Quality in Research: International Symposium on Materials, Metallurgy, and Chemical Engineering

PREFACE

WELCOME FROM THE RECTOR OF UNIVERSITAS INDONESIA

It is both a pleasure and honor for me to welcome you all to the 15th International Conference on QiR (Quality in Research) 2017 in Nusa Dua, Bali, Indonesia.
Universitas Indonesia strives to be one of the leading research universities and the most outstanding academic institution in the world. UI is distinctive among research universities in its commitment to the academic invention and research activities through various scientific programs. QiR 2017 is our main academic conference in the field of engineering and technology which has been successfully held for the last two decades. It is our hope that this world class scientific program would showcase our scientists and researchers achievements and provide forums for scientific exchanges in their respective fields.

The theme this year of 'Science, Technology and Innovation for Sustainable World', is very relevant with the fact that the globalization today results in very competitive atmosphere in all aspects. However, this flourishing competition should consider the harmony and balance between human needs and the environment quality for creating favorable sustainable future. Scientists and researchers, hand in hand with industrial experts are creating and developing new sustainable technologies that enable us to make products and services more efficient, design better buildings, produce safer cars, keep people healthier and building smarter cities.

I extend my sincere thanks to the Faculty of Engineering Universitas Indonesia, supporting parties and institutions for their participation and contributions in QiR 2017. I would also thank our colleagues from Universitas Udayana and Politeknik Negeri Bali for their gracious support and hospitality. Additionally, I extend a hearty thank you to the members of the organizing committees for dedicating their valuable time so that each one of us enjoys an exceptional conference program over the next several days. May we have a successful, stimulating, fruitful and rewarding conference.

Prof. Dr. Ir. Muhammad Anis, M.Met.
Rector
Universitas Indonesia

PREFACE

WELCOME FROM THE DEAN OF FACULTY OF ENGINEERING UNIVERSITAS INDONESIA

Welcome to the 15th International Conference on QiR (Quality in Research) 2017. The Faculty of Engineering Universitas Indonesia is delighted to host our flagship international academic event this year back in Bali, Indonesia. This two-day, biennial conference is presented together with our co-hosts Universitas Udayana and Politeknik Negeri Bali with the hope that this would be able to provide an international media for exchange of the knowledge, experience and research as well as the review of progress and discussion on the state of the art and future trend of prospective collaboration and networking in broad field of science, technology and innovation.

The main theme for this year conference, "Science, Technology and Innovation for Sustainable World" is consistent with the mission of our faculty to be a leading institution with the initiatives that responds to local, national and global societal needs. In that context, the Faculty of Engineering Universitas Indonesia is performing state-of-the arts research and development in engineering and architecture areas which results in technology and innovation which contribute to sustainable development at both national and global level. QiR 2017 provides platforms and forums to disseminate our scientific achievements and exchange information with our counterparts from Indonesia and all over the world. This event will allow for further research and education collaborations between Universitas Indonesia and its partners worldwide.

I would like to express my deepest appreciation to our sponsors, supported parties and various contributors for their never ending supports of this conference. I would also like to convey my gratitude to all of our distinguished speakers for making the time to share their knowledge with us. To our fellow researchers and/or practitioners from Indonesia and overseas, welcome and enjoy your stay in this Nusa Dua, Bali. I would also like to invite all participants in expressing our appreciation to all members of the QiR 2017 organizing committee for their hard work in making this conference success.

Prof. Dr. Ir. Dedi Priadi, DEA
Dean Faculty of Engineering
Universitas Indonesia

PREFACE

WELCOME FROM THE QiR 2015 ORGANIZING COMMITTEE

On behalf of the organizing committee, it is a great pleasure for us to welcome you to the 15th International Conference on Quality in Research (QiR) 2017 to be held in Bali, Indonesia on July, 24 – 27, 2017. This biennial event is co-organized with the Faculty of Engineering Universitas Udayana and Politeknik Negeri Bali.

The main theme for this year conference is "Science, Technology and Innovation for Sustainable World". Under this theme the conference focuses on the innovative research and contribution in science and technology toward achieving sustainable world. In line with this theme, it is our utmost pleasure to hold the QiR 2017 in conjunction with the 6th IEEE-International Conference on Advanced Logistics and Transport (ICALT), the 2nd International Symposium on Biomedical Engineering (ISBE 2017), International Conference in Saving Energy in Refrigeration and Air Conditioning (ICSERA) and the 3rd Biannual Meeting on Bioprocess Engineering.

The QiR 2017 brings together national and international academicians, researchers, executives, government, industrial and business officials, practitioners and leaders to present and discuss a vast range of engineering, architectural designs and community development based on green and smart technology. It is our hope and aim that this conference would be able to provide an international media for exchange of the knowledge, experience and research as well as the review of progress and discussion on the state of the art and future trend of prospective collaboration and networking in broad field of science, technology and innovation. Furthermore, QiR 2017 benefits industry sector, since it would create a close contact between and among the audiences. The audiences mostly come from different job and activities: therefore this is a great potential and opportunity to meet each other, creating fruitful discussions and broaden business relationship.

QiR has been growing, since its first event two decades ago, into our flagship academic event with international reputation. This year, we have received almost 1000 submissions from more than 26 countries. Along with our events in conjunction, more than 500 oral and poster presentations is scheduled with expected 700 participants gather in the event.
On behalf of QiR 2017 committee, we would like to thank all of our speakers, participants, contributors, partners and professional associations for their generous contributions. We also would like to acknowledge the support from our International Advisory Board members and distinguished reviewers. Last but not least, a special thanks to our local co-organizer, Universitas Udayana and Politeknik Negeri Bali.
We wish all of you a productive and rewarding conference, also a pleasant and memorable stay in Nusa Dua, Bali, Indonesia.
Thank you and we hope to see you again in QiR 2019.

Ardiyansyah, Ph.D.
General Chair of QiR 2017 Organizing Committee

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Studies of Carbonization Process on the Production of Durian Peel Biobriquettes with Mixed Biomass Coconut and Palm Shells

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STUDIES OF CARBONIZATION PROCESS ON THE PRODUCTION OF DURIAN PEEL BIOBRIQUETTES WITH MIXED BIOMASS COCONUT AND PALM SHELLS

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Abstract. Biobriquettes as alternative energy that can replace the role of kerosene. Biobriquettes made from agricultural waste biomass. Biobriquettes durian peel has been researched and developed continuously to obtain optimal quality in terms of calorific value, compressive strength and duration of ignition. In making durian peel biobriquettes needed other biomass mix to sustain duration of Ignition for biobriquettes durian skin quickly burned out. Stages of making biobriquettes durian skin are: material of drying, carbonization of biomass, grinding, mixing with adhesives, and printing. Carbonization process is a process that is important in obtaining the biomass charcoal. Carbonization is done by means of karbonisator pyrolysis. The purpose of this research is to study the process of carbonization to obtain biobriquettes durian skin that of quality in terms of value compressive strength, calorific value, and duration of ignition. Variations that done was kind mix of biomass,coconut shells and palm shells with the massa ratio 2 : 1, type of adhesive used tapioca powder and banana peels, carbonization of temperature 200^{o}C, 300^{o}C and 400 ^{o}C . The results showed that the highest compressive strength of the durian skin with a mixture of coconut shell and adhesive tapioca powder and carbonization temperature of 300 ^{o}C namely 12,7 g/cm^2. The calorific value of the highest on the mix of skin durian with coconut shells and adhesive banana skin with temperature of carbonization 400 ^{o}C ie 6040 cal/g, and duration of ignition highest on a mixture of skin durian with coconut shell and adhesive banana skin at a temperature of carbonization 300 ^{o}C is 73 minutes.

Keywords **:** Biobriquettes, Durian peel , Carbonization.

1. Introduction

Renewable alternative energy sources is being developed in Indonesia. One of these is biobriquettes from biomass. Biomass is composed of cellulose, hemicellulose and lignin that is commonly found in plant parts. Biomass is a renewable reseources that can be used sustainably.

Durian peel waste is one of biomass that could be used as a raw material source of renewable energy. Several studies of Biobriquettes of durian peel has been conducted. (Pramudya, et al.,2011) studied the variation of biomass and adhesive mixture. However, these studies without using the carbonization process of durian peel. In the biobriquettes manufacture, carbonization is a very important process because it is the main process in the biobriquettes manufacture which can affect the biobriquettes quality.

Carbonization process is done by burning biomass in open condition, the burning process then stopped when the charcoal formed, by spraying water on the charcoal that has been formed. This kind of process generated a lot of ash and smoke so that the charcoal making process is not optimal and produced only a little charcoal. Therefore it is necessary to look for solutions, so

that the carbonization process authoring maximum results, which produces little ash, it also can take advantage of combustion smoke as liquid smoke which can be used as a natural food preservative,which is not harmful.

This is known as pyrolysis process (Mira, M, 2002). The characteristics of durian peel as an alternative fuel by the pyrolysis process has been investigated (Wahidin, 2014). In this study, the ash content obtained is still high (18.8%), caused not using a mixture of biomass. The process of making biobriquettes by pyrolysis carbonization been done by (Feri Fuji,2010), at a temperatures of 210, 250, 300, 350, and 390^{0}C using rice husk as raw materials, and the highest calorific value obtained at 5609.453 cal/g. In addition (Warapon R, *et.al,* 2011) also examined biobriquettes durian peel with a mixture of rice straw (9: 1) the calorific value obtain is 24,674MJ/kg (5902 cal/g). While (G. Siresh, *et al,*2016) examined the types of palm briquette powder and binder, providing a calorific value of 20 945 MJ /kg (5010 cal/g) at 80.79% efficiency.

(Paisal,2014) conducted a study ofbiobriquettes made from durian peel using an adhesive with banana peel waste without mixing other biomass, and the calorific values obtained 5074 cal/g. (Sari, E, *et.al* ,2015) also did research on biobriquettes durian peel with a mixture of biomass palm shells and rubber shell, using starch as an adhesive.From this study, the highest calorific value obtained of 5118 cal/g. (Merry, *et.al,*2015) also examined using an adhesive calcium hydroxide and obtained calorific value of 4968 cal/g. Accordingly it is need to do research with the pyrolysis carbonization process of durian peel, so that the higher ash levels can be reduced by using a mixture of other biomass.

Moreover carbonization pyrolysis also produces liquid smoke which can be used as a preservative. This research will be carried out at a pyrolysis carbonization temperature of 200-400^{o}C with adhesive from banana peels waste and starch as a comparison, by add biomass from coconut shell and palm shell to increase the calorific value of biobriquettes.

The purpose of this study was to determine the effect of carbonization temperature to the biobriquettes result, the effect of biomass mixture with biomass durian peel to the calorific value, and the effect of adhesive type to quality of biobriquettes produced.

2. Methodology/ Experimental

This research was conducted at the Laboratory of Chemical Engineering, Universitas Bung Hatta Padang. The research parameters consist of Fixed Parameters, Variable Parameters, and Output Parameters. Fixed Parameters arebiomass of durian peel, adhesive: 10% from the total biomass mixture, biomass mixture with composition ratio 2: 1, with a total weight of biomass at 140 grams. Variable parameters is another biomass mixture,: palm shells, coconut shells; different types of adhesives: starch and banana peels; Carbonization temperature at 200, 300, and 400^{o}C. Output parameters are compression strength, porosity, calorific value, ash content and burning time.

2.1. Tools

Pyrolysis carbonization reactor, condenser, biomass cutlery, sifter, Mixers, grinding, Biobriquettes Molds, basin, Zinc for drying, Stove, Pots, Spatula, scales, oven, desiccator and porcelain dish.

2.2. Materials

Durian peels from Padang, Biomass mixture consist of palm shells, Coconut shell, adhesive from starch flour, banana peel, and water.

2.3. Working Procedures

2.3.1. Carbonization Stage by means of Pyrolysis Carbonization

a. The durian peel was chopped up small, so that the drying process can be faster and more volume of material can be fed into the reactor
b. All material is dried under the sun for 4-5 days.
c. once the ingredients dry, biomass was entered in the carbonization reactor, then temperatur of heating was set and biomass was entered until almost full and then reactor was covered tightly.
d. The heater is switched on and the carbonization temperature is adjusted (according to variations at 200, 300 and 400^{o}C) with a heating time of 2 hours each.
e. After two hours, pull out the carbonization results, then crush until smooth at size of 60 mesh.
f. The same thing is done on another biomass mixture; palm shell and coconut shell

2.3.2. Adhesives Manufacturing Phase

A. MakingAdhesives From Starch

Starch weighed as much as 10% of the total biomass feedstock, next insert the water at a ratio of 1: 10, then stirred. Starch solution was then heated on a stove until thickened.

B. Making Adhesives from Banana Peel

Banana peel retted ± 10 days, then was mashed. The smooth banana peel is mixed with 10% of the total weight of the biomass feedstock, then was add water gradually until homogeneous.

2.3.3. Briquetting Phase

The smooth durian peels charcoal is weighed according to the specified weight and the specified biomass variation. The refined durian peel is mixed with the adhesive in the container while stirring until evenly Further the mixture were molded using biobriquettes mold. Biobriquettes then dried under the sun until completely dry.

2.4. The tools image series can be seen in Figure 1.

Figure 1. The series of pyrolysis carbonisator dual function tool

Information :

1. Reactor; 2. Furnace; 3.Thermometer; 4. Pressure Gauge; 5. Condenser; 6. The Hot Water flow; 7. The Cold Water flow in; 8. Condensate Flow; 9. Liquid smoke Container; 10. The cooling water hose

3. Results and Dicussion

Biobriquettes shape produced from the research of Manufacturing of biobriquettesdurian peel from the mixture of biomass and adhesive, can be seen in Figure 2.

Figure 2. Biobriquettes of Mixture of Biomass and Adhesives

3.1. Effect of Raw Materials to the Biobriquettes Porosity/ Density

Porosity/density is the ratio between the weight to the volume of briquettes. Density size is influenced by the size and homogeneity of the briquettes materials. Based on observations and calculations performed on the density value of each treatment,smaller particle size can expand the field of bonding between powders, thus increasing the density of briquettes (Masturin 2002). The effect of a biomass mixture to porosity can be seen in Figure 3 and Figure 4.

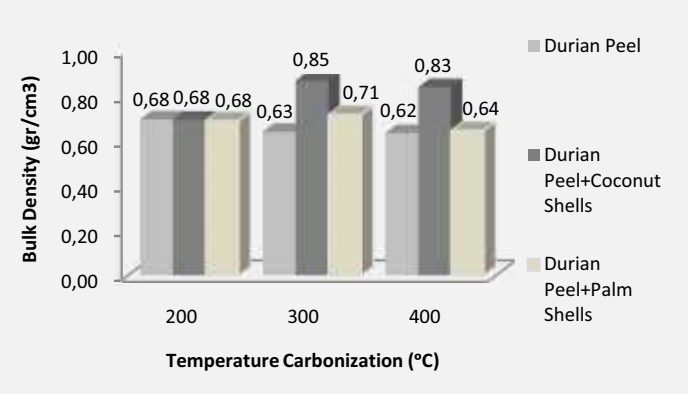

Figure 3. Effect of Biomass Mixture Using Adhesives Starch To The Porosity

From Figure 3 and Figure 4 can be seen that the mixing of biomass coconut shell and palm shells charcoal with durian peel (agricultural waste) at a smaller size (60 mesh) could expand the bonding between particles, thereby increasing the biobriquettesdensity, since the bonds between powder are stronger and more compact.

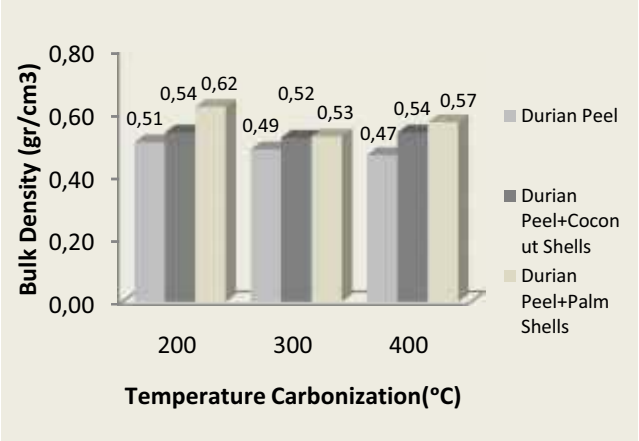

Figure 4. Effect of Biomass Mixture Using Adhesives Banana Peel to the Porosity

Figure 3 and Figure 4 show that biobriquettes porosity values ranged from 0.47 to 0.85 g/cm^3. Biobriquettes with adhesive starch obtained the best porosity of 0.85 g /cm^3 with a mix of biomass durian peel and coconut shell, while biobriquettes with adhesive banana peel earned best porosity of 0.62 g/cm^3 with a mixture of durian peel biomass and palm shells. Adhesive banana peel does not have a strong bond between the fibers, it is because the banana peel adhesion is not as strong of starch adhesion. This leads to a lower density value. Thus, the composition of the constituent material effect the biobriquettes density.

3.2 Effect of the Mixture of Biomass and Adhesive on CompressionStrength

Effect of biomass mixture and adhesive onbiobriquettescompression strength can be seen in Figure 5 and Figure 6.

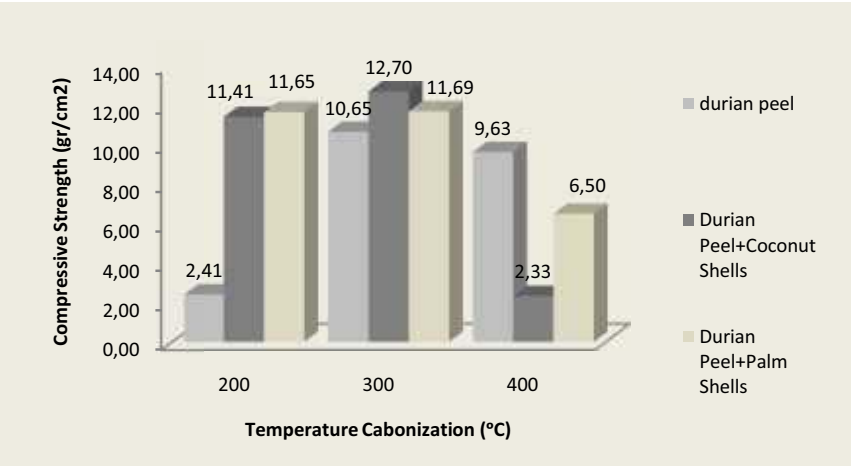

Figure 5. Effect of Biomass Mixture using Adhesives Starch To The Compression Strength

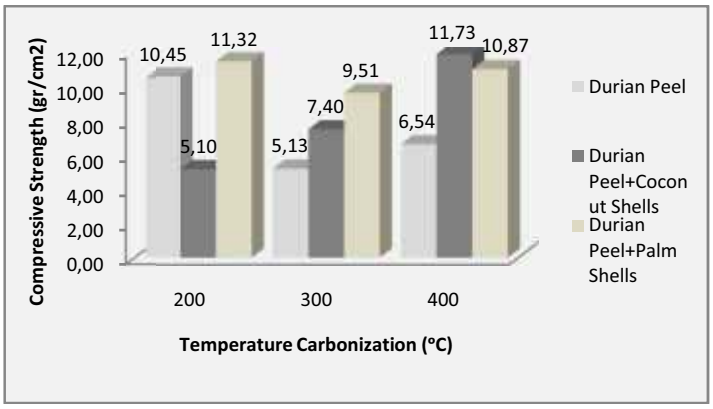

Figure 6. Effect of Biomass Mixture Using Adhesives Banana Peels To The Compression Strength

Figure 6 and 7 shows that the highest compression strength at 12.70 g/cm^2, using adhesive starch with a mixture of coconut shell biomass at temperatures of 300^{o}C, while the highest compression strength using adhesive banana peel with a mixture of biomass palm shell at temperature of 400^{o}C, namely 11.73 g/cm^2.

Adhesive starch has a better compression strength than adhesive banana peel, this is due to starch adhesion is higher than banana peel, moreover high density biomass would produce high compression strength biobriquettes as well, as proposed by (Sudrajat,1984), that charcoal biobriquettes from high density raw materials will also provide a high compression strength

3.3. The Effect of Biomas Mixture and Adhesive to the Calorific Value

The biomass mixture and adhesives used in biobriquettes manufacture also affect the calorific value. Each sample variation had been tested the calorific value.

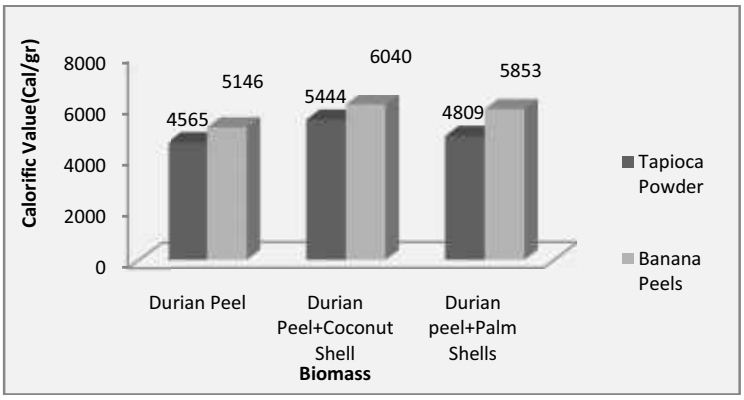

Figure 7. The Effectof Biomass Mixture and Adhesives To The Calorific Value

Figure 7 show that the increasing of calorific value is also influenced by a mixture of biomass used. Calorific value of Biobriquettes durian peel without other biomass mixture are 4564 and

5146 cal/g, and the calorific value were increased become 5444 and 6040 cal/g when biobriquettes durian peel mixed with coconut shell,.
Calorific value of biomass using a mixture of palm shells decreased to 4809 and 5853 cal/g. In the research by Pramudya, et.al (2011), the highest calorific value obtainedon durian peels and palm shells with jackfruit seed adhesive was 5495 cal / gr. Thereby it can be concluded that the used of adhesive type is can influenced the caloric value. Banana peel adhesive gives the higest calorific values than with the jackfruit seeds adhesive in research Pramudya ,et.al (2011).

The addition of biomass can increase the calorific value of biobriquettes durian peel. The addition of coconut shell biomass provides the best calorific value. This is due to coconut shell has a high carbon compound that gives additional calorific value to the durian peel biobriquettes produced. Adhesive type is also affects the calorific value obtained. Figure 7 shows that adhesive banana peel provides a higher calorific value than adhesive starch.

3.4. Effect of carbonization temperature and biomass mixture to the Burning Time

Effect of carbonisation temperature and biomass mixtures to the biobriquettes burning time can be seen in Figure 8 and Figure 9.

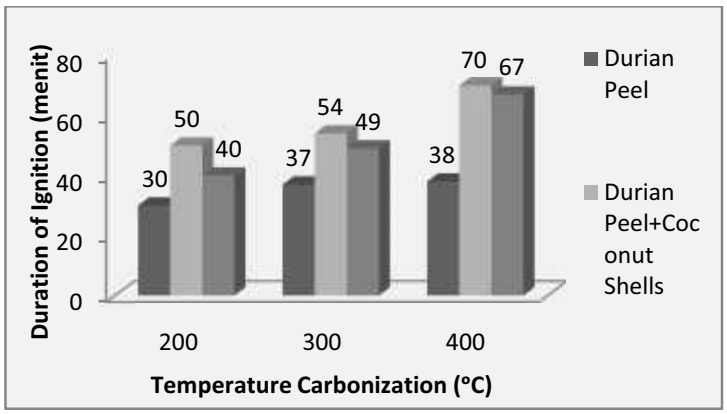

Figure 8. Effect of Carbonisation Temperature and Biomass Mixture Using Adhesives Starch To The Burning Time

Figure 8 and Figure 9 shows that the best burning time of biobriquettes obtained at carbonization temperature of 400^{o}C ie 73 minutes on biobriquettes with adhesive banana peel and coconut shell mixture.This is because the burning temperature of 400 ^{o}C completely carbonized biomass as compared with 200^{o}C and 300^{o}C burning temperature, so that the carbon content tied will be higher at burning temperature of 400 ^{o}C, so the biobriquettes ignition time to ashes will be longer.

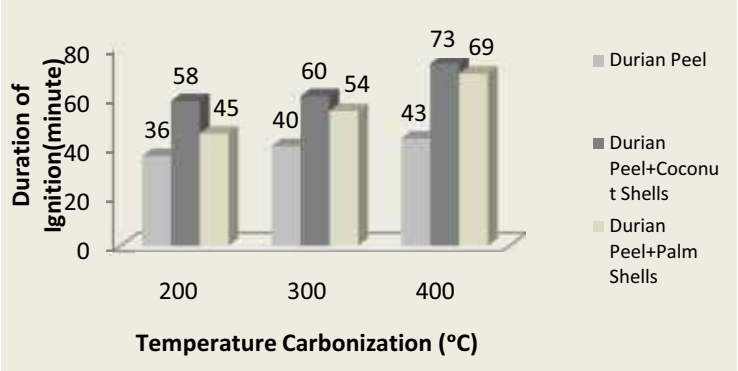

Figure 9. Effect of Carbonisation Temperature and Biomass Mixture Using Adhesive banana peels To The Burning Time

The effect of biomass mixture show that Biobriquettes mix with coconut shells provide the best ignition when compared with other. In research by Munas, et.all (2012) that the best burning time of biobriquettes is 40 minutes on biobriquettes with cocoa beans biomass without the addition of other biomass, but in this study the best burning time of biobriquettes is 73 minutes on biobriquettes with durian peels and coconut shells with banana peel s adhesive.

3.5. Effect of Carbonization Temperature and Biomass Mixture to Ash Content

Effect of carbonization temperature and the biomass mixture to ash content can be seen in Figure 10 and 11.

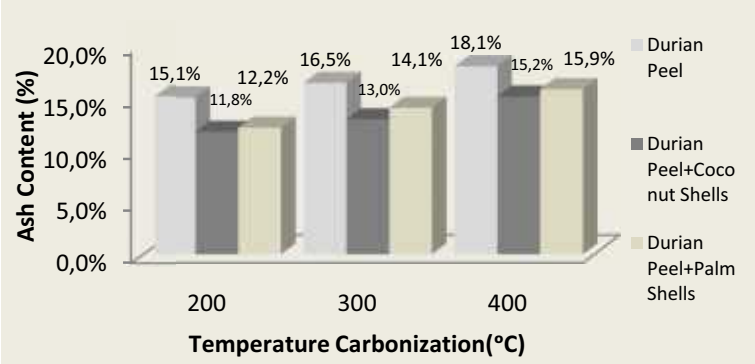

Figure 10. Effect of Carbonisation Temperature and Biomass Mixture using Adhesive starchs To Ash Content

Figure 10 and 11 shows that ash content obtained ranged between 10% - 24%. Ash content obtained is not yet meet the standards of <10%. Carbonization temperature of 400 ^{o}C give the highest ash content compared to the carbonization temperature of 200 ^{o}C and 300 ^{o}C.

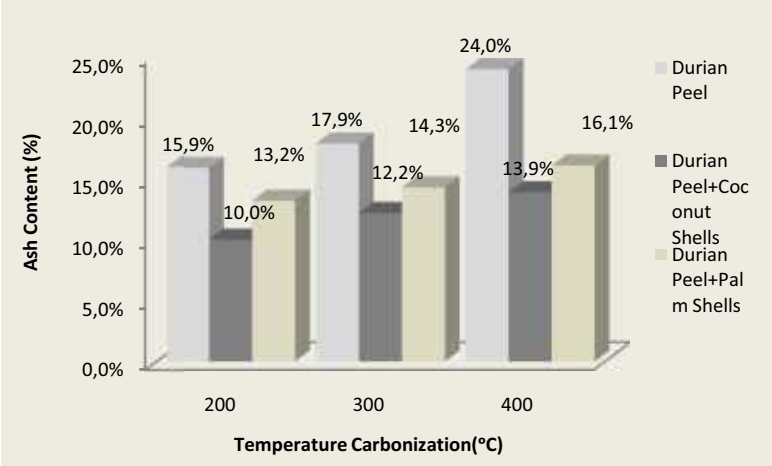

Figure 11. Effect of Carbonisation temperature and Biomass Mixture Using Adhesive banana peels To Ash Content

This is due to the ash content will increase at the higher carbonization temperature. Carbon will burn out at higher temperature and leave the ashes as a result from the combustion (Rosdiana, 2016), so it can be said that the carbonization temperature rise is directly proportional to the biobriquettesash content. On the influence of the biomass mixture, biobriquette mixture of durian peel with coconut shell biomass with adhesive banana peel provide the best ash content is 10%. In research by Pramudya, et. All (2011), biobriquettes mixture of durian peel with palm shell biomass with durian seeds adhesive provides the lowest ash content is 11.90%. This is due to mineral deposits that can not be burned in the coconut shell is lower compared to the others, so that the ash obtained is also low.

4. Conclusion

Results from the study of biobriquettes durian peel give some following conclusions:

a. Utilisation of durian peel waste, coconut shell, and palm shells on making biobriquettes may increase the economic value of raw materials.,
b. Banana peel waste can be use as an adhesive in the biobriquettes manufacture, but the adhesiveness given still low compared than adhesive starch, but adhesive banana peel can improve the calorific value of biobriquettes.
c. The addition of coconut shell and palm shell biomass improve the quality of biobriquettes durian peel.
d. Biobriquettes has the highest calorific value at 400^{o}C carbonization temperature, with a mixture of coconut shell and adhesive banana peel of 6040 cal/g. Calorific values obtained reached the calorific standard based on ISO (5000 cal/g).

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