GASIFICATION ANALYSIS OF RICE HUSK USING VARIATION OF PRIMARY AIR SPEED 4 M/S, 5 M/S, 6 M/S

Submitted as a Partial Fulfillment of the Requirements

for Mechanical Engineering Department International Program In

By:

TRI ATMAJA HARYONO IMAM MULIA PATABARA

D200217262

MECHANICAL ENGINEERING DEPARTMENT INTERNATIONAL PROGRAM IN AUTOMOTIVE/MOTORCYCLE ENGINEERING

MUHAMMADIYAH UNIVERSITY OF SURAKARTA

2022

APPROVAL

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PUBLICATION ARTICLE

Oleh

TRI ATMAJA HARYONO IMAM MULIA PATABARA

D200217262

It has been inspected and approved for testing by:

Consultant,

Ir. Wijianto, S.T.,M.Eng.Sc.

ACCEPTANCE

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D200217262

Accepted by the Board Examiners
Mechanical Engineering Department International Program In
Automotive/Motorcycle Engineering
Muhammadiyah University Of Surakarta
February 2022

Team of Examiners :

1. Ir. Wijianto, S.T., M.Eng.Sc. (.....)
   (Head of Examiner)
2. Ir. Subroto, MT. (.....)
   (Member I of Examiner)
3. Dr. Tri Tjahjono, MT. (.....)
   (Member II of Examiner)

Dean,

Rois Fatoni, SIT, MSc, Ph.D.
NIK. 892

TESTIMONY

Herewith, I testify that in this research proposal, there is no plagiarism of the previous literary work which has been raised in order to gain bachelor degree of university, nor there are masterpieces that have been written or published by other, except those in which writing are referred in the manuscript and mentioned in literature review and bibliography. If the result of this research is proven as plagiarisms, I will be fully responsible and get the sanction with applicable regulation.

Surakarta, February 7th 2022

The Researcher

TRI ATMAJA HARYONO IMAM MULIA PATABARA

D200217262

EFFECT OF RICE HUSK GASIFICATION WITH VARIATION OF AIR PRIMER SPEED 4 M/S, 5 M/S, 6 M/S FOR GASIFICATION STOVE

Abstrak

Metode kompor gasifikasi updraft merupakan salah satu sumber kehidupan manusia salah satu pemanfaatan energi biomassa untuk mengurangi emisi udara. Variasi udara primer adalah salah satu improvisasi desain memasak kompor metode updraft gasifikasi yang digunakan dalam kompor dalam penelitian ini. Tujuan dari penelitian ini adalah untuk menggambarkan suhu api. waktu nyala api yang efektif, dan hitung efisiensi termal kompor gasifikasi updraft dengan berbagai variasi udara primer. Tes ini dilakukan dengan mengambil data suhu api dan suhu mendidih air setiap 30 detik pada variasi kecepatan aliran udara primer (4 m / s, 5 m / s, 6 m / s) tanpa penambahan udara pada metode updraft gasifikasi dinding kompor reaktor. Total waktu operasi dicatat pada setiap tes. Hasil penelitian ini menunjukkan bahwa suhu nyala api rata-rata tertinggi diperoleh pada variasi kecepatan aliran udara utama 5 m / s. Efisiensi termal terbaik diperoleh pada pengujian variasi kecepatan aliran udara utama 6 m / s.

Kata kunci: gasifikasi, kompor gasifikasi draft, sekam padi, variasi kecepatan primer.

Abstract

updraft gasification stove method is one source of human life one of the utilization of biomass energy to reduce air emissions. The variation of primary air is one of improvisation of cooker cooking design of gasification updraft method used in the stove in this research. The purpose of this study was to describe flame temperature, effective flame time, and calculate the thermal efficiency of updraft gasification stove with different variations of primary air. The test is carried out by taking flame temperature data and boiling temperature of water every 30 seconds on the variation of primary air flow velocity (4 m/s, 5 m/s, 6 m/s) without air addition on the reactor cooker wall gasification updraft method. The total operating time is recorded on each test. The results of this study indicate that the highest average flame temperatures are obtained on the primary airflow velocity variation of 6 m/s. The best thermal efficiency is obtained on testing the primary airflow velocity variation of 6 m/s.

Key words: gasification, up draft gasification stove, rice husk, primary speed variations.

1. INTRODUCTION

Currently energy needs is one source of human life that can not be separated. Energy can be classified into two: energy that comes from fossils of living things and plants. In this study, researchers focused on energy sourced from plants called

biomass. Biomass is often referred to as bioresource.The biomass resource base includes Biogas, Plants, Agricultural Waste, Energy Plants, and others. Biomass resources can be renewed so that biomass energy is a renewable energy.

In ancient times, the use of biomass has been used since early humans discovered fire until in 1970, and in 1975 scientists named the fossil fuel other than the name of biomass. Emerging new technologies regarding the utilization of the biomass. One such technology is the process of gasification.

Based on fluidization mode gasification can be divided into four, there are fixed gasification gasification, moving bed gasification, fluidized bed gasification and etrained bed gasification.

Based on the flow direction, gasification can be divided into three, there are downdraft gasification, updraft gasification, and cross draft gasification. Gasification process with updraft gasification method can produce fewer emission which can endanger human health. At this time has been a lot of application of updraft gasification method on cooking stove gasification with various designs. This is done to get the best results from cooking stove gasification.

Fuel for cooking stove gasification rice husks updraft gasification method can vary. One of the fuels that can be used is rice husk. Rice husk is often interpreted as waste material from rice mill, its existence tends to increase which experienced natural and slow destruction process, so it can disturb environment also human health. Rice husk has a bulk density of 125 kg / m, with a calorific value of 1 kg rice husk of 3300 k.calory and in terms of chemical composition, carbon husk (charcoal) 1.33%, 1.54% hydrogen, oxygen 33,645, and Silica (SiO_2) 16,98%, which means husk can be utilized as raw material of chemical industry and as source of heat energy for human need.

The variation in primary airof the gasification stove reactor is improvisation of cooker cooking design of rice husk gasification updraft method used in this research. It aims to obtain the best performance of cooking stove gasification rice husk updraft method used. Therefore, in this study, researchers need to make measurements of flame temperature, recording time of flame and thermal efficiency generated on the stove used.

Based on the description above, can be formulated problems in this study as follows, How does the variation of primary airflow velocity affect the reactor to the flame temperature on gasification stoves? How does the variation of primary airflow velocity affect the reactor to the time of the flame on the gasification stove? How does the variation of primary airflow velocity affect the reactor to the thermal efficiency generated on the gasification stove?

Objective Of Study, Referring to the background and formulation of the problem, then the purpose of this study is: To describe the effect of variation of air velocity of primary air to flame temperature on gasification stove by updraft method; To describe the effect of primary air velocity variation on flame time on gasification stove by updraft method; To describe the effect of primary airflow velocity variation on the thermal efficiency generated on the gasification stove by updraft method.

Problem Limitation Analyzing the existing problems required some limits to the discussion more concentrated on the issues to be studied. Limitations of the problem taken are as follows. The fuel used is rice husk with 1 kg mass and Original mesh; The stove used is updraft gasification stove with primary air variation; The insulating material used is refractory clay; Variations in primary air flow velocities are 4, 5, and 6 m/s; The environment is at 1 atm pressure; The value taken in this study is the temperature of the flame, the time of the flame and the resulting thermal efficiency; This study does not discuss the stoichiometry of fuel combustion with air and the type of stream entering the reactor; In this study does not discuss the calculation and movement of conduction heat transfer, convection, and radiation. In this study does not discuss the type of gas that can burn and cannot burn.

Wijianto (2016),conducted a study of variations in airflow velocity on biomass waste gasification stoves against effective flame and combustion temperatures. The process of gasification is done by limiting oxygen (O2) into the gasifier. Generally, gasification processes produce gases such as CH4, H2 and CO as well as other compounds such as H2S, CO2, and Tar. This study aims to obtain the best effective combustion temperature and flame time with variations of

airflow velocity on gasifiers and biomass variations. This research is based on updraft gasifier. The gas produced by the gasification process flows to the burner, where the direction of the gas flow is equal to the flow of air from the blower. Air flow variations resulting from air blowers are used to supply oxygen to the reactor. Biomass wastes such as bamboo cuts, straw, wood pieces, and rice husks are used as raw materials for gasification processes. All biomass waste is destroyed to obtain a uniform size using 20 mesh. The results of this study indicate that the best airflow velocity of 10 m / s and the best raw material as a source of heat from the gasification process is rice husk. This gasification produces an effective flame time of 33 minutes and the average temperature is 600°C

The focus of the research is the process of gasification on the stove by using rice husk fuels, while in this study tested the effect of variation of primary air flow velocity and the addition of air to gasification stove reactor of TLUD method with difference of diameter of cylider in reactor. The novelty of this research is to examine the influence of air velocity variation, beside that this research also have differentiation variable that is addition of air of 2.5 m / s and difference of diameter of silider in reactor wall.

Surjadi, Eko and Edy Susilo Widodo (2012), conducted a study of the effect of primary air velocity on the output power of the downdraft gasification type furnace. The purpose of this study was to obtain initial primary air velocity producing as large a power output as possible in a Biomass Type Gasification Furnace Downdraft. Experiments with the Water Boilling Test method were conducted using rice residues (husks) as feeds with primary primary air velocity variations. The design of this study has a treatment that is primary primary air velocity, imposed on an object research, namely downdraft gasification furnace and then treatment results were observed. With Water Boilling Test obtained data start up time, operating time and total operating time from use of Downdraft Biomass Gasification Furnace on variations in pimer air velocity first between 2-3,8 m/s, with mass of 600 gram of bait and water 1 liter. The results showed that the higher initial primary air velocity causes better power output or increase in

size, Stove efficiency of this gasification furnace increases with increased initial primary air velocity. Output Power of gasification furnace at speed initial air of 3.8 m / s (highest fan air speed) is 1.32 kW.

2. METODH

2.1 Flow Chart Of Research

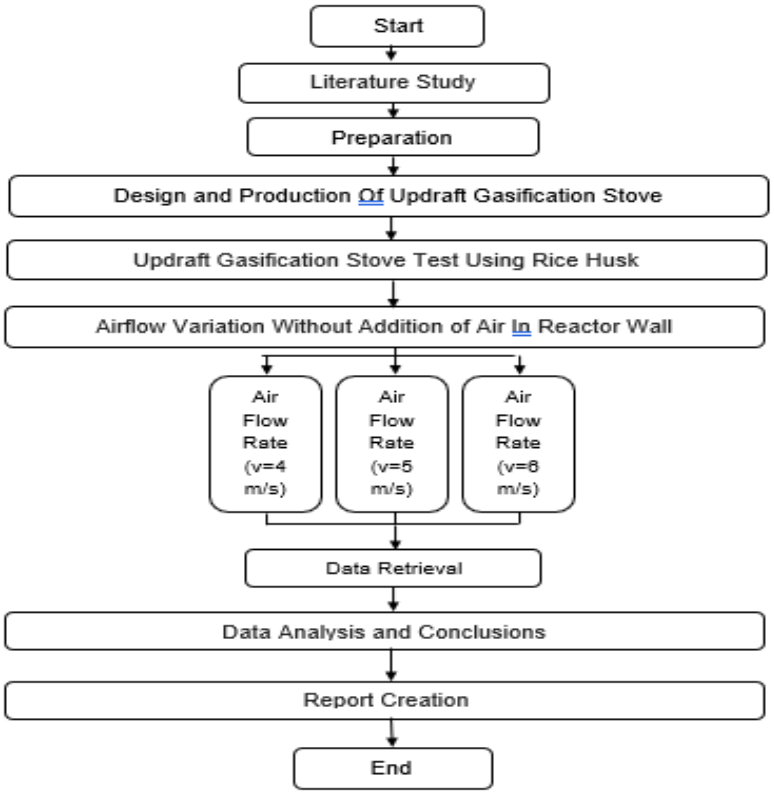

Figure 1. Research Flowchart

2.2Installation Assembly

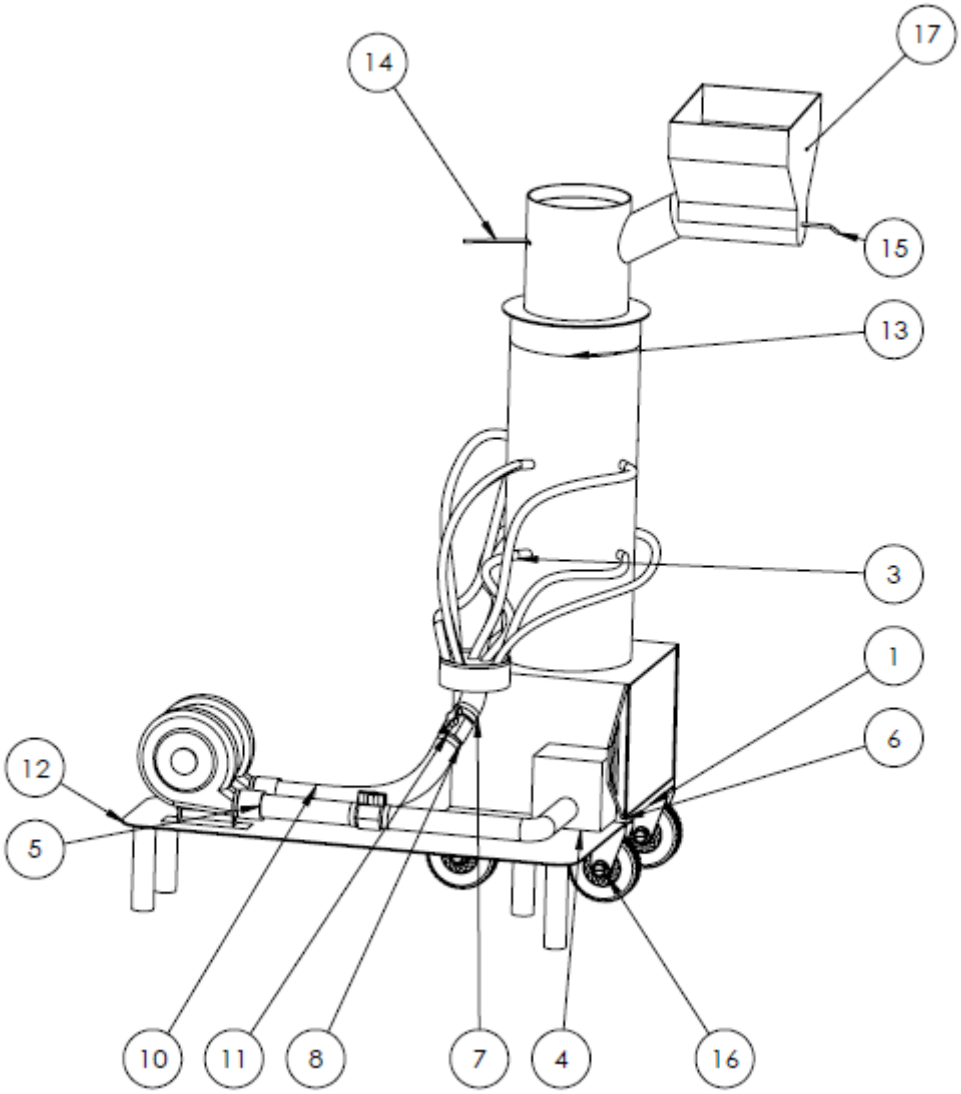

Figure 2. Installation Assembly

Information :

1. Base Of Stove
2. Stove Furnace
3. Hose
4. Connecting
5. Blower
6. Sliding Door
7. Pipe
8. Faucet
9. Connecting Pipe To Blower 1
10. Connecting Pipe To Blower 2
11. Lever Faucet
12. Pedestal Of Blower
13. Head Of Stove
14. Reservoir Cap
15. Cutter Spiral
16. Wheel
17. Continous Input Of Rice Husk

Examination Stage of performance testing of rice husk gasification Up Draft stove is as follows: Set the blower speed used as the primary airflow supplier according to predetermined variations. Install the research tools according to the test installation. Insert a heated charcoal at the bottom of the reactor. Insert rice husk that has been measured mass (1 kg) into the gasifier and continue (250 gram) every 10 minutes 3 times. Turn on the blower as the primary air supply. Test the gas that is formed by burning to the formation of fire. Recording time data, flame temperature and water temperature every 30 seconds of the total operating time of the furnace. Considering the charcoal of rice husk burning; Repeat the test with variations in primary airflow velocity and predefined air wall of the reactor.

3. FINDINGS AND DISCUSSION

3.1 Flame Temperature Variation Of Primary Air Flow Rates 4 m/s.

Research using a variation of primary airflow velocity of 4 m/s w. The results of the study are presented using the following graphic:

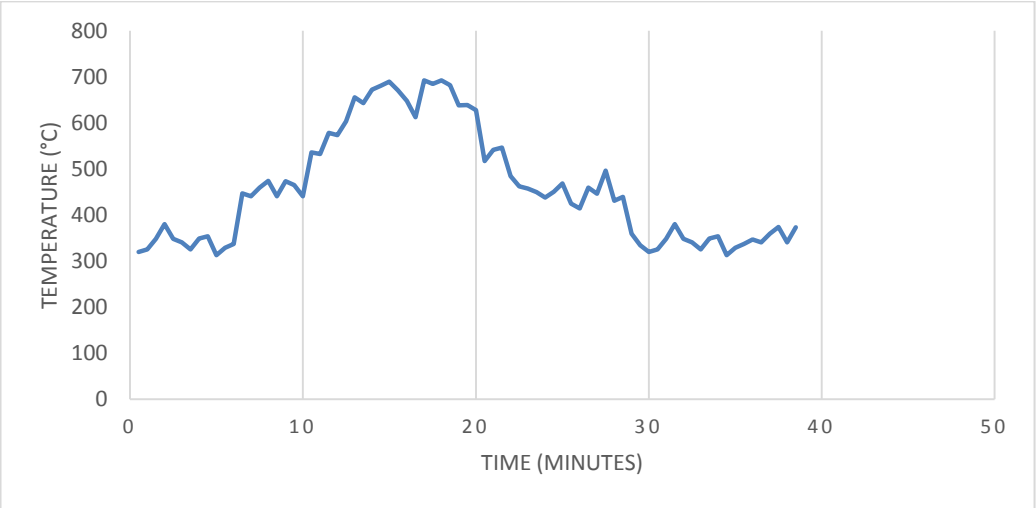

Figure 3. Graphic Temperature Relation of Flame to Time With Variation of Primary Airflow Speed 4 m/s .

Figure 3. shows that the initial temperature of the flame with a variation in the primary airflow velocity of 4 m/s is at 319.5°C and continues until it reaches the highest temperature at 692°C at 18 minute. The final temperature of the flame with the variation of the primary airflow rate of 4 m/s is at 373,5°C at 38 minutes over 18 seconds.

3.2 Flame Temperature Variation Of Primary Air Flow Rates 5 m/s.

Research using a variation of primary airflow velocity of 5 m/s. The results of the study are presented using the following graphic:

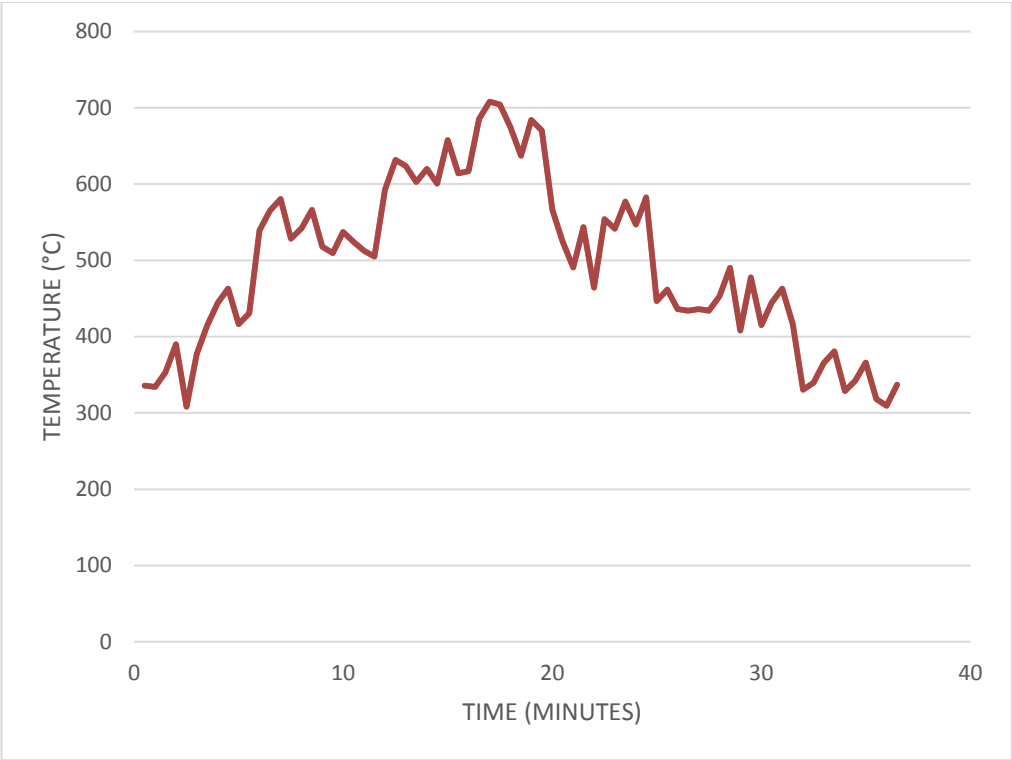

Figure 4.Temperature Relation of Flame to Time With Variation of Primary Airflow Speed 5 m/s.

Figure 4.shows that the initial temperature of the flame with a variation in the primary airflow velocity of 5 m/s is at 336°C and continues until it reaches the highest temperature at 708°C at 18. The final temperature of the flame with the variation of the primary airflow rate of 5 m/s is at 337°C at 36 minutes over 20 seconds.

3.3 Flame Temperature Variation Of Primary Air Flow Rates 6 m/s.

Research using a variation of primary airflow velocity of 6 m/s without the addition of air to the reactor wall has been done. The results of the study are presented using the following graphic:

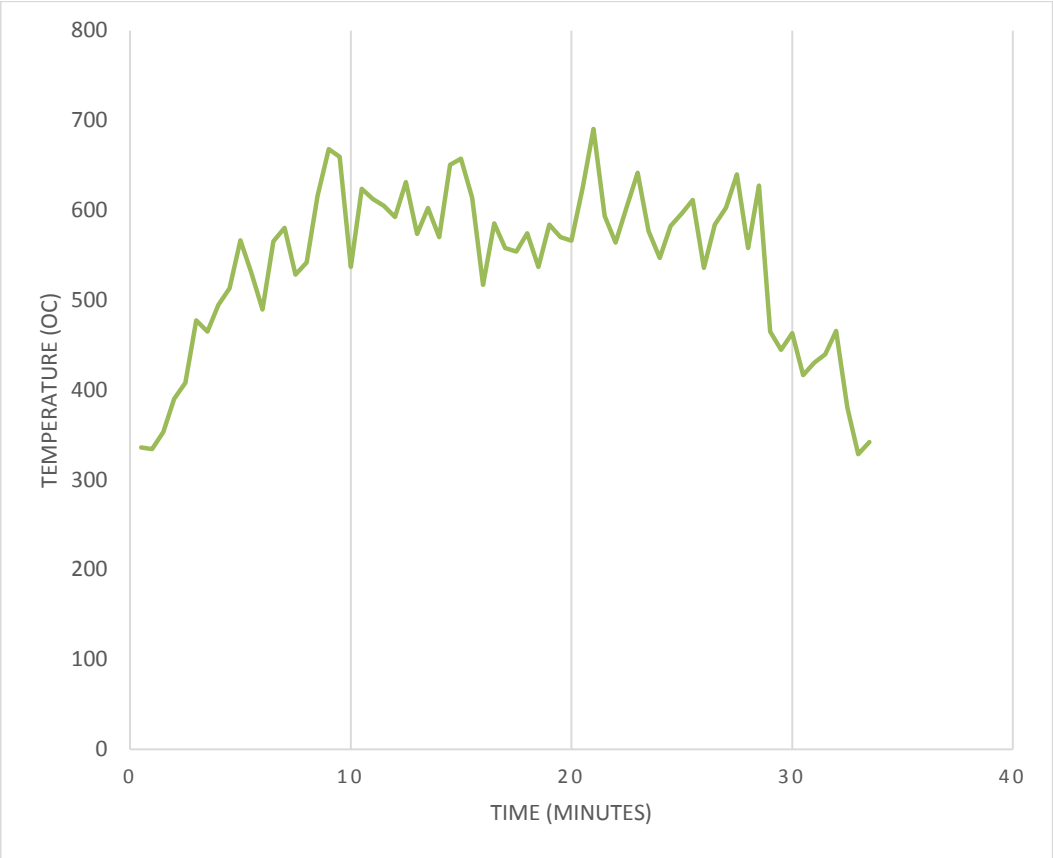

Figure 5.Temperature Relation of Flame to Time With Variation of Primary Airflow Speed 6 m/s.

Figure 5. shows that the initial temperature of the flame with a variation in the primary airflow velocity of 6 m/s is at 336°C and continues until it reaches the highest temperature at 690,5°C at 21 minute. The final temperature of the flame with the variation of the primary airflow rate of 6 m/s is at 342°C at 33 minutes over 40 seconds.

3.4 Comparison Of Flame Temperature To Time With Variations Primary Air Flow Rate.

The comparison of the flame temperature to the time obtained after conducting the study using variations of primary air flow velocity and exposed using graphs. The following graph shows the comparison between the flame temperature over time using the primary airflow velocity variation.

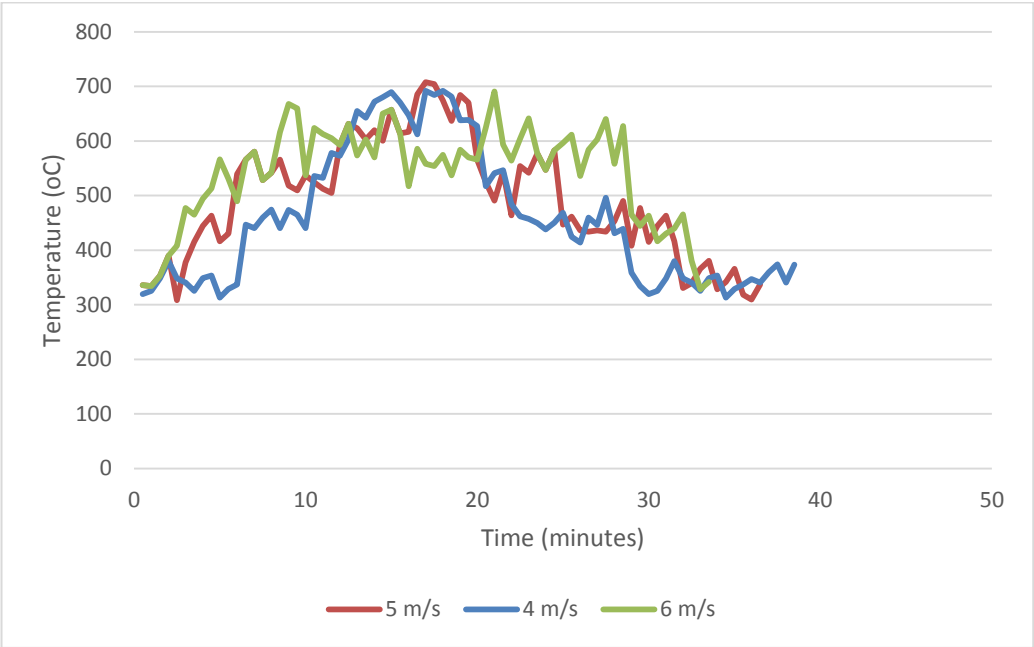

Figure 6. Comparison Of Flame Temperature To Time With Variations Primary Air Flow Rate.

Figure 6. shows that the initial temperature of the flame with a variation in the primary airflow velocity of 4 m/s, 5m/s, and 6 m/s is sequentially at 319,5°C, 336°C, and 336°C. The highest average flame temperatures were obtained on a 6 m/s primary airflow velocity variation. because the higher air accelerates the process of gas formation in the gasification process.Effective flame time variations in primary airflow velocity of 4 m/s, 5 m/s, 6 m/s sequentially are 38 minutes over 18 seconds, 36 minutes over 20 seconds, 33 minutes over 40 seconds.

This is in line with the theory that the less air supplied the faster the process of formation of gas from the bottom up, but for the combustion process becomes imperfect because the air is given less. Thus, the lower the rate of primary air flow without the addition of air, the less total time required for the gas formation process but the resulting combustion is not perfect.

3.5 Comparison Of Water Boiling Temperature To Time With Variations Primary Air Flow Rate.

The comparison between the boiling temperature of water to the time obtained after the study by cooking water using variations in primary air flow velocity is expressed using graphs. In this study water boils at a temperature of 100°C and a pressure of 1 atm. The following graph shows the comparison between boiling water temperature over time using variations in primary airflow velocity without adding air.

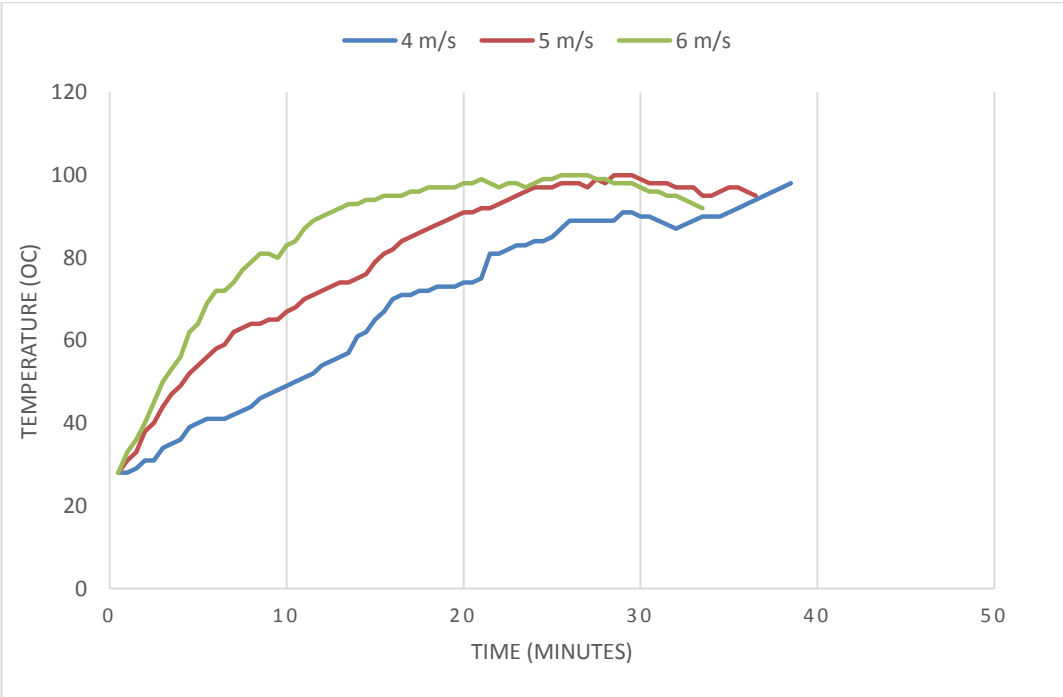

Figure 7. Comparison Of Water Boiling Temperature To Time With Variations Primary Air Flow Rate.

Figure 7.showed that with a primary airflow rate of 4 m/s the recorded time was not boiling water. At the primary airflow velocity of 5 m/s the recorded time during boiling water is at 28 minutes over 30 seconds. At a primary airflow velocity of 6 m/s the recorded time during boiling water is at 25 minutes over 30 seconds.

3.6 Comparison Of Thermal Efficiency With Variations Primary Air Flow Rate.

The comparison between Thermal Efficiency obtained after conducting the study using variations of primary air flow velocity without additional air has been made and exposed using graphs.The following graph shows the comparison between thermal efficiency using the primary airflow velocity variation.

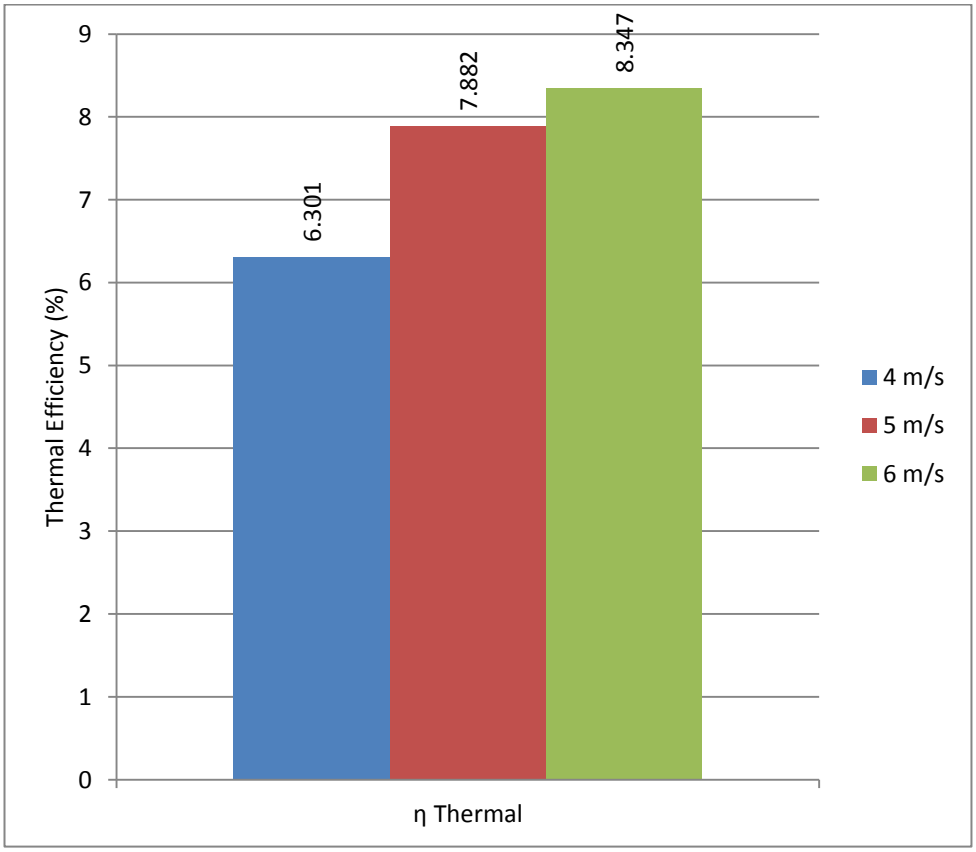

Figure 8 .Comparison Of Thermal Efficiency With Variations Primary Air Flow Rate.

Figure 8. showed that with a primary airflow rate of 4 m/s The Thermal Efficiency was at 6.301%. At the primary airflow velocity of 5 m/s The Thermal Efficiency was at 7.882%. At a primary airflow velocity of 6 m/s The Thermal Efficiency was at 8.347%.

4. CONCLUSIONS

After conducting the test, the analysis and discussion on the performance of the updraft gasification stove with the variation of primary air flow velocity without additional air obtained the following conclusion: The highest average flame temperatures were obtained at a variation in the primary airflow velocity of 6 m / s. This is because of the variation graph of the primary airflow velocity of 6 m / s. This is because the higher air accelerates the process of gas formation in the gasification process, Variations in primary airflow velocity affect the effective effective flame time recorded. The higher the speed of the pimer airflow, the less effective flame time it produces, The highest thermal efficiency was obtained at testing the variation of the primary airflow velocity of 6 m/s.

The researcher gave suggestion to the next test using the updraft rice husk gasification stove as follows: The reactor or the furnace section shall be in a sealed condition without leakage so that gasification and combustion of the gas can be smooth; When conducting tests and data retrieval should be done in a place that is blocked from the wind blow directly because the wind can directly affect the stability of the temperature of the flame; Attention to testing or research steps carefully so that there is no difference in the determination of fixed variables. Such as rice husk condition, furnace condition and implementation time of test phase. This needs to be considered to maintain the quality of the data to be generated in the testing phase; Use safety equipment such as masks, gloves and goggles (glasses of dust) during testing to reduce the risk of injury during testing; Always check the condition of the tool component for each test.

BIBLIOGRAPHY

Surjadi, Eko. 2012. "Experimental Assessment of Top-Draft Biomass Gasification Stage Measures in Various Combinations of Biomass Size and Early Primary Air Velocity". Volume XIII No.1. PP 22-31. ISSN 977-19799705.

Gunawan, I Gede Indra. 2016. "Performance Analysis of the Updraft Gasification Reactor With Fuel Of Coconut Shell". Volume 1 No.2. PP 28-34. ISSN 1412-xxxx.

Surjadi, Eko and Edy Susilo Widodo. 2012. "Effect Of Primary Air Pressure On Output Power Furniture Gasification Type Downdraft".

Wijianto. 2016 "Airflow Velocity Variation In Gasification Furnace Biomass Wastes On Effective Flame and Combustion Temperature". *The 4th Universty Research Coloquium.* Universitas Muhammadiyah Surakarta. PP 43-48. ISSN 2407-9189