INTERNATIONAL JOURNAL OF INNOVATION IN MECHANICAL CONSTRUCTION AND ENERGY
Vol. 2 No. 2 (2025), 36-43

IJIMCE
https://ijimce.ppj.unp.ac.id/index.php/ijimce
University of Negeri Padang

International Journal of Innovation in Mechanical Construction and Energy

ISSN: 3046-9112 e-ISSN: 3046-9104

DESIGN OF LIQUID SMOKE EQUIPMENT WITH A CAPACITY OF 120 ML PER HOUR

Bakri Anuar[1], Muchlisinalahuddin[2*], Malikil Kudus Susalam,[3] Ilham Alghani[4] Reyhan Stevano[5]

[1]Departemen of Mechanical Engineering, Univeristas Muhammadiyah Sumatera Barat, INDONESIA
Jl. By Pass, Tarok Dipo, Kec. Guguk Panjang, Kota Bukittinggi, Sumatera Barat 26181
[2]Departemen of Mechanical Engineering, Univeristas Muhammadiyah Sumatera Barat, INDONESIA
Jl. By Pass, Tarok Dipo, Kec. Guguk Panjang, Kota Bukittinggi, Sumatera Barat 26181
[3]Department of Agroindustry, Animal Husbandry Study Program, Faculty of Mathematics and Natural Sciences, State University of Padang, Padang 25131, Indonesia.
[4]Departemen of Mechanical Engineering, Univeristas Muhammadiyah Sumatera Barat, INDONESIA
Jl. By Pass, Tarok Dipo, Kec. Guguk Panjang, Kota Bukittinggi, Sumatera Barat 26181
[5]Departemen of Mechanical Engineering, Univeristas Muhammadiyah Sumatera Barat, INDONESIA
Jl. By Pass, Tarok Dipo, Kec. Guguk Panjang, Kota Bukittinggi, Sumatera Barat 26181

*Corresponding Muchlisinalahuddin, Muchlisinalahuddin.umsumbar@gmail.com

Received 20 February 2025; Accepted 11 June 2025; Available online 30 June 2025

Abstract

Liquid smoke is the result of pyrolysis of various types of biomass used in various industrial applications, including food preservation and waste treatment. This study aims to design and test a liquid smoke production device with a capacity of 120 ml per hour using six types of raw materials: coconut husk, coconut shell, straw, rice husk, corn cob, and corn stalk. The graph of the test results shows that the second experiment (test 2) produced a higher volume of liquid smoke than the first experiment (test 1), with the maximum volume reaching 310 ml. Nonetheless, the processing time varies depending on the type of raw material used. The results of this study show that optimizing the pyrolysis process can improve the efficiency of liquid smoke production, both in terms of volume and processing time. Thus, the device design used in this study has the potential to be further developed to increase production capacity and efficiency. Keywords: liquid smoke, pyrolysis, equipment design, production capacity, coconut shell.

Keywords: *Liquid smoke, pyrolysis, equipment design, production capacity, coconut shell.*

INTRODUCTION

Organic waste is waste that has advantages, especially being environmentally friendly. Organic waste can be processed to become something useful. A very active method is to process organic waste into pyrolysis to create liquid smoke [1]. Some examples of waste such as food and drinks that have been consumed, Regardless of whether additives are used, addictive substances are basically made by extracting animals and plants with the help of chemicals [2]. Liquid smoke is created from the results of distillation or from the condensation of vapors from indirect combustion of materials that contain a lot of carbon [3]. Liquid smoke is created from condensation. The pyrolysis process creates liquids, gases, and solids [4]. Currently, consumer use of food products with a smoky taste is increasing. Many examples are seen such as grilled chicken, satay, and others. How to get the function of liquid smoke such as antimicrobials, antioxidants, can provide a distinctive smoke taste by fractionation because the compounds in the liquid smoke content have different boiling points [5]. Based on research, liquid smoke can slow down bacterial growth. According to research conducted in the food preservation industry, it can slow the growth of bacteria that can minimize the shelf life of the food [6]. From liquid smoke, it removes the unique taste and aroma of smoked products and their color characteristics. In terms of visual appearance and chemical results of meat, the damage caused is physical changes to the meat based on changes in the form of mucus, changes in color, and others. It is expected to replace the role of artificial preservatives in the use of liquid smoke [7]. Liquid smoke is divided into several groups according to its level. First, there is Grade 3 level where liquid smoke contains high tar and benzopyrene, causing food products to be considered unsafe. For the safest level, using Grade 1 level where liquid smoke from grade 3 has been processed sustainably [8]. Liquid smoke produces a solution obtained from direct or indirect combustion of materials that have carbon content. Materials from waste residues include wood, coconut shells, and others. Indonesia is in great need of energy. In several large cities, there is a very large accumulation of waste due to the increasing population of Indonesia. Indonesia has very limited energy by still using fossil fuels [9]. So for now, all researchers are still looking for more efficient and effective ways to replace the use of fossil fuels [10]. Indonesia is a country called an agricultural country, because the majority of the population throughout Indonesia are farmers. Rice produces dry waste called husks.Rice husk is made from the outer skin of dry rice. Rice husk can be used as fertilizer, briquettes, etc. One of the organic insecticides produced from rice husk valley is liquid smoke product [11].

RESEARCH METHODS

The research method describes the process of activities carried out during data search from the beginning to the end of data collection for research. The research method is displayed in the form of a Flowchart with can be seen in **Fig. 1.**

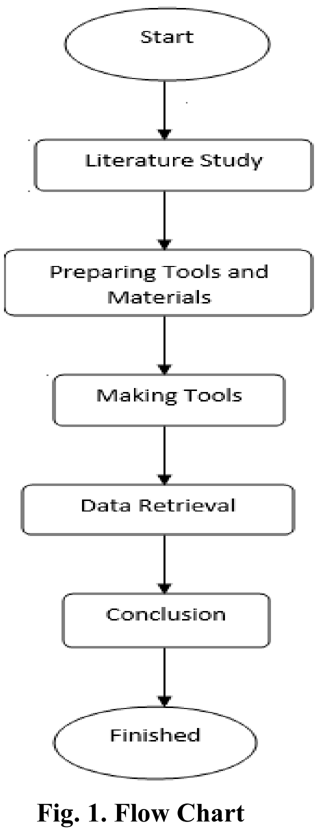

Fig. 1. Flow Chart

The tools used in the research include a pyrolysis reactor which can be seen in **Fig. 2**.

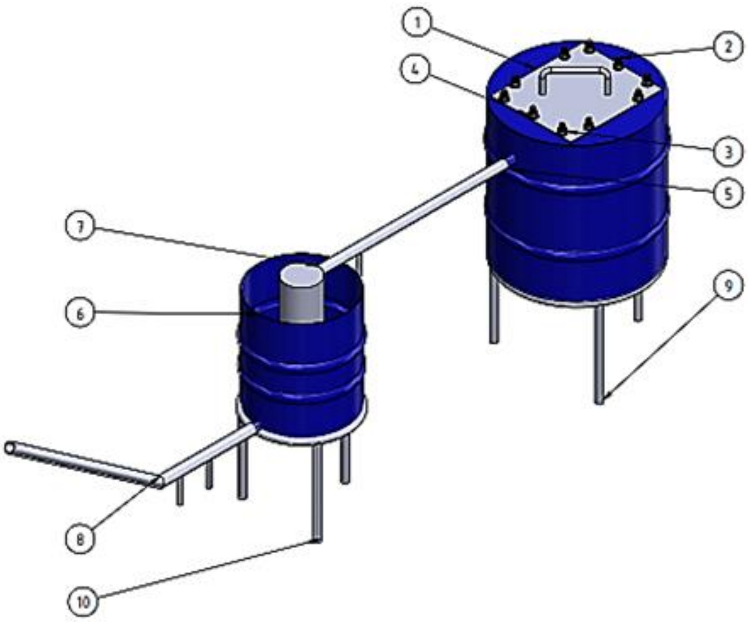

Fig. 2. Liquid Smoke Pyrolysis Tool

The drum capacity used is 70 liters for the main drum as seen in **Figure 2**. Then the second drum uses a capacity of 20 liters as seen in **Fig. 3.**

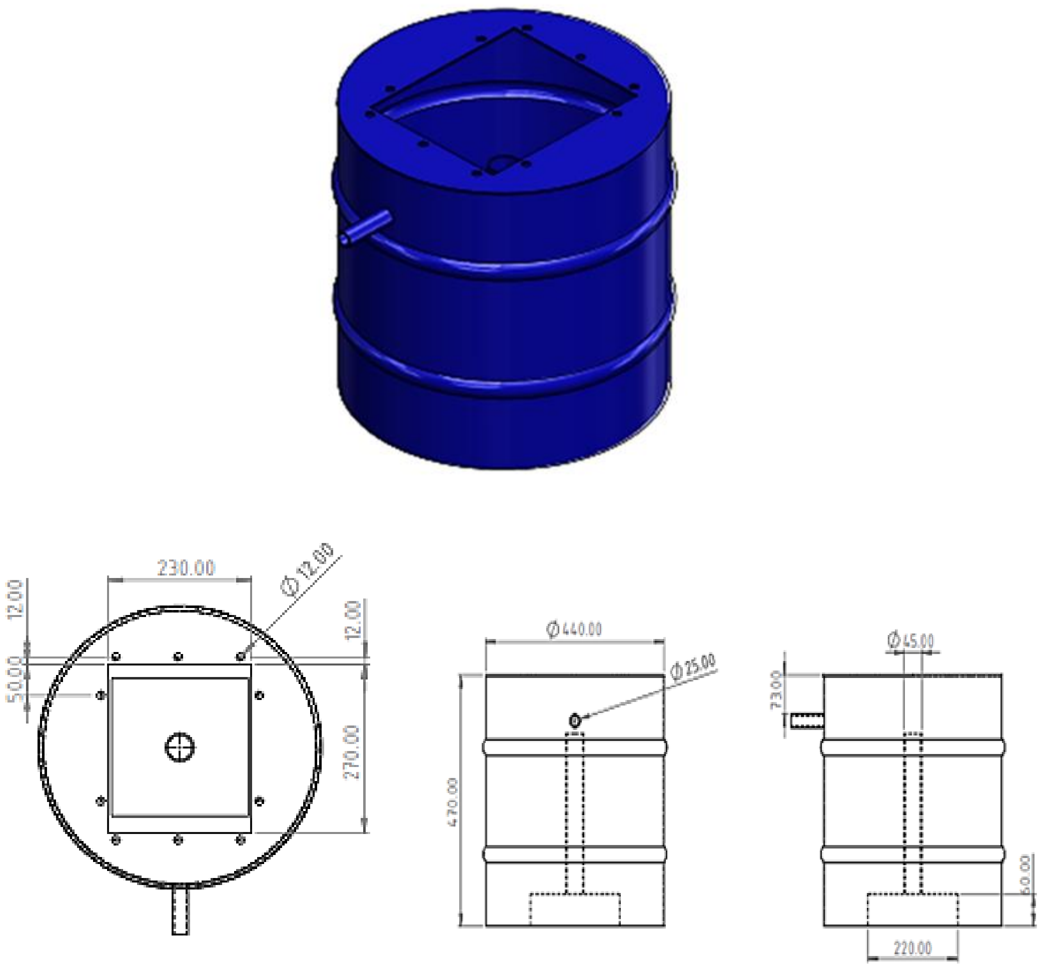

Fig. 3. Main drum capacity

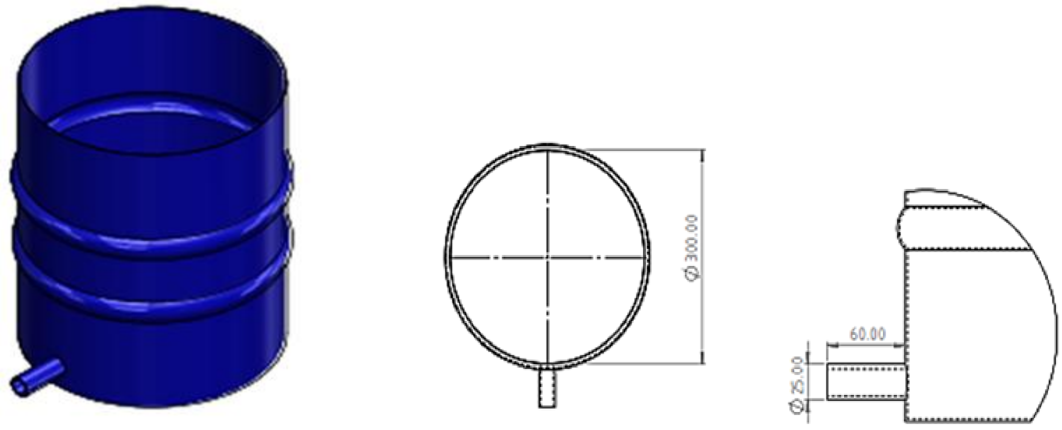

Fig. 4. Second drum capacity

RESULTS AND DISCUSSION

A. Test time 1 and 2

The values obtained in conducting combustion experiements on materials can be seen in **Table 1**.

Table 1. time value obtained in 2 test

materials	Times 1	Times 2
Coconut belt	83	93
shell	97	84
Straw	57	60
Rice husk	160	77
Corn cob	83	95
Corn stalks	83	72

The graph shows the comparison of combustion times obtained in two tests using 1 kg of different types of biomass materials, namely coconut husk, shell, straw, rice husk, corn cob, and corn stalk. The vertical axis represents the burning time in minutes, while the horizontal axis shows the type of material tested.

From the test results, it can be seen that the burning time in the first test tends to be higher than the second test for most of the materials. Rice husk had the highest burning time in the first test, 160 minutes, which then decreased to 77 minutes in the second test. In contrast, straw showed the lowest burning time among all materials with 60 minutes in the first test and slightly decreased to 57 minutes in the second test. Other materials, such as coconut husk, shell, corn cob, and corn stalk, experienced fluctuations in burning time with relatively small differences between the two tests. The results of the test can be seen in **Fig. 5**.

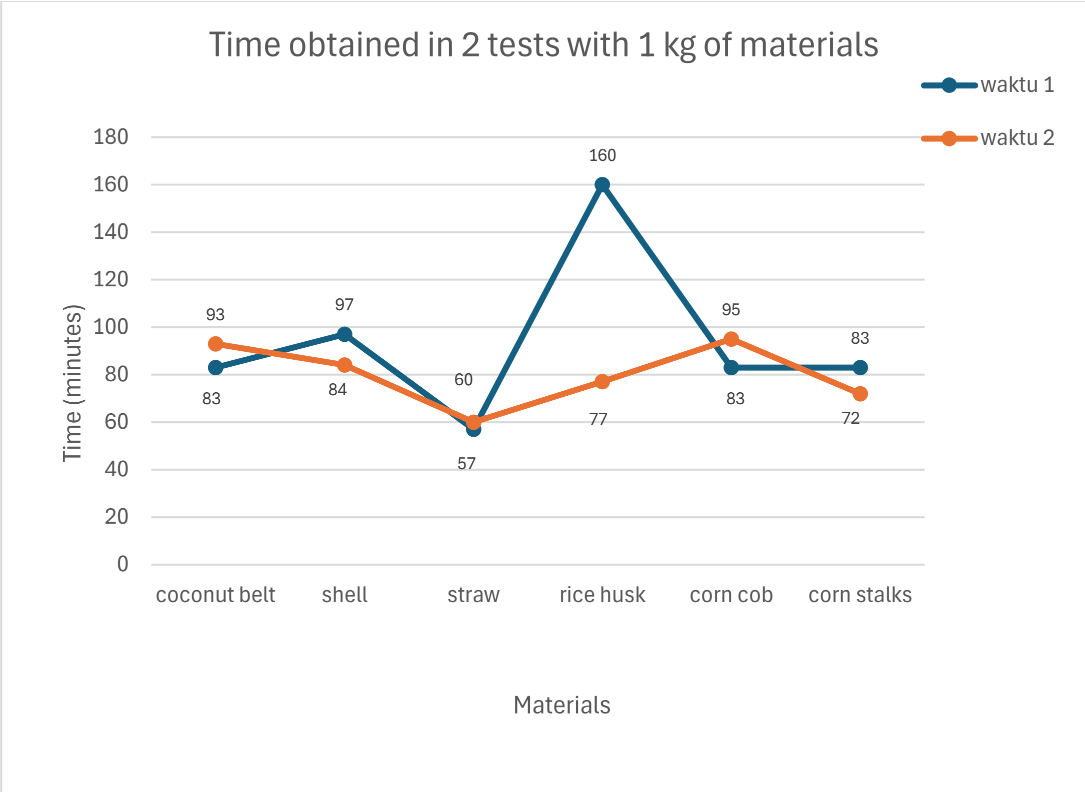

Fig 5. graph oh the value of combustion

B. Test volume 1 and 2

Volume values produced in 2 tests with 1 kg of material csn be seen in **Table 2.**

Table 2. volume value produced in 2 test

materials	volume 1	volume 2
Coconut belt	161	176
shell	48	45
Straw	150	180
Rice husk	133	119
Corn cob	218	201
Corn stalks	195	310

The graph shows a comparison of the volume produced by different types of material in two tests. The materials tested include coconut husk, shell, straw, rice husk, corn cob and corn stalk. The test results show that there are variations in the volume of each material in both tests. In general, most of the materials showed an increasing trend in volume in the second test compared to the first, except for some materials such as husk and rice husk which showed slight differences. The material with the highest volume in the second test was maize stalks with 310 ml, which was a significant increase compared to the first test of 195 ml. Meanwhile, the husk had the lowest volume of all the materials with 45 ml in the first test and 48 ml in the second test. This graph shows that certain factors, such as physical characteristics and material content, can influence the volume variation in each test. The results of the test can be seen in **Fig. 6**.

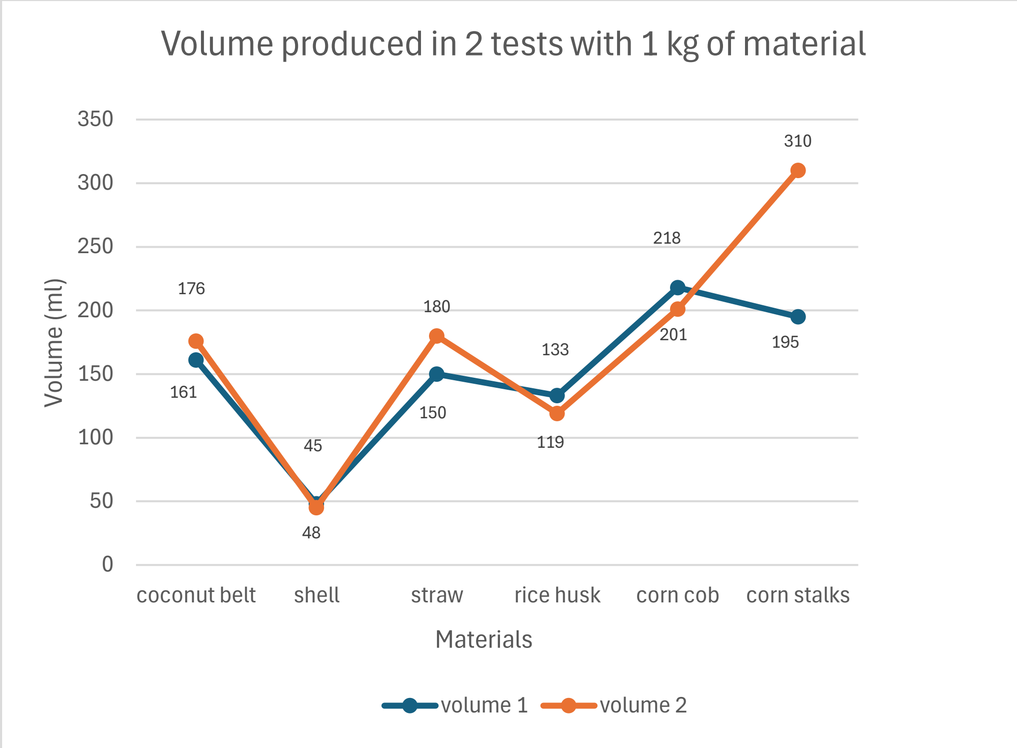

Fig 6. Volume value graph

Time and volume comparison results of 2 materials

Table 3. Average burning time

materials	Times 1	Times 2	average
Coconut belt	83	93	88
shell	97	84	90.5
Straw	57	60	58.5
Rice husk	160	77	118.5
Corn cob	83	95	89
Corn stalks	83	72	77.5

The graph shows a comparison of the average burning time of different types of biomass fuel with a mass of 1kg. The vertical axis represents the burning time in minutes, while the horizontal axis represents the type of material tested, namely coconut husk, shell, straw, rice husk, maize cob and maize stalk.

The test results show that rice husk has the highest average burning time of 118.5 minutes, while straw has the lowest burning time of 58.5 minutes. The other materials showed a more even variation in burning time, with coconut husk at 88 minutes, shell at 90.5 minutes, maize cob at 89 minutes and maize stalk at 77.5 minutes.

From these results it can be concluded that each type of biomass has different combustion characteristics, which can be influenced by factors such as water content, density and material structure. Biomasses with longer combustion times tend to have a higher energy potential for use as alternative fuels. The results of the test can be seen in **Fig 7.**

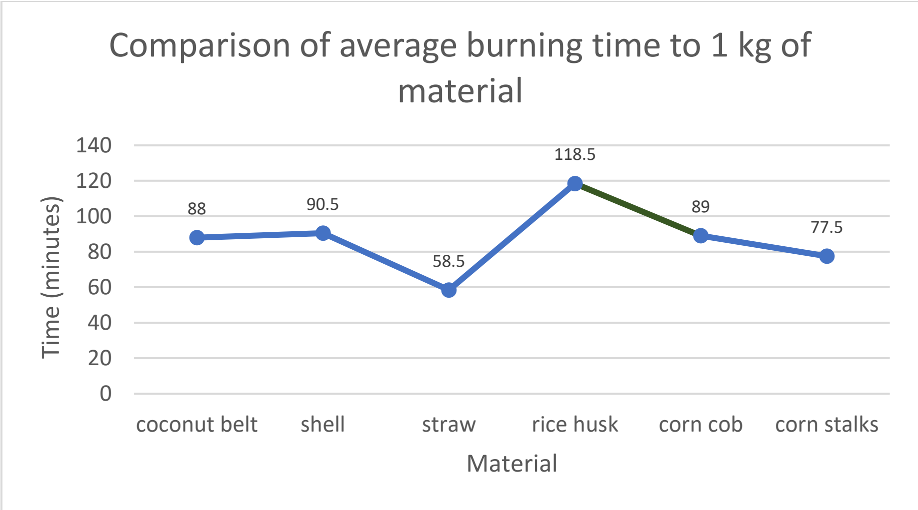

Fig 7. Graph of average time on burn

Table 4. Average volume on combustion

materials	Volume 1	Volume 3	average
Coconut belt	161	176	168.5
shell	48	45	46.5
Straw	150	180	165
Rice husk	133	119	126
Corn cob	218	201	209.5
Corn stalks	195	310	252.5

The graph compares the average combustion volumes of different types of biomass fuels, each weighing 1kg. Corn stalks were found to have the highest combustion volume at 252.5 ml, followed by corn cobs at 209.5 ml. On the other hand, the shell had the lowest combustion volume at 46.5 ml. Other materials tested, such as coconut husk, straw, and rice husk, showed varying combustion volumes of 168.5 ml, 165 ml, and 126 ml respectively. These results indicate that the combustion rates of biomass fuels differ depending on factors like density, moisture content, and material structure. A higher combustion volume suggests a higher presence of flammable substances and greater efficiency in the burning process. The results of the test can be seen in **Fig 8.**

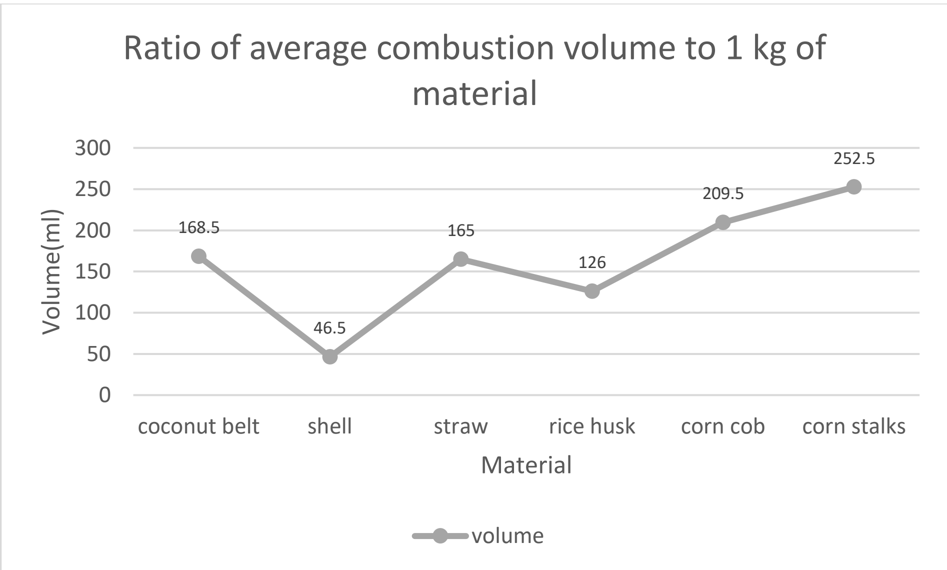

Fig 8. Graph of average volume on burn

CONCLUSIONS.

Based on the results, the second experiment produced a higher volume of liquid smoke than the first, with a significant increase to 310ml. The processing time varied, with the second experiment taking less time than the first at some points, but increasing at others. This shows that the efficiency of liquid smoke production is affected by the type of raw material and the test conditions. Overall, the second experiment showed more optimal results in terms of the amount of liquid smoke produced, although further optimisation is required to improve the efficiency of the processing time.

REFERENCES

[1] JOURNAL OF DIVERSIFICATION AND CHARACTERIZATION OF TENGGIRI FISH MEATBALL (Scomberomus Commerson) TASTE WITH THE ADDITION OF COCONUT SHELL LIQUID SMOKE. (nd).

[2] Rizky, J., Topol, R., Anom, DK, & Caroles, JDS (2024). Characterization of Physical and Chemical Properties of Liquid Smoke from Pyrolysis of Human Hair Cuttings Waste from Minahasa with KG-SM. In General Chemistry Journal (Vol. 2, Issue 3).

[3] Suherman, S., Suroso, B., Yusuf, M., Ilmi, M. Amirul, & Harahap, M. (2023). Empowerment of Women's Farmer Groups in West Stabat Lama Village with Liquid Smoke Making Training. Aksiologiya: Journal of Community Service, 7(4). https://doi.org/10.30651/aks.v7i4.10549

[4] Febriana, I., Effendy, S., Krysthin, V., Fenoldi, N., Energy Engineering Study, P., Chemical Engineering, J., & Sriwijaya State, P. (nd). Energy Consumption of Double Condenser Pyrolyzer for Conversion of Teak and Meranti Wood Powder into Liquid Smoke (Vol. 8, Issue 2).

[5] Purwantisari, S., Jannah, SN, Ariyanto, HD, Setiyana, B., Lathifa, AD, & Wardaja, B. (2024). Application of Liquid Smoke Made from Coconut Shell in Agriculture and Animal Husbandry in Kataan Village, Ngadirejo District, Temanggung Regency. To Maega: Journal of Community Service, 7(2), 311. https://doi.org/10.35914/tomaega.v7i2.2578

[6] Coconut Shell, P., Corn and Rice Husk as Environmentally Friendly Pesticides Nurlia, T., Muhamad Irfan Taufan Asfar, A., Muhamad Iqbal Akbar Asfar, A., Sri Rahayu, A., Ilham Ridwan, M., Muhammadiyah Bone, S., Ujung Pandang State, P., Mathematics Education Study, P., Science, J., Chemical Engineering, J., Economic Education Study, P., Social Science Education, J., & Biology Education Study, P. (nd). PROCEEDINGS OF THE NATIONAL SEMINAR ON COMMUNITY SERVICE OF LANCANG KUNING UNIVERSITY 2020.

[7] Hari Tunggal Prasetiyo, D., Wahyudi, D., Maskur, O., Teknik, F., & Panca Marga, U. (2021). UTILIZATION OF RICE HUSK WASTE AS LIQUID SMOKE. In INTEGRITAS: Jurnal Pengabdian (Vol. 5).

[8] *JOURNAL Characteristics of Liquid Smoke from Coconut Shells, Candlenut Shells, and Corn Cobs*. (nd).

[9] Karudin, A., Sharma, J. K., Leni, D., Abbas, M. R., & Adriansyah, A. (2024). The Influence of External Cooling Load on the Distribution of Temperature and Humidity in Conditioned Spaces. IJIMCE: International Journal of Innovation in Mechanical Construction and Energy, 1(1), 1-10.

[10] Mushollaeni, W., Santosa, B., Tunggadewi Jl Tlaga Warna Blok Tlogomas Malang, TC, & TIP Study Program Tribhuwana University Tunggadewi, D. (2019). WATER CONTENT AND TOTAL BACTERIA OF GOAT MEAT GIVEN CORN COB AND COCONUT SHELL LIQUID SMOKE. JFTA, 1.

[11] JOURNAL OF CHARACTERIZATION OF LIQUID SMOKE PYROLYSIS DEVICE USING VARIATION OF CORN COB AND SUGAR CANE BAGASSE WASTE PERCENTAGE. (nd).