose naturally by microbes in the soil, resulting in the accumulation of plastic waste that causes pollution and demage to the environment. Therefore, to replace the conventional plastics with biodegradable plastic base on starch can solve this problem.

Starch is a natural polymer, inexpensive, readily available, and often used as a filler for the replacement of petroleum-derived synthetic polymers to decrease environmental pollution. However, starch has severe limitations because of its solubility and poor water-resistance, making starch products very sensitive to the relative humidity at which they are stored and used. Starch and its major components, amylose and amylopectin, are biopolymers, which are attractive raw materials for use as barrier in packaging materials. Starch often used in industrial foods. They have been used to produce biodegradable plastics to partially or entirely replace conventional plastics (plastic polymers) because of its low cost and renewability, and it has good mechanical properties (Xu et al., 2005).

Starch has been considered as the most promising raw material to develop new environmentally friendly materials especially for packaging and disposable applications because of its low density, its renewable character and its complete biodegradability, and its availability worldwide under different shapes at relatively low cost (Chivrac et al., 2010a,b; Garcia et al., 2011; Wu et al., 2009; Wilhelm et al., 2003a; Almasi et al., 2010).

The main disadvantages of biodegradable plastic base on starch, compared to conventional plastics, are their hydrophilic character and their poor mechanical properties which lead to low stability (Li et al., 2011; Lopez et al., 2011). In order to replace conventional polymer by biopolymers, these drawbacks have to be circumvented. Indeed, depending on the targeted applications, one may need specific properties such as stiffness, flexibility, and strength.

And also, there are some strong limitations for developing starch based products, since they present poor tensile properties and high water vapor permeability when compared to conventional films derived from crude oil (Souza et al., 2010) on account of their hydrophilic nature and their sensitivity to moisture content, a factor that is difficult to control (Wilhelm, Sierakowski, Souza, & Wypych, 2003).

Numerous studies have been conducted to optimize the properties of biodegradable plastic base on starch. The most important properties in bioplastic materials include mechanical and thermoforming properties, gas and water vapor permeability, transparency and availability (L. Janssen, 2009).

The main objective of this study is to the synthesis and characteristic of bioplastic base on casavva starch with glycerol and polylactic acid (PLA) modification. To be selected of PLA due to PLA has attracted both industries and research institutions. It is one of the biopolymer whose properties are comparable with the commercial plastic such as poly(ethylene terephthalate) (PET) (M. A. Huneault, et al, 2007).

PLA production is derived from annually renewable resources such as corn starch, cassava starch or sugarcanes. PLA exhibits good properties such as biodegradability, heat resistance, transparency, good mechanical properties and processability (S. L. Yang, 2009 and Y. Lemmouch, 2009), causing it to be used in many packaging applications. The important requirement for packaging materials is high tensile

strength, ductility, flexibility, transparency and good barrier properties (N. Ljungberg, 2003). However, PLA is still limited for its application because of its price (expensive because of the complicated synthesis), brittleness, rigidity and low crystallization rate (M. A. Huneault, 2007 and S.L. Yang, 2009). Therefore, plasticizers are used to increase the flexibility of PLA for packaging applications such as, packaging films, wrap films, stretch films and agricultural mulch films.

Materials and Methods

Procedure

a) Starch extraction

Starch was extracted from cassava and tree cassava tubers, grown in Indonesia and was purchased from the lokal market. The cassava roots are ripe after 12 months (Chatakanonda et al., 2003). For each species, the tubers were washed, peeled and grated. The resulting paste was mixed with water and the solution was filtered on a clean cloth. The collected filtrate was then allowed to stand for 6 hours followed by the removal of the supernatant. The white precipitate (starch) was then recovered, sun-dried and stored in polyethylene bags at room temperature.

b) Film preparation

The method of preparation was adapted from Cyras et al. (2008), Müller et al. (2008) and Araujo-Farro et al. (2010). Cassava starch film solutions (concentration 10% w/v) was stirred at room temperature for 15 minutes on a magnetic stirrer (250 rpm). The solutions was added glycerol (Merck Millipore, 85%) and polylacted acid (PLA) that polylacted acid produced by polymerization of lactic acid (L (+) Sigma-Aldrich, 98%) to polilaktat acid (APL) by heating 200 ml of lactic acid in the temperature of 70-75 OC for 10 minutes then added 2 grams of catalyst SnCl2 evenly stirred while heated in the same temperature for 15 minutes and then cooled and the viscous liquid obtained polylacted acid. The mixture was then heated at 80±2 OC in a thermal bath under constant stirring for 30 minutes. Then the films were obtained by casting, pouring the hot suspension into rectangular moulds. These moulds were left at room temperature for at least 4 hour to allow bubbles to dissipate and then dried in an oven with air circulation, at 30 OC for 24 hours. The dry films were removed from the moulds and stored at controlled conditions (25 OC and 75% of relative humidity) for at least 48 hours before measurements.

c) Film Testing Method

In general, the physical and electrical properties of plastics are influenced by temperature and relativ humidity in a manner that materially affects test resualts. In order to make reliable comparisons between different materials and between different laboratories, it is necessary to standardize the humidity conditions, as well as the temperature, to which specimens of these materials are subjected prior to and during testing. Therefore, all films were conditioned prior to subjecting them to permeability and mechanical tests according to Standard method, ASTM-D618-61. Films used for testing Water Vapor Permeability (WVP), Tensile Strength (TS) and Elongation (E) were conditioned at 75% relative humidity and 25 OC by placing them in a desiccators over a saturated solution of Mg (NO3)2.6H2O for 24

hours or more. For other tests, film samples were transferred to plastic bags after peeling and placed in desiccators. The tensile strength and elongation at break of the films were measured using a computer type universal testing machine (HUNG TA, TH-8503) according to the ASTM D 882-02 method.

d) Scanning Electron Microscopy (SEM)

Scanning elektron microscopy film surface morphology was examined using scanning electron microscopy. The samples were mounted on stub with double-sided adhesive tape and coated with a thin layer of gold (JEOL JFC-1600 auto fine coater). Images were taken using a JEOL JSM-6510-LA Japan with an accelerating voltage of 0.5 to 30 kV. TEM images were recorded with a JEOL model transmission electron microscope, operating at 200 kV, with a point-topoint resolution of 0.3 nm.

Results and Discussion

The effect of the addition of glycerol (1.00; 1.50; 2.00; 2.50; and 3.00 ml of cassava starch film solutions) to cassava starch films to test the mechanical properties was studied. The mechanical properties of films plasticized by glycerol was assessed by measuring their tensile strength (TS) and elongation at break (E%) for five plasticizer concentrations.

Elongation at break is the extendibility of film length from initial length to the point of break. Moraes et a, defined elongation at break (E%) as the ability of films to deform before finally breaking. This parameter (E%) helps to determine the flexibility and stretchability of films. In general, the film appearance was transparent. The addition of glycerol from 1.00 to 2.00 ml improved the flexibility of the cassava starch films (Figure. 2). However, films which had more than 2.0 ml of added glycerol were hard to peel since the film was so sticky it would tend to and stick to itself.

Table 1. Effect of glycerol and PLA concentration on tensile strength and elongation

No	Glycerol (ml)	Tensile Strength (Mpa)					Elongation (%)				
		Polylacted Acid, PLA (ml)					Polylacted Acid, PLA (ml)				
		1.00	2.00	3.00	4.00	5.00	1.00	2.00	3.00	4.00	5.00
1	1.00	3.33	3.82	2.94	3.43	4.31	35.52	16.12	55.00	33.88	16.40
2	1.50	3.65	4.80	4.61	4.71	5.00	43.60	103.44	74.04	80.76	93.72
3	2.00	4.31	4.84	4.12	5.00	5.10	51.56	101.40	50.76	48.32	84.96
4	2.50	3.33	4.61	3.55	4.70	4.61	29.56	49.00	36.56	27.44	31.00
5	3.00	3.43	4.41	3.14	4.21	4.70	83.28	41.24	40.52	50.08	39.40

Figure 2 show the changes in tensile strength (TS), elongation at break (E%) as well as Young's modulus (E) of cassava starch films with different amounts of concentration of glycerol and polylacted acid. The results showed that an increase in the concentration of plasticizers yielded a increasee in TS and elongation (E) (Figure 2.). Glycerol is added in the composition of the plastic compiler will insert into the structure of the starch and then the hydrogen bonds in the starch is reduced in the presence of glycerol. Plasticizer has the ability to reduce internal hydrogen bonding intermolecular bonds. The addition of the plasticizer lowers intermolecular force, increase the flexibility of the film and the film barrier properties.

Figure 1a. Cassava starch film

Figure 1b. Cassava starch film

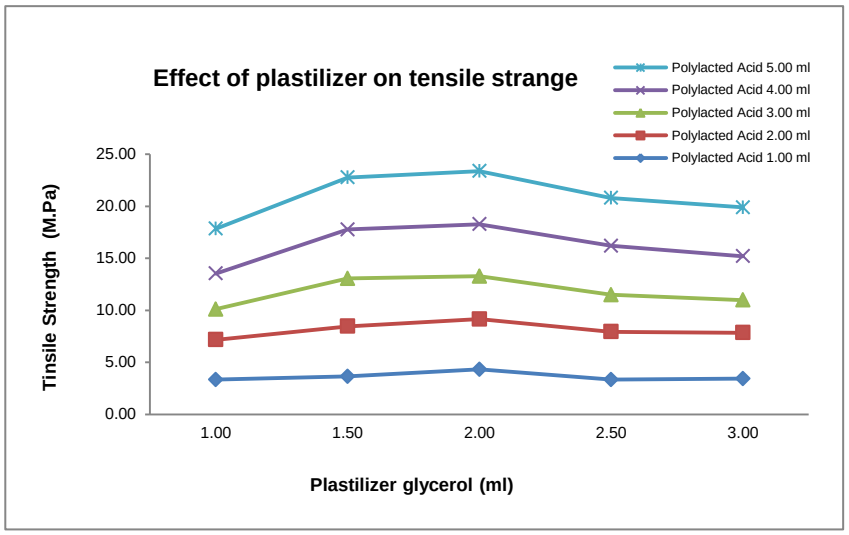

Figure 2. Effect of plastilizer on tensile strange at variaty PLA

The changes in mechanical properties of characterized by the plasticizers weakening the intermolecular forces between the chains of adjacent macromolecules, increasing the free volume and causing a reduction of mechanical resistant (Sorbal et al., 2001). Thus the increase in the plasticizer concentration causes a reduction of the TS due to the decrease in the intermolecular interactions. Besides, the increase in the plasticizer concentration increases the moisture content of the film because of its high hygroscopic character, which also contributes to the reduction of the forces.

Film Plastic Surface Morphology

Morphology, hygroscopicity and mechanical characteristics of the film plastic produced is closely related to the concentration of glycerol and APL that were added in synthesizing of the film plastic produced. Effect of glycerol concentration and APL were added to the on morphology films can be seen in Figure 3.

Visually one of the results of scanning electron microscopy film plastic produced for optimum conduction (plastilizer glycerol 2.0 ml and APL 5.0 ml) is not porous and its looks smoother, no cracks or air bubbles.

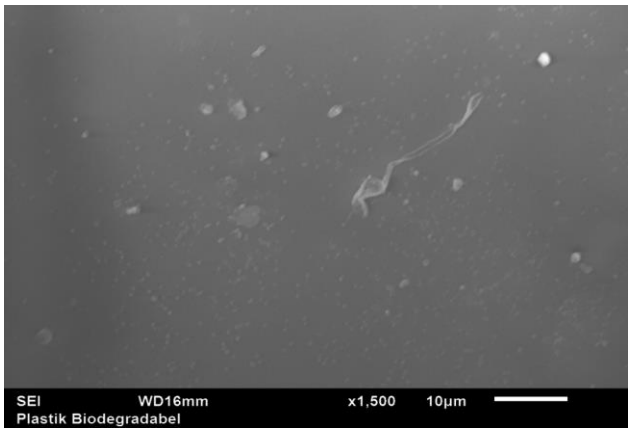

Figure 3. Film Plastic Surface Morphology

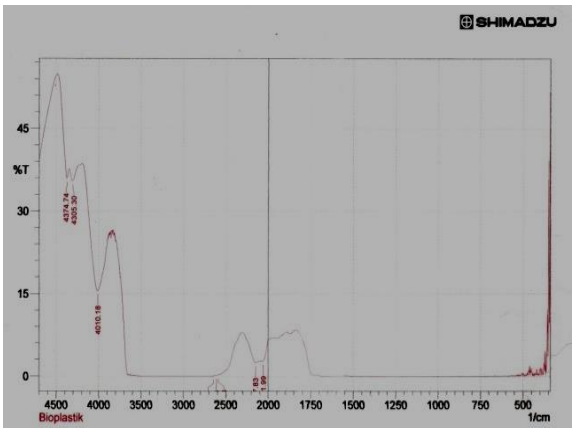

Figure 4. Spectrum FTIR Film Plastic

Indeed, if review again packing the resulting film morphology there are a number of starches that this clumping occurs because of the starch is not soluble depleted due to the effect of stirring the temperature conditions at the time the plastic film is made. According to the spectral data in Figure 4, the spectrum of the plastic film produced is almost similar to the constituent components of starch, constituent components of starch. There is no happen change and there only is the process of blending physics. There are the group C = O and CO ester carbonyl is indicated that film plastic is environmentally friendly.

Conclusions

1. Cassava starch based films plasticized with glycerol showed interesting mechanical properties being transparent, clear, homogeneous, flexible, and easily handled.
2. The results establish that films plastic based on cassava starch mixture with polylacted acid and plasticized with glycerol can be considered as an interesting biodegradable alternative packaging material.
3. Plastic film made from cassava starch by using glycerol and the addition of plasticizers polilaktat acid (PLA) has mechanical properties such as transparent white, clean, homogeneous, easily bent and easily handled.
4. The optimum value of tensile strength occurs upon the addition of plasticizers glycerol 2.0 ml and 5.0 ml polilaktat acid additions is to 5.10 MPa.
5. Plastic film hydrophilic or not resistant to water and the resulting functional groups together with the constituent components of starch.
6. In the synthesis of plastic film that is happening is the process of blending physics and the group C = O and CO ester carbonyl make environmentally friendly plastic.
7. further research needs to be conducted to see the effect of temperature variation on mechanical properties of bioplastics.

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Alternatives to Chemical Fertilizer on Making Nata De Coco

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Abstract

Nata de Coco is a type of light snacks rich in fiber and minerals. The basic raw material manufacture of Nata de Coco is pure coconut water can be obtained on the coconut fruit sellers in the market. Fiber structure owned by the product Nata de Coco is very good for health and is recommended by health experts to consume regularly. Nata seeds are bacteria Acetobacter xylinum which will be able to form fibers nata if grown in coconut water that has been enriched with carbon and nitrogen through a controlled process. In such conditions, these bacteria produce enzymes that can be compiled into a thousand chain sugars or cellulose fibers. From the millions of microorganisms that grow on the coconut water, will produce millions of sheets of cellulose threads that eventually appear solid white to transparent, known as Nata. Sources of nitrogen needed by the bacteria Acetobacter xylinum are usually taken out of ZA fertilizer, Urea fertilizer, or fertilizer P. On April 1, 2015, all producers of nata de coco in Indonesia charged under the Food Act, where all kinds of food should not contain chemicals. Because of these findings, many companies nata de coco to be sealed by the relevant authorities and nata de coco sales dropped dramatically. Therefore, we are of the academic society Lhokseumawe State Polytechnic trying to find the solution replacement of chemical fertilizer in the process of making nata de coco. And we managed to replace chemical fertilizers with bean sprouts.

Key words: Nata de coco, ZA fertilizer, Urea fertilizer, P fertilizer, and bean sprouts.

Introduction

Nata de coco is a product of fermentation of coconut water with the aid of bacterial activity Acetobacter xylinum. Nata is derived from the Spanish language, which means floating. This by its nature is observed since the beginning of the process of formation of nata a thin layer floating on the surface that the longer it will be thicker. Nata seeds are bacteria Acetobacter xylinum which will be able to form fibers nata if grown in coconut water that has been enriched with carbon and nitrogen through a controlled process. In such conditions, these bacteria produce enzymes that can be compiled into a thousand chain sugars or cellulose fibers. From the millions of microorganisms that grow on the coconut water, will produce millions of sheets of cellulose threads that eventually appear solid white to transparent, called nata.

Acetobacter Xylinum can grow at pH 3.5 - 5.5 but will grow optimally when the pH is 4.3, while the ideal temperature for growth of bacteria Acetobacter Xylinum at 28 ° - 31 ° C. These bacteria are in need of oxygen. Acetic acid is used to lower the pH or increasing the acidity of coconut water. Good acetic acid is glacial acetic acid (99.8%). Acetic acid at low concentrations can be used, but in order to achieve the desired level of acidity is pH 4,5 - 5,5 required in large quantities. In addition to acetic acid, organic acids and other inorganic useable. There are several advantages or appeal of nata de coco that make it a promising industry, including:

First, nata de coco is known as fiber-rich products. Community needs for fiber does something absolute, especially the community middle and upper. In line with the development of the next era of globalization people begin to look for health problems. Even used as primary health needs compared to other needs. And nata de coco is very good for health because it contains fiber. Lately, many people are willing to spend money in order to consume additional fiber in the form of supplements. Nata de coco is a natural product. The tendency of society is more interested in natural products compared to synthetic products.

Secondly, nata de coco is rich in nutrients. One thing that is characteristic of the future society is the tendency to consume nutritious food is a necessity. And again nata de coco answer the expectations of society, nata de coco is rich in nutrients. In the nata de coco itself contains proteins, fats, sugars, vitamins, amino acids, and growth hormones.

Third, nata de coco has pretty good taste. Besides rich in nutrients, nata de coco is also delicious to eat. If mixed with ice jazzed, ice cream or fruit cocktail making foods appetizing. Fourth, nata de coco-making materials are easy to obtain and are not seasonal. Nata de coco is made from coconut water. And coconut are many and almost evenly spread across the corners of the country. Also coconut fruit throughout the year and not seasonal.

Fifth, processing and industrial equipment nata de coco is simple and does not take a long time. Making nata de coco is quite simple. Taggapun home industry is able to produce it. The construction is also relatively short, about one week of already can be consumed.

Sixth, nata de coco industry, an industry that is environmentally friendly.

Seventh, nata de coco industry has not been so rapid development. This opportunity if utilized and managed properly, is not impossible to bring in huge profits. Thus some advantages nata de coco as future industry is quite tempting.

Materials and Methods

Nata is a biomass consisting mostly of cellulose, gelatin-shaped and white. This mass is derived from Acetobacter xylinum growth on the surface of the liquid medium that is acidic and contain sugar. Making nata is not difficult and the costs involved are also not much. The making of nata is a business that is quite promising alternative. Ways of making nata consists of several stages as will be described below.

a. Preparation of Pure cultures

To prepare a pure culture, the way is as follows:

1) Jelly powder (15-18 grams) put into 500 ml of coconut water and then heated until dissolved. After that add yeast extract (5 g) and stirred until dissolved (solution a).
2) Sugar (75 grams) and acetic acid (15 ml) put into 500 ml of fresh coconut water to another and stirred until the sugar is dissolved (solution b).
3) Solution (a) of 3-4 ml put in a test tube is then covered with cotton. Solution (b) 3-4 ml was also incorporated into another test tube which is then covered with cotton. Each sterilized at 121 ° C for 20 minutes.
4) Once sterilization is complete and the solution is not too hot yet, the solution (a) was poured into the solution (b) aseptically. After the tube containing the solution (b) is placed at an angle to make the tilt and wait until slightly hardened.
5) Acetobacter xylinum inoculum was inoculated at room temperature or at a temperature of 30 ° C until it appears the growth of bacteria in the form of colloidal shiny and translucent on the surface of the jelly slant.
6) Acetobacter xylinum inoculum was inoculated at room temperature or at a temperature of 30 ° C until it appears the growth of bacteria in the form of colloidal shiny and translucent on the surface of the jelly slant.

b. Making the starter.

To make the starter, the way is as follows:

1) Coconut water is deposited, then filtered with gauze. Once it is heated to a boil over high heat, stirring. After boiling, added (a) glacial acetic acid (10-20 ml of acetic acid for every 1 liter of coconut water), and (b) sugars (75-100 grams of sugar per 1 liter of coconut water). This mixture is stirred until the sugar dissolves. This solution is called sour sugared coconut water.
2) Bean sprouts (bean sprouts 5 grams for every 1 liter of coconut water sugared acid prepared in no. 1 above) are blended in a little coconut water (each 1 gram sprouts requires 20 ml of coconut water). This solution is boiled and then poured into sugared sour coconut water. While still hot, the media is moved into some wide-mouthed bottles, each 200 ml. Bottle closed with sterile cotton. Once cool, the media were incubated at room temperature for 6-8 days (until it forms a white coating on the surface of the media).

c. Fermentation Nata.

For fermentation nata, do the following:

1) Fresh coconut water filtered by several layers of gauze and then heated to boiling over high heat, stirring. Once boiling, add glacial acetic acid (10 ml acetic acid for every 1 liter of coconut water).

This mixture is stirred until the sugar dissolves. This solution is called sour sugared coconut water.

2) Bean sprouts (bean sprouts 5 grams for every 1 liter of coconut water sugared acid prepared in no. 1 above) was dissolved in a little coconut milk that has been cooked (each 1 gram sprouts requires 20 ml of coconut water). This solution is boiled and then poured into sugared sour coconut water. The solution obtained is referred to as media nata. This solution was cooled to lukewarm.
3) Media nata coupled with the starter (every 1 liter of media nata require 50-100 ml starter) and then transferred to the fermentation containers with a height of 4 cm media. Container covered with paper that has been heated in an oven at 140 ° C for 2 hours. The container containing this media is stored in a fermentation chamber for 12-15 days until it forms a thick enough layer nata (1.5 to 2.0 cm).

d. Harvesting and washing.

Nata layer removed and then washed with clean water. After that nata immersed in flowing water or water is replaceable with fresh water for 3 days. After that nata cut into pieces with a length of 1.5 cm and 1.5 cm wide. Nata pieces boiled 5-10 minutes, then washed and boiled again for 10 minutes. This is repeated until nata odorless and tasteless sour again.

e. Bottling.

For making nata finished, steps are as follows: Syrup. A clean white sugar dissolved in water (each 2 kg of sugar dissolved in 4 liters of water), then added vanilie (to taste) and benzoate (1 gram for every liter of sugar solution). Syrup is boiled for 30 minutes.

Packaging. Nata is still hot immediately put into syrup and then cooled to lukewarm. After that nata packed in plastic bags duplicate, or in plastic cups and packaging closed tightly (a plastic bag tied with rubber, and plastic cups in-sael).

Results and Discussion.

In principle making nata de coco is the breeding of bacteria Acetobacter Xylinum. Chemical fertilizers such as urea (NH_2CONH_2), ZA (NH_4SO_4), and Diammonium Phosphate ((NH_4) $2PO_4$). The three compounds are commonly used in making nata de coco as a source of nitrogen necessary for bacterial growth Acetobacter Xylinum. Self-development outcome of these bacteria formed nata white and floats on the surface of the liquid medium.

Lack of knowledge about safe source of nitrogen which causes many entrepreneurs nata de coco had to cease operations for fear ensnared by the Food Act. Having studied the content of the bean sprouts and try to replace chemical fertilizers in the process of making nata de coco, turns Xylinum Acetobacter

bacteria can multiply and form nata in a medium that has been enriched with extracts of bean sprouts. Sprouts actually provide the nutrients much better than chemical fertilizer compounds.

Conclusion

Making nata de coco is one of the titles in the laboratory practicum Bioeknologi Lhokseumawe State Polytechnic. Since the introduction of nata de coco, always made using chemical fertilizers as nitrogen source necessary for the growth of bacteria Acetobacter xylinum. However, since the question ZA fertilizer use in the manufacture of nata de coco, we have replaced them with bean sprouts. The quality of nata de coco made with adjuvant sprouts better than nata created using chemical fertilizers.

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Response Surface Methodology Approach to Optimizing Process Variables for the Densification of Coffee Husks Briquettes

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Abstract

Coffee husks is one of the largest contributors of waste material in Aceh Tengah. The use of this material can be an effective alternative fuel solution, as it can not only contributes as an energy source but also solves environmental issues related to coffee husks. This study was carried out to establish the optimum conditions for converting coffee husks with starch as binding agent into a densified biomass fuel. The study was conducted following the Response Surface Methodology (RSM) using Box-Behnken experimental design with three levels (-1, 0, and +1). Briquette samples were made by compressing the coffee husks-starch mixture in a piston and die assembly with die pressure 2000 psi. The factors in the study were the quantity of starch as a binder which is contain 8%, 10%, and 12%, pyrolysis time which is varied from 50 min, 100 min, and 150 min, and material particle size varied from 20/24 mesh, 42/48 mesh, and 60/65 mesh. The higher heating value (HHV) of the fuel was determined by using a bomb calorimeter. The result of the study indicated that a combination of particle size of 57.82 mesh, pyrolysis time of 82.93 min, and amount of starch as binding agent of 8 % was optimum. Under the optimum settings of the variables, the briquette produced had a higher heating value (HHV) of 5415.06 Calgr-1 and density about 0.77354 grcm^{-3}. The study shows that the coffee husks can be converted into briquettes that can be used to provide the energy required for the development of industry in Indonesia.

Key words: Briquettes, Densification, Optimization, Pyrolysis

Introduction

The production of coffee in Aceh, generate significant quantities of coffee husks biomass as agro-residues. Agro residues are usually burned in an open area, causing pollution to the environment and, moreover, the ash contains a large proportion of unburned carbon due to incomplete combustion. A major disadvantage of agricultural residues as a fuel is their low bulk density, which makes handling difficult and transport and storage expensive (Suarez JA *et al*, 2003).

Biomass densification, which is the application of mechanical pressure to loose biomass to convert it into a high density solid material, is employed to overcome these limitations (Munoz-Hernandez *et. al.*, 2004).

Research on the utilization of coffee husks as an alternative fuel in the form of bio briquettes has been done by Okello C *et al*, (2010). According to him, the durability bio briquettes coffee husks with increasing pressure briquetting and moisture reduction. In the study, the optimum response bio briquettes coffee parchment skin obtained in briquetting pressure, moisture content and milase levels respectively is 14.91 MPa, 8% and 45%. In these conditions, the density of the briquettes obtained 718.09 kg / m3, 80.77% durability and stability of 14.98%.

In line with Okello, research conducted by Adapa, *et al*, (2013) also concluded that the pressure briquetting is a very significant factor affecting density, durability and specific energy bio briquettes. The higher the pressure briquetting increasing density and durability of briquettes. The quality of biomass briquettes usually determined by its density and durability. High density showed high energy per unit volume of material, while the durability is the resistance of the briquettes in the hold strain and force collisions that may occur during handling and transport processes (Larsson S., *et al*, 2008).

Briquetting pressure on this research have been relatively low (2000 psi) with easily applied by society. Sustainability-income research will certainly provide a very promising prospect to be applied in the countryside.

The quality of bio briquettes is also affected by the content / moisture content. Increased levels of water will reduce the value of fuel bio briquettes which in turn will reduces the efficiency of combustion, since a large amount of energy is used to evaporate the water in the fuel during the combustion process (Suarez JA., et al (b), 2003).

In the view of the previous works, the aim of this study is to carbonize a biomass source which is a coffee husks as biomass material, and then usage of starch as an alternative binding agent.

Materials and Methods

Procedure

The coffee husks biomass was collected from coffee hullers in the rural areas of Gayo Highlands Central Aceh, Indonesia. Prior to reducing its size, the coffee husks was dried in the open air for a week. The dried coffee husks was then pyrolysis on the furnace into three pyrolysis time categories of 50,100, and 150 minutes. The dried coffee husks was then ground in a milling machine and results were screened into three particle size categories of 20, 40, and 60 mesh. A starch was introduced to 8, 10, and 12 % by weight, respectively to promote the binding among particle.

Gross calorific value was measured using adiabatic bomb calorimeter following the ASTM standard D. 5685. The independent variables being studied were pyrolysis time x1, particle size X2, and starch binder content X3, keeping a 2000 psi densifying pressure as a constant variable. The dependent variables analyzed were density and higher heating value of densified biomass produced. The densification experiments were conducted using bench type manually operated laboratory hydraulic press

having a capacity of 20 ton (Hydraulic press Shop CMC ISO9002) and a densification die. The densification die was constructed from stainless steel cylinder of 30 mm in internal diameter and 250 mm in length, equipped with stamp of 30 mm in external diameter. A Bob-Behnken design with three levels, low, medium and high coded as -1, 0, and +1 was applied to this study. The test was carried out according to Yunardi et al. (2011) method, where the level values of each variable and code investigated in this study is presented in Table 1.

A Bob-Behnken design has succesfully applied for oftimization of mechanical densification process of rice straw as a rural alternative solid fuel (Yunardi, et al. 2011).

The density of the produced briquettes was found by a simple method as a ratio of weight and volume determined from the briquette geometric shape.

Table 1. Experimental range and levels of independent variables.

Independent variable	Coded level and range		
	-1	0	+1
Pyrolysis time, X_1(min)	50	100	150
Particle size, X_2 (mesh)	20	40	60
Starch, X_3 (%)	8	10	12

$$Y_k = \beta_o + \sum_{i=1}^{3} \beta_i X_i + \sum_{i=1}^{3} \beta_{ii} X_i^2 + \sum\sum_{i<j} \beta_{ij} X_i X_j + \varepsilon_j \qquad (1)$$

Results and Discussion

Direct combustion of biomass is not preferable because of the negative aspects coming from the intrinsic properties of biomass such as low density, low calorific value in a unit volume, and high moisture (Haykiri-Acma, H and Yaman, S, 2010).

Table 2. Bob-Behnken Design matrix along with experimental and peredicted results

No.	Dependent variable			Independent Variable			
	Pyrolysis time, X_1(min)	Particle size, X_2 (mesh)	Starch content, X_3 (%)	Densitas (grcm^{-3})		Heating value (Calgr^{-1})	
				Exp.	Predicted	Exp	Predicted
1	100	60	12	0.8204	0.7870	5433.27	5485.16
2	50	40	8	0.6565	0.6463	5238.37	5246.88
3	100	20	8	0.6262	0.6286	5711.04	5659.15
4	150	40	12	0.7288	0.7510	5503.97	5495.46
5	150	60	10	0.8011	0.8092	5282.79	5239.41
6	150	40	8	0.7680	0.7799	5548.15	5496,35
7	100	40	10	0.7402	0.7225	5665.90	5583.83
8	100	40	10	0.7063	0.7225	5539.55	5583.83

9	100	60	8	0.8208	0.7976	5323.16	5418.34
10	150	20	10	0.7392	0.7217	5552.21	5655.90
11	50	60	10	0.7452	0.7755	5337.01	5233.32
12	100	20	12	0.6846	0.6768	5634.61	5539.43
13	50	40	12	0.7129	0.7129	5143.07	5194.87
14	100	40	10	0.7016	0.7225	5523.31	5583.83
15	50	20	10	0.5790	0.5837	5068.55	5111.93
16	100	40	10	0.7286	0.7225	5634.61	5583.83
17	100	40	10	0.7233	0.7225	5555.79	5583.83

From this point of view, it is important to develop strategies by which biomass is converted to secondary fuels which have better characteristics in comparison to the parent material. For this purpose, biomass is first carbonized to eliminate the moisture and volatile matter contents and then the volatile matter-free solid char, which is called as “smokeless fuel”, is briquetted to form firm bio-fuel briquettes.

Table 3 presents the calorific analysis of coffee husks before and after carbonization. The higher calorific value of the coffee husks was 5713,672 $Calgr^{-1}$ which is very high compared to that of the original sample 3971,052 $Calgr^{-1}$. According to these results it is clear that the coffee husks have a typical biomass structure with respect to high heating value after carbonization process.

Table 3. Calorific analysis of coffee husks

Parameter	Heating value ($Calgr^{-1}$)
• Coffee husks before carbonization (original sample)	3971.052
• Coffee husks after carbonization	5713.672

The briquetting of a smokeless fuel that obtained from the carbonization of coffee husks at 350ºC gave very good results in terms of quite high calorific value and almost hardly any volatile matter is a reasonable technique to take advantage of the energy potential of biomass in environmental friendly way. The research continued and carried out following the Box-Behnken Design Experiment consisting of 17 treatments randomly as shown in Table 2. The table presented the actual and prediction of heating value from experiment. Prediction of heating value calculated using quadratic equations that modeled according to Equation (1). The mathematical relationship between the dependent variable (response) with independent variables (factors) can be written according to Equation (2).

$$Y = 18246.55 + 85.42583A + 36.65875B - 171.06250C - 0.256348A2 - 0.55769B2 - 5.26875C2 - 0.46917AB + 0.44583AC + 4.88125BC \quad (2)$$

Model Statistics validation

Analysis of variance (ANOVA) used to evaluate the effect linearity, quadratic, or the interaction of independent variables (factors) on the dependent variable (response). Analysis of variance for heating value and density gave results as in Table 4 and Table 5. As indicated by Table 4 and Table 5, all the linearity and quadratic model terms were found to have highly significantly effect on heating value and density of coffee husks briquettes. In addition interaction of pyrolysis time with particle size together also have significant effect ($p>0.05$) on the heating value and density.

Table 4. Analysis of variance (ANOVA) to describe the heating value briquettes using starch as binding agent

Sumber Variasi	Sum of Squares	Mean Square	F, Value	Prob > F	Judgement
Model	5.020E+5	55773.61	5.58	0.0169	Significant
A	1.513E+5	1.513E+5	15.13	0.0060	Significant
B	3539.05	43539,05	4.35	0.0754	
C	1399.20	1399.20	0.14	0.7194	
A^2	2.046E+5	2.046E+6	20.45	0.0027	Significant
B^2	11953.12	11953.12	1.20	0.3105	
C^2	106.57	106.57	0.011	0.9207	
AB	72328.72	72328.72	7.23	0.0311	Significant
AC	653.31	653.31	0.065	0.8056	
BC	8699.29	8699.29	0.87	0.3820	
Residual	70002.59	10000.37			
Lack of Fit	54278.87	18092.96	4.6	0.0872	**Not significant**
Pure Error	15723.72	3930.93			
Cor Total	5,720E+005				

Quadratic models

$R^2 = 0.8776$; adj. $R^2 = 0.7203$; Std. Dev. = 100; C.V. = 1.83

The significance level that described Equation (2) would also be seen in Table 4 and Table 5. As shown on the Table 4 and Table 5, the proposed model was statistically significant because the probability value (Prob> F) smaller than $\alpha = 0.05$. That is, the effect of variations between the independent variables and the response variable can be explained precisely by the equation. Table 4 and table 5 also shows that the quadratic model proposed does not contain Lack of Fit, no significant lack of fit means that the corresponding quadratic equations proposed to describe the relationship between the factor with the response thus need not be filed with the equation of higher order.

Evaluation of goodness (goodness of fit) a regression model not only be observed from lack of fit, but also from the coefficient of determination (R2) and adjusted R2 large (approaching the value of 1). The greater value of R2 obtained, the greater the contribution or the role of variable factors to the variation in the response variable. In this case, the value of R2 is 0.8776 means that 87.76% of the variation is caused by

variation of the response variable factors, while 12.24% were caused by other factors that are not included in the regression model. While it's adjusted R2 is 0.7202. Meanwhile, the size of the diversity of the data stated by the Coefficient of Variation (CV) showed an excellent value that is 1.83%. The smaller the CV value, the more homogeneous distribution of research data. Conversely, the CV is large means that the research data heterogeneous.

Table 5. Analysis of variance (ANOVA) to describe the density briquettes using starch as binding agent

Variation	Sum of Squares	Mean Square	F, Value	Prob > F	Judgement
Model	0.060	0.010	20.88	<0.0001	Significant
A	0.015	0.015	30.63	0.0002	Significant
B	0.039	0.039	80.97	<0.0001	Significant
C	7.069E–4	7.069E–4	1.47	0.2535	
AB	2.720E–3	2.720E–3	5.65	0.0388	Significant
AC	2.285E–3	2.285E–3	4.74	0.0544	
BC	8.644E–4	8.644E–4	1.80	0.2100	
Residual	4.815E–3	4.815E–3			
Lack of Fit	3.796E–3	6.327E–4	2.48	0.1989	**Not significant**
Pure Error	1.019E–3	2.5484			
Cor Total	0.065				

Model Two-Factor Interaction (2FI)

R^2 = 0.9261; adj. R^2 = 0.8817; Std. Dev. = 0.022; C.V. = 3.04

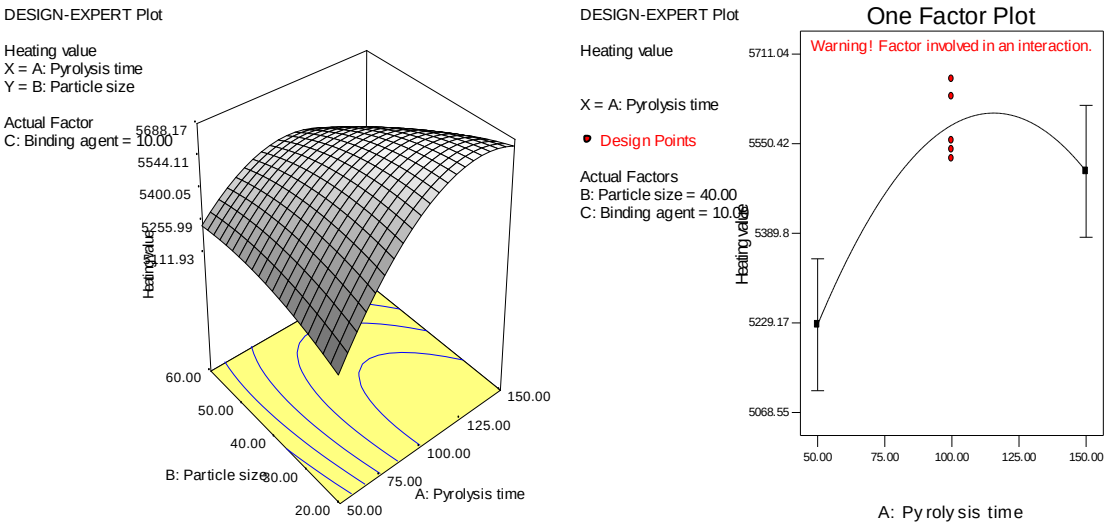

Figure 1. Response plots between pyrolysis time and particle size for heating value of coffee husks briquettes

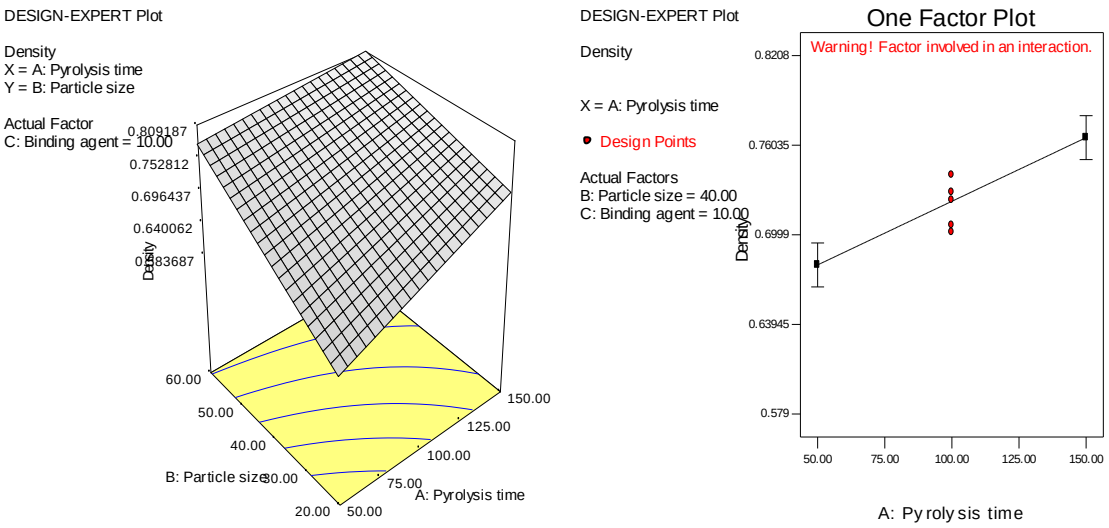

Figure 2. Response plots between pyrolysis time and particle size for density of coffee husks briquettes

The response surface plots for the interaction between pyrolysis time and binding agent content on the heating value and density of the briquettes are illustrated in Figure (1) and Figure (2). Heating value would be increase as long as pyrolysis time from 50 minutes until 150 min as a maximum time. The maximum briquettes heating value of about 23430 Jgr^{-1} was observed at a pyrolysis time of about 115 min, particle size of about 42/48 mesh and binding agent content of approximately 10%. After reaching the maximum point, the heating value decreases with the length of the pyrolysis process.

Optimization of Variable Response

The optimization process aimed to get the technical parameters of the conditions that can provide optimum response at an economical operating cost. The quality of solid fuels is determined by a high calorific value (at least 21000 J / g, SNI. No. 1/6235/2000). To reduce the cost of operation, the pyrolysis time should be kept to a minimum, because the longer the pyrolysis process, the greater the energy required and the greater the cost. Therefore, to get the optimum response at low cost, the set-up goal pyrolysis time should be set at the "minimum" with a lower limit of 50 minutes and an upper limit of 150 minutes. For more details, refer to the table 5.

Table 5. Optimization of dependent variable of coffee husks briquettes

No	Parameters			Response	
	Pyrolysis time (min)	Particle size (mesh)	Starch content (%)	Heating Value ($Calgr^{-1}$)	Density ($grcm^{-3}$)
1	82.93	57.82	8.00	5415.06	0.7735
2	83.20	57.59	8.00	5417.83	0.7747
3	84.46	55.66	8.00	5437.76	0.7648
4	88.58	54.85	8.00	5456.08	0.7650
5	110.93	34.71	8.00	5644.66	0.7069

Conclusions

A desirability function approach has been utilized to optimize the process variables of pyrolysis time, particle size, and starch content on the multiple-response variables of density and heating value of coffee husks briquettes produced through a mechanical densification. The optimum conditions to produce solid fuels from coffee husks biomass were obtained at a pyrolysis time Variation of the pyrolysis time of 82.93 min, particle size of 57.82 mesh and starch content of 8%, with heating value of 5415.06 $calgr^{-1}$ and density about 0.77354 $grcm^{-3}$.

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Analysis of the Quality of Bio-briquettes from the mixture of Palm Empty Fruit Bunches and Palm Kernel Shells

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Abstract

The quality of bio-briquettes from palm empty fruit bunches (PEFB) and palm kernel shells (PKS) has been studied. The research aimed to determine the effect of ratio PEFB to PKS and sago starch as adhesive agent to the characteristics of the bio-briquettes. The characteristics include heating value, water content, relaxation, and density. Response Surface Method was applied both in initial design factors as well as in the evaluation of the result obtained. PEFB and PKS were carbonized separately and then mixed together according to the ratio of 0: 100; 30:70; 50:50; 70:30; and 100: 0 (% w/w). Charcoal mixed, affixed with an adhesive made from sago starch 4%, 6%, 8%, 10% and 12% concentration (w/w). Furthermore, the bio-briquette was formed using a cylindrical mold with a hydraulic press. The results showed that the use of 100% palm kernel shell charcoal and 8% adhesive provided the highest calorific value to 5509 cal/g. In addition, the water content, relaxation, and density of the bio-briquette were 10.24%; 1.42%, and 0.87 g/cm^3, respectively. The bio-briquette produced meets the standards SNI 1-6235-2000 for charcoal.

Key words: bio-briquette, palm oil empty fruit brunches, palm oil shells, calorific value

Introduction

The issue of scarcity of fuel and cooking gas was a big problem in most developing countries, including Indonesia, especially in rural areas. Not only scarcity is a constraint, fuel prices are also getting bounced. The transfer of fuel oil into CNG (natural gas) is not able yet to resolve the energy crisis in the community. Various studies have been conducted to get around and look for alternatives to overcome the problem. One way to do is to reduce people's dependence on non-renewable fuels and turned it over to renewable energy by utilizing local wisdom. Finding the new energy resources is not only the point; it also needs to get a simple way to be used by the community. Besides, it should be obtain from areas of occurrence and distribute as appropriate.

One of the renewable energy sources comes from palm oil industrial waste, particularly palm empty fruit bunches and palm kernel shells (PEFB and PKS) which are widely dispersed in many areas in Indonesia today. It's just that their utilization is still very unpopular in the community. Continuous research needs to

be done in order to obtain an effective method of converting the waste to substitute the dependence on fossil fuel. The product should be easy to use and inexpensive.

Generally, palm kernel shells and palm empty fruit bunches are used in their crude form for heating boiler in palm oil industry itself. However, it is only a part of the waste, some others are not useful at all. Ugwu and Agbo (2011) stated that in some rural area in Nigeria, crude palm kernel shells were directly used as energy source for heating and cooking. The problem is, a lot of smoke comes out due to the organic content. It could, furthermore, pollute the air and have a bad effect to the human health.

In order to eliminate the inadequate organic content, carbonizing and briquetting should be applied. These processes make an efficient and sustainable use of palm kernel shells and palm fruit bunches. Additionally, the binding agent should be from natural resource as well in order to keep the product as a clean and environmental friendly energy source.

Many researches have been conducted to create a compatible energy source from biomass waste of palm oil waste industry. Sunarwan, B and Juhana, R (2013) have studied the utilization of industrial biomass waste oil to generate electricity in Papua, it found that the empty fruit bunches has 4492.7436 cal/g calorific value and able to generate electricity up to 7.33 MW. On the other hand, Bahrin D., *et al* (2011) states that the use of biomass from palm kernel shells as an energy source in the rubber industry in South Sumatra could reduce greenhouse gas emissions (CO_2) to 22.8% and ash 62% compared to using coal. Therefore, energy from palm biomass waste is expressed as a clean and environmentally friendly. Furthermore, Syafriuddin and Hanesya, R (2012), obtained the palm kernel shell charcoal calorific value of 6877.32 cal/g, greater than the calorific value of coal where only 5619.16 cal/g. To generate 10 MWh of electricity, 1.2 tons of palm kernel shells charcoal was required, equivalent to 1.3 tons of coal.

This work aimed to harness palm fruit bunches and kernel shells to make a contribution to the energy source. The palm empty fruit bunches and palm kernel shells were converted into briquettes by firstly carbonizing them in less oxygen combustor through pyrolisis method. Central Composite Design (CCD) of Response Surface Methodology from the Design Expert software was applied in the determination of optimization composition among the independence variables. The briquettes produced were tested for their physical characteristics including calorific value, relaxation, water content, and density.

Materials and Methods

The palm empty fruit bunches (PEFB) and palm kernel shells (PKS) were collected from local palm oil industry, PKS Cot Girek, North Aceh. Sago starch was from local market in North Aceh. The research was conducted in Chemical Engineering Laboratory of Lhokseumawe State Polytechnic.

Procedure

The charcoal of palm empty fruit bunches (PEFB) and palm kernel shells (PKS) 40/60 mesh, mixed with the ratio of 0 : 100, 75 : 25, 50 : 50, 25 : 75, 100 : 0 (% w/w). Sago starch was weighed according to the concentration 4%, 6%, 8%, 10% and 12% (w/w) from total charcoal weight. Each was cooked with additional water to form paste. The pastes were ready to use as binding agent. The PEFB and PKS charcoal in a certain ration, mixed with the sago adhesive, stirred well, put into cylinder shape mold of 2.5 cm diameter and 3.5 cm height. At last, it was pressed using hydraulic press up to 2000 lb/in^2. Briquettes produced then put below sunshine to remove the moisture. Finally, the tests were performed for the

calorific value by means of Bomb Calorimeter K88890, density was conducted by caliper according to ASAE S269.2 DEC96, in accordance with relaxation test, where it was measured during weeks. At last, water content was analyzed using Moisture Analyzer Mx-50.

Results and Discussion

Calorific value of PEFB and PKS raw and charcoal form

The analysis results of calorific values of raw as well as charcoal of palm empty fruit bunches (PEFB) and palm kernel shells (PKS) compare to any other references are given in Table 1. In the next, PEFB would always be named instead of palm empty fruit bunches, and PKS instead of palm kernel shells.

Table 1. The calorific value of raw materials and charcoal form compare to the reference

Materials	Calorific value (cal/g)	
	Present results	References
Palm empty fruit bunches	4.463,52	4.492,74[a]; 4.489,11[b]
Palm kernel shells	4.629,36	4.445,33[c]; 4594[d]
Palm empty fruit bunches charcoal	5.077,20	Not defined
Palm kernel shells charcoal	6.448,32	6.877,33[e]

[a]Sunaryawan, B and Juhana, R (2013), Kamal, N (2014)

bGunadi, D.H, dkk (2008)

[c]Ugwu dan Agbo (2011)

[d]Vidian, F dan Fikri (2009)

[e]Syafriuddin dan R. Hanesya (2012)

The raw material of PEFB and PKS has shown lower calorific values than the charcoals form. The carbonization process removes several volatile matters and inadequacies materials (Ugwu and Agbo, 2011). Carbonization of solid materials passes through several stages: heating, drying, and removal of volatile compounds. Several volatile compounds out of the combustion products are CO, CO_2, CH_4 and H_2 (Jamilatun, S, 2008). Meanwhile, the type of materials being burned determines the composition of the gas generated (Pengmei, *et al*, 2004). Hence, the use of raw materials of PEFB and PKS to be briquettes (without pyrolysis) could obtain some disadvantages, creating a lot of smoke when burned or used for energy source, and contain organic materials that can damage mold when stored for long periods. In addition, PKS is extremely rigid, unbreakable, and somehow difficult to destroy before charred. Based on these factors, carbonization is essential to improve the quality briquettes. Moreover, the calorific value enhanced so that more efficient and sustainable to be used.

The next process is the oxidation of solid material due to the activity of oxygen. To avoid oxidation, carbonization must be done in a state of lack of oxygen in order to produce favorable carbon charcoal.

After pyrolysis process, the calorific values of PEFB and PKS charcoals become 5,077.2 cal/g and 6,448.32 cal/g, each increased significantly up to 14% and 39% compared to the raw materials.

Initial analysis

Optimization among the dependence variables in this study was carried out by Design Expert 6.0.8 application by using Response Surface Methodology (RSM). The method is a set of statistical and mathematical techniques that are useful for developing, improving and optimizing a process (Myers and Montgomery, 2002). Response surface method is mainly applied when there is some potential variables that affect the performance or quality characteristics of a process or a product called the response variable (response). Input variables or free variables are sometimes referred to as the independent variables, which are fully controlled by the researcher. This study used Central Composite Design (CCD) with two factorial, X1 (adhesive concentration, %) and X2 (material composition,%), with 25 treatment combinations and 4 response that consists of heating value, water content, relaxation and density. According to the results of the initial analysis using this program, 11 treatment combinations were selected to optimize the research.

Effect of material compositions to calorific value

The calorific value is the main characteristic to determine the quality of bio-briquettes. The higher the calorific value of the bio-briquettes the better is to be used as fuel. Fig. 1 shows the influence of the ratio of the PEFB and PKS to the calorific values.

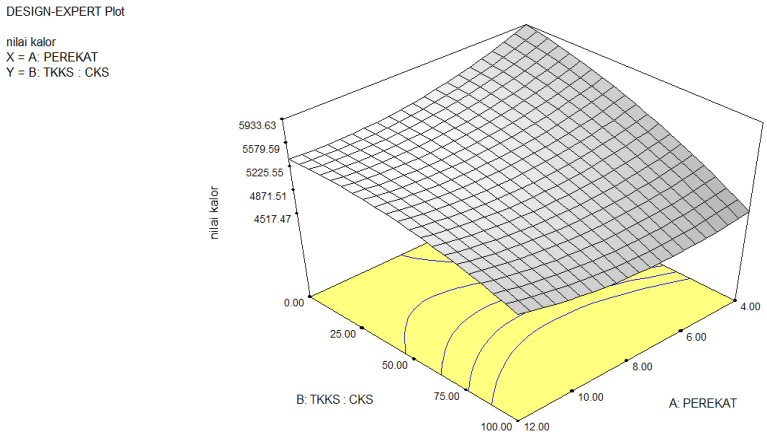


Figure 1. Calorific value of bio-briquettes with various PEFB to PKS compositions and adhesive concentrations

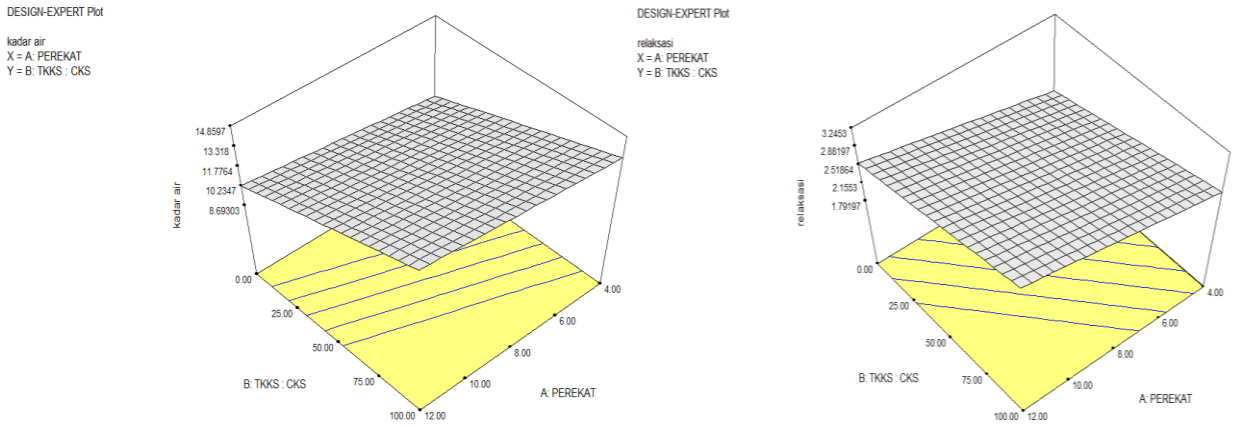
The more PKS composition put in making bio-briquettes, the higher calorific value was achieved. The use of PKS charcoal 100%, the calorific value of 5,509.2 cal/g was obtained. The calorific value of charcoal briquettes of 100% PKS in this study is equivalent to the bio-briquettes from PKS using cassava starch as binding agent, where 5,638.62 cal/g of calorific value (Agbo dan Ugwu, 2011), and higher than the one of sawdust, where only 5,479 cal/g (Jamilatun, S, 2008). In contrast, the use of charcoal PEFB 100% as bio-briquettes materials has immensely reduced the calorific value. It might be caused by the origin of both sources; PEFB and PKS have different natural characteristics. From Table 1 it can be seen that the raw PKS gives more calorific value than the raw PEFB. The hardness of the wood influences the heating value, the harder the wood the more calorific value obtained.

Furthermore, Fig.1 explained about the effect of adhesive concentration to calorific value. The use of 4% as well as 6% sago adhesive produced the highest calorific value of bio-briquettes, up to 5,933 cal/g. Nevertheless, the structure of bio-briquettes becomes rupture and breakable due to the lack of binding among the charcoal particles. Consequently, the bio-briquettes cannot be either stored or used. Therefore, 8% sago starch paste concentration gave an optimal bio-briquettes product, good shape and comparable heating value. In the case of more adhesive concentration applied in one side offer strengthen bio-briquettes, on the other side has significantly diminish the calorific value. It was caused by the origin of sago starch itself that contain lower heating value than the charcoal, beside the water content in the paste. This result is in accordance with Gandhi (2010) which obtained the energy of briquettes become lower with the increasing of adhesive concentration utilized.

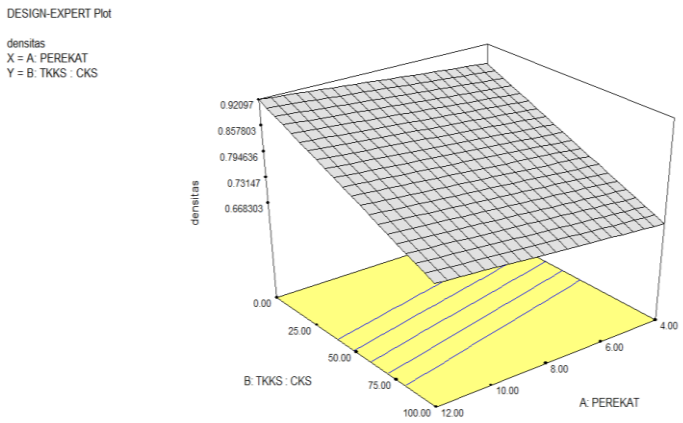
Effect of material compositions to water content, relaxation, and density

Water content of bio-briquettes raised with the increasing concentration of sago starch paste (see Fig.1 (a)). The paste contains some water that makes the bio-briquettes hold more water. From the research of Soelaiman, J.R (2013), the higher moisture content in briquettes the lower calorific value would be. Hence, water content in the bio-briquettes can be one of the quality indicators to the calorific value. Additionally, the more composition of PEFB charcoal, the moisture of bio-briquettes tends to enhance. The water content of bio-briquettes in this research 10.01 to 12.56%, even up to 14.9% according to design expert of RSM (Fig.1 (a)). The amounts are out of range of SNI 1-6235-2000 for charcoal where it should be not more than 8%. To accomplish the standard, longer drying time will be required.

Another characteristic shown in Fig. 1(b) is relaxation. It explained that, relaxation considerably depends on the binder concentration. Less adhesive generate less relaxation. The more PKS composition in the bio-briquettes has increased the relaxation. Relaxation is required during storage process which could have an impact to volume of keeping. The relaxations of bio-briquettes were in the range 0.73% – 3.93%. According to Riyanto, S (2009), briquetting pressure is the main factor influents the relaxation, the higher the briquetting pressure the more compact the biomass particles in the briquettes, so the binding of the particles would be stronger. Consequently, less relaxation was obtained.



(a) **(b)**



(c)

Figure 2. Water content (a), relaxation (b), and density of bio-briquettes from various PEFB to PKS compositions and adhesive concentrations

Fig. 2 (c), explained about the density of bio-briquettes in accordance with the composition of PEFB and PKS, as well as concentration of sago starch. The greater amount of PKS applied as the bio-briquettes, the higher the density is. The density of 0,92 g/cm^3 has achieved when using 100% PKS charcoal as material, contrary, without PKS, means with 100% PEFB, the density was immensely low, about 0,66%. Similar to PEFB effect, the additional of more sago starch produce lower density. Sari, N,M, *et al.*, (2010), have studied the effect of mixing acacia wood charcoal to coal in producing briquettes. Briquettes from the mixture of acacia wood and coal have density of 0.7082 – 0.872 g/cm^3. The charcoal of acacia wood and adhesive concentration has decreased the density of briquettes. The reasons for this condition are more pores in acacia wood charcoal, greater particles sizes, and affect of binder agent as well. It can be conclude that, density depends on the porosity of the briquettes. In order to produce dense briquettes to achieve international standard, less pores materials should be implied, and more pressure in forming the briquettes.

Conclusions

The briquettes produce from PEFB and PKS have different physical characteristics. PKS contribute to fabricate a higher calorific value of briquettes, up to 5,509 cal/g by using 8% sago starch. The other properties are relaxation, water content, and density where correspondingly 24%; 1.42%; and 0.87 g/cm^3. According to calorific value and density, these results meet the Indonesian national standard SNI 1-6235-2000 for charcoal.

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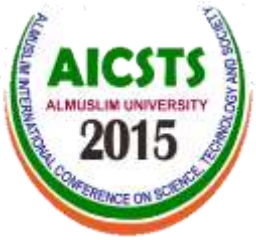
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