Journal of Innovative Technology and Sustainability Education
Homepage : https://journal.i-ros.org/index.php/JITSE
Email : jitse@i-ros.org
e-ISSN XXX-XXX
Vol. 1, No.1, April 2025

The Effect of Percentage Composition of Briquettes Randu Fruit Husk Charcoal and Rice Husk on Calorific Value and Burning Rate

Yogi Harti Ningrum[1], Dwi Pangga[1*], Sukainil Ahzan[2], Habibi[3], Imam Sya'roni[4]
[1]Mandalika University of education, Mataram, Indonesia
[2]Ganesha University of Education, Singaraja, Indonesia
[3]Surabaya State University, Surabaya, Indonesia
[4]National Taiwan University of Science and Technology, Taipei, Republic of China

DOI : https://doi.org/10.63230/jitse.1.1.35

Sections Info

Article history:
Submitted: April 29, 2025
Final Revised: May 12, 2025
Accepted: May 12, 2025
Published: May 15, 2025

Keywords:
Briquettes;
Burning Rate;
Calorific;
Randu Fruit;
Rice Husk.

ABSTRACT

Objective: *This study is to determine the effect of the percentage composition of briquettes made from kapok fruit husk charcoal (AKBR) and rice husk (ASP) on calorific value and burning rate.* ***Method:*** *This research is an experimental study conducted in the Physics Laboratory of FSTT Undikma. The research design was carried out in four stages: preparing tools and materials, the carbonization process, briquette production, and briquette testing.* ***Result:*** *The results of the study on briquettes made from AKBR and ASP showed that the highest calorific value was obtained with a composition of 90% AKBR + 0% ASP, reaching 8,632 calories. Meanwhile, the lowest calorific value was recorded at a composition of 0% AKBR + 90% ASP, amounting to 7,428 calories.* ***Novelty:*** *The optimal burning rate was observed at a composition of 90% AKBR + 0% ASP, achieving 0.57 grams/minute, whereas the lowest burning rate was found at a composition of 0% AKBR + 90% ASP, with a value of 0.39 grams/minute.*

INTRODUCTION

Indonesia is currently facing the issue of declining fossil fuel reserves, which are becoming increasingly scarce due to continuous usage and their non-renewable nature. Meanwhile, the energy demand continues to rise in line with population growth, affecting fuel availability. The scarcity of fossil fuel resources has consequently increased fuel prices (Jannah et al., 2022). Biomass is one of the alternative energy sources that can be prioritized for long-term development compared to other energy sources (Fatmawati, 2014). Using briquettes as an alternative energy source is an appropriate choice to address the scarcity of energy derived from petroleum (Pangga et al., 2021).

Several studies on briquette fuel production have explored the use of various underutilized waste materials, ranging from industrial waste such as sawdust from furniture manufacturing, fibrous waste like cotton fibers, jute, and coconut husks, to food processing waste such as peanut and grain shells. Agricultural waste, including straw, rice husks, bagasse, dried leaves, and corn cobs, has also been identified as a suitable raw material for briquette production. However, further efforts are needed to optimize biomass-based raw materials, particularly in briquette manufacturing. One of the potential materials that can be utilized is cassava peel and kapok fruit peel waste (Azkiya, 2023). Kapok fruit peel waste remains vastly underutilized, with most of its use focused solely on the kapok fiber. According to national data from the Indonesian Central Bureau of Statistics (BPS) in 2022, the harvested area of kapok trees in the West Nusa Tenggara province was estimated at 989.33 hectares, yielding a production of 220.97 tons of kapok fiber. Despite its significant potential, the utilization of kapok fruit peel remains minimal. This makes it a highly suitable material for charcoal briquette production. Kapok fruit peel has a high calorific value, ranging from 4,126 to 4,493 kcal/kg, making it an excellent raw material for briquette manufacturing (Putra, 2014).

In addition to kapok fruit peel and other biomass waste materials, numerous alternative sources can be used as fuel, including rice husk. Rice husk is the outer layer that encases the caryopsis of rice grains, consisting of two interlocking parts known as the lemma and palea. The husk separates from the rice grains during the rice milling process, becoming a byproduct or milling waste. This process generates approximately 16.2% to 28% rice husk from the total paddy weight. Rice husk is categorized as biomass that can be used for various purposes, including industrial raw materials, animal feed, and energy production. Due to its high cellulose content, rice husk enables uniform and stable combustion, making it a viable heat energy source and an alternative to kerosene (Sari et al., 2016).

In 2023, the harvested area of rice in Lombok reached approximately 10.20 million hectares, with a total rice production of around 53.63 million tons of dry milled grain (DMG). When converted into rice for human consumption, the estimated rice production in 2023 amounted to approximately 30.90 million tons. Additionally, Central Lombok remains the primary rice-producing region in the West Nusa Tenggara Province, with an estimated production of around 373.22 thousand tons (Central Bureau of Statistics, 2023).

According to previous research by Aljarwi et al. (2020), the combustion rate and calorific value of rice husk wafer briquettes are influenced by variations in applied pressure. Briquettes pressed at 20 PSI produced a calorific value of 4,793.94 calories, while those at 30 PSI yielded 5,137.64 calories, and briquettes pressed at 40 PSI exhibited the highest calorific value of 5,266.52 calories. Similarly, Alfi et al. (2023) conducted a study on briquettes made from candlenut shells and rice husks, reporting a moisture content of 5.12%, a density of 0.61 g/cm^3, a maximum calorific value of 5,019 calories, and a combustion rate of 0.33 g/min. These findings indicate that candlenut shell and rice husk briquettes can serve as an alternative fuel source due to their high calorific value of 5,019 cal. Moreover, these briquettes comply with the Indonesian National Standard (SNI 01-6235-2000), which mandates a minimum calorific value of 5,000 cal/g.

RESEARCH METHOD

Types of Research

This study is an experimental research conducted in the Physics and Chemistry Laboratory of Universitas Pendidikan Mandalika.

Research Design

This study utilizes kapok fruit husk and rice husk as raw materials, following these procedures: material preparation, which involves the collection and drying of kapok fruit husk and rice husk; the carbonization process, where the kapok fruit husk and rice husk are converted into charcoal; the production of briquettes in block form using the prepared materials; and finally, the testing phase, which aims to determine the calorific value and combustion rate of the produced briquettes.

Table 1. Percentage composition of briquette materials and adhesives used

AKBR (%)	ASP (%)	Adhesive	Total
0	90	10%	100%
15	75	10%	100%
30	60	10%	100%
45	45	10%	100%
60	30	10%	100%
75	15	10%	100%
90	0	10%	100%

Time and Place of Research

The research was conducted in September 2023 - May 2024 at the Physics Laboratory of FSTT UNDIKMA.

Research Instrument

In this study, the equipment used includes a measuring cylinder, a manual briquette press, a sieve shaker, a molding block, a stopwatch, a gas lighter, a mortar (grinder), a thermometer, a bucket, a pot, a tray, and a weighing scale. Meanwhile, the materials used consist of kapok fruit husk and rice husk, tapioca flour, and adequate water.

Research Procedures

The research procedures in this study involved several sequential steps. First, kapok fruit husks and rice husks were collected as primary raw materials. The kapok husks were obtained from the kapok peeling waste in Bangket Parak Village, Pujut District, Central Lombok Regency, while the rice husks were sourced from a local rice milling facility in the same village, amounting to two and three kapok fruit husks. Following collection, both types of biomass were dried by spreading them in an open area exposed to direct sunlight. The materials were turned every hour to ensure uniform drying, a process which lasted approximately six days due to variable weather conditions.

Next, the dried kapok fruit husks and rice husks underwent carbonization. They were gradually placed into a pan and roasted for about 15 minutes to produce charcoal. The resulting Kapok Fruit Husk Charcoal (AKBR) and Rice Husk Charcoal (ASP) were then ground using a mortar until finely crushed. After grinding, the charcoal was sieved to obtain finer particles, which were then collected and weighed to ensure consistent proportions in the subsequent process.

The weighed charcoal materials were then mixed with a binding agent to form a uniform dough. This mixture was placed into molds and manually pressed until compact or until the mold was fully filled, shaping the mixture into briquettes. Finally, the molded briquettes were dried under direct sunlight for approximately six days to achieve the desired hardness and moisture content, completing the production process.

RESULTS AND DISCUSSION

Results

10% tapioca starch adhesive is used in the production of these briquettes. The tapioca starch is mixed with water and heated in a container until it thickens into a glue-like consistency. The prepared adhesive is then mixed with kapok fruit husk charcoal (AKBR) and rice husk charcoal (ASP) according to the designated percentages: 0%, 15%, 30%, 45%, 60%, 75%, and 90% for AKBR, while the corresponding percentages for ASP are 90%, 75%, 60%, 45%, 30%, 15%, and 0%. The charcoal and adhesive are thoroughly mixed until a uniform briquette dough is formed. Once the mixture reaches the desired consistency, it is placed into molds, compressed using a manual press, and dried under direct sunlight.

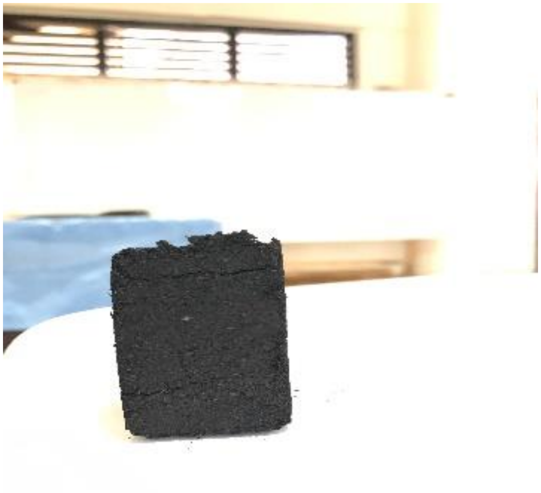

Figure 1. Briquettes made from kapok fruit skin and rice husks.

Density (ρ) is a measure of the concentration of a substance and is expressed as mass per unit volume.

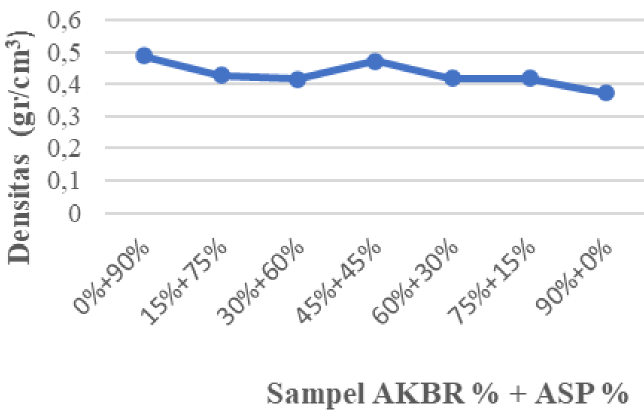

Figure 2. Density analysis graph.

Based on the graph above, it can be observed that the percentage composition of the materials has varying effects on the density of the briquettes. The resulting density values range from 0.487 g/cm^3 to 0.371 g/cm^3. The highest briquette density is obtained with a 0% AKBR + 90% ASP composition, while the lowest density is observed at 90% AKBR + 0% ASP. The homogeneity of the mixture between the binder and the charcoal also influences briquette density. The more homogeneous the mixture, the stronger the charcoal briquette (Rusman et al., 2023). Briquette density significantly affects briquette quality, as the density level is influenced by particle size and the uniformity of the briquette's constituent materials. Smaller particle sizes create stronger intermolecular bonds, increasing briquette density. In contrast, larger particle sizes reduce the contact area between molecules, leading to lower briquette density. The density of a charcoal briquette is essential for transportation and packaging, ensuring the briquettes do not easily break and facilitating easier handling (Lestari et al., 2017). The density obtained in this study meets the quality standard for activated charcoal based on SNI 01-6235-2000, which is 0.48 g/cm³. Moisture content refers to the amount of water remaining in the briquette after heating. It significantly affects the briquette's calorific value, and a higher moisture content leads to a decrease in briquette quality.

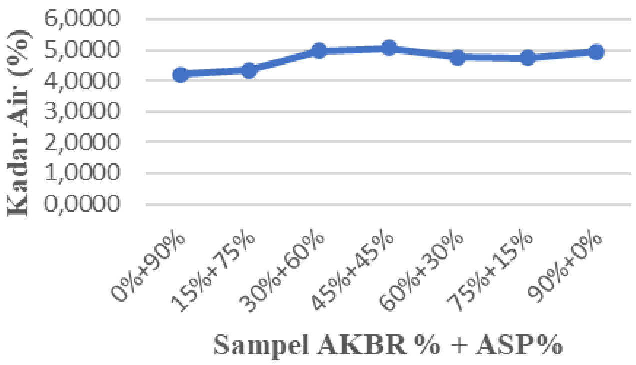

Figure 2. Moisture content graph

Based on the data from the briquettes made from kapok fruit shell and rice husk, the moisture content percentage ranges between 4.2% and 5.0%. The highest moisture content recorded in this study was 5.0%, observed in briquettes with a composition of 45% AKBR + 45% ASP. Meanwhile, the lowest moisture content, 4.2%, was found in briquettes with a 0% AKBR + 90% ASP composition. The relatively low moisture content is influenced by several factors, including the manual drying process using direct sunlight, which resulted in unregulated temperatures across different samples, leading to inconsistencies. This finding aligns with the study by Faizal et al. (2014), which states that variations in moisture content are due to differences in pore sizes between particles, affecting their ability to absorb water. In addition to particle size, moisture content is also influenced by the inherent water content in raw materials, the drying process, and the adhesive material, which retains a certain amount of moisture. According to Rahmadani et al. (2017), moisture content in briquettes significantly affects their calorific value or heat energy output, where higher moisture content leads to a decrease in calorific value. The moisture content obtained in this study meets the quality standards for activated charcoal as specified in SNI 01-6235-2000, which sets a maximum limit of 8%.

The ash content test aims to determine the residual waste produced after the briquettes undergo the combustion process. After completing the ignition duration test, the resulting ash residue is weighed to measure the ash content generated as briquette waste. Briquettes with excessively high ash content can reduce their overall quality.

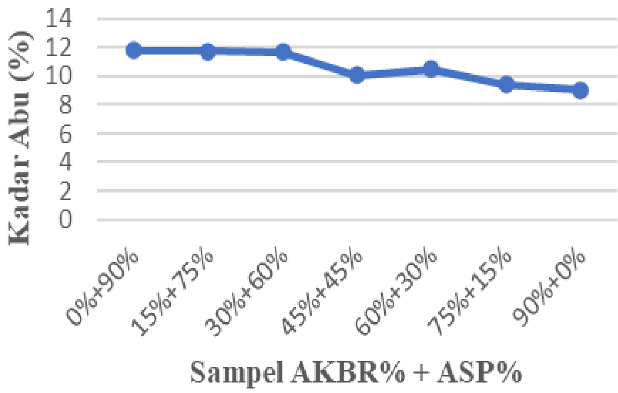

Figure 3. Ash content analysis graph

The graph above illustrates the calculated ash content in samples of kapok fruit husk and rice husk briquettes, with values ranging between 11.78% and 9.07%. The lowest ash content was observed in the sample with a composition of 90% AKBR + 0% ASP, while the highest ash content was found in the sample with 0% AKBR + 90% ASP. The raw materials used also influence the ash content in charcoal briquettes. Materials with high silica content tend to produce higher ash content, which may lead to lower briquette quality (Sukowati et al., 2019). An increased charcoal composition in briquettes tends to elevate ash content; thus, based on this study, the composition of raw materials plays a crucial role in determining the ash content of briquettes.

The calorific value is the maximum amount of heat energy generated by a fuel through a complete combustion reaction per unit mass or volume of the fuel (Aljarwi et al., 2020). It is a key parameter in determining the quality of the briquettes produced. The higher the calorific value of a briquette, the better its quality.

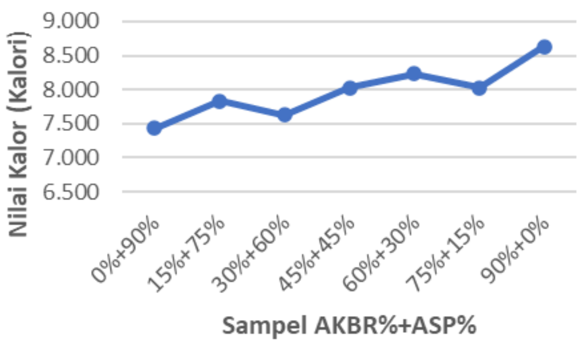

Figure 4. Calorific value analysis graph

Based on the data from the charcoal briquettes made from kapok fruit shell and rice husk, as presented in the table and figure above, the calorific value of the briquettes ranges from 8,632 kcal to 7,428 kcal. The graph illustrates that the lowest calorific value was observed in the briquette sample containing 0% AKBR + 90% ASP, with a calorific value of 7,428 kcal. In contrast, the highest calorific value was recorded in the briquette sample containing 90% AKBR + 0% ASP, reaching 8,632 kcal. The findings of this study indicate that the calorific value is significantly influenced by the raw materials used. The lower calorific value is attributed to the high moisture content in the briquettes. According to Aziz (2019), moisture content directly impacts the calorific value; lower adhesive moisture content results in a higher calorific value, while higher moisture content leads to a lower calorific value. The calorific values obtained in this study meet the quality standards for briquettes as specified in SNI 01-6235-2000, which requires a minimum calorific value of 5,000 kcal/g for high-quality charcoal briquettes. Combustion Rate Analysis.

The combustion rate describes the reduction in weight per unit of time during the burning process. A higher combustion rate results in a shorter burning duration for the briquette (Idrus et al., 2013). Combustion is a chemical reaction or transformation in which a combustible material reacts with oxygen or another oxidizing agent in an exothermic process. Factors influencing combustion include moisture content, bulk density, ash content, and volatile matter content (Aziz et al., 2019). A high-quality briquette is characterized by a low combustion rate.

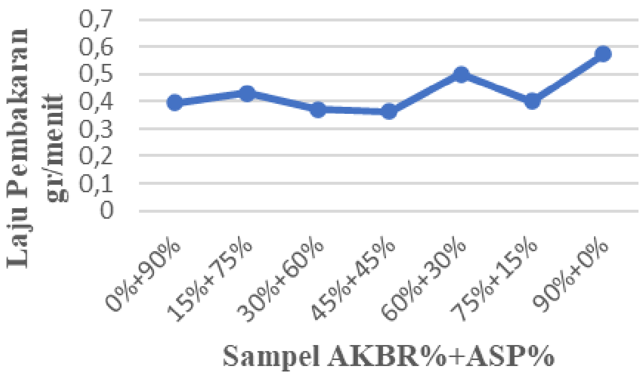

Figure 5. Combustion rate analysis graph

Based on the graph above, it can be observed that the material composition has varying effects on the combustion rate of the produced briquettes. The combustion rate values for kapok fruit shell charcoal and rice husk briquettes range between 0.57 g/min and 0.36 g/min. The lowest combustion rate is found in briquettes with a composition of 45% AKBR + 45% ASP, while the highest combustion rate is observed in briquettes with 90% AKBR + 0% ASP. The combustion rate indicates that the burning rate decreases as the activation temperature increases. This is due to the fact that their density influences the combustion rate of briquettes.

Additionally, the combustion rate is also affected by moisture and ash content. Higher moisture and ash content result in a longer combustion time. Aryani (2019) stated that briquettes made from activated charcoal tend to have more open pores, providing additional space for oxygen penetration, which enhances combustion efficiency and reduces the combustion rate. The combustion rate of briquettes is inversely proportional to their burning duration; the longer the briquette burns, the lower its combustion rate.

Discussion

The present study investigated the characteristics of charcoal briquettes produced from kapok fruit husk (AKBR) and rice husk (ASP), with varying compositions and the use of a 10% tapioca starch adhesive. Several important parameters were analyzed to determine the quality of the briquettes, including density, moisture content, ash content, calorific value, and combustion rate.

The results demonstrate that density is strongly influenced by the composition of AKBR and ASP, as well as the homogeneity of the mixture. A higher ASP composition correlates with greater density values, with the peak density (0.487 g/cm^3) observed at 0% AKBR + 90% ASP. This is consistent with findings from Lestari et al. (2017), who asserted that smaller particle sizes increase the contact area between particles, enhancing intermolecular forces and producing more compact briquettes. Denser briquettes are preferable for packaging and transportation, as they are less prone to breakage and can be handled more efficiently.

The moisture content of the briquettes ranged from 4.2% to 5.0%, remaining well within the standard set by SNI 01-6235-2000, which specifies a maximum of 8%. The lowest moisture content was associated with briquettes comprising 0% AKBR + 90% ASP. Variations in moisture levels were likely due to inconsistencies in the manual sun-drying method and the differences in pore structures of the raw materials. According to Faizal et al. (2014), materials with smaller pores tend to retain less moisture, thereby enhancing fuel quality. Moisture content is a crucial factor because it directly affects the calorific value, with higher moisture reducing the amount of energy released during combustion (Rahmadani et al., 2017).

The analysis of ash content revealed an inverse trend to that of density and calorific value. Briquettes with a higher ASP content tended to yield greater ash residues. The maximum ash content (11.78%) occurred at 0% AKBR + 90% ASP, while the minimum (9.07%) was found at 90% AKBR + 0% ASP. This could be attributed to the higher silica content naturally found in rice husks, which contributes to increased ash production (Sukowati et al., 2019). Ash content is an important quality indicator because excessive ash can inhibit the combustion process, reduce thermal efficiency, and increase the frequency of cleaning during usage.

In terms of calorific value, the highest energy content (8,632 kcal/kg) was observed in briquettes with 90% AKBR + 0% ASP, while the lowest (7,428 kcal/kg) was noted in the inverse composition. This trend aligns with the hypothesis that kapok fruit husk produces more energy per unit mass compared to rice husk. Moisture plays a key role here; as noted by Aziz (2019), the lower the moisture content in the adhesive and raw materials, the higher the calorific value achieved. The results not only meet but exceed the calorific minimum of 5,000 kcal/kg as outlined in SNI 01-6235-2000, indicating that both raw materials are suitable for high-quality fuel production.

Finally, the combustion rate of the briquettes varied significantly, ranging from 0.36 g/min to 0.57 g/min. Interestingly, the lowest combustion rate was observed in briquettes with an even mixture of 45% AKBR + 45% ASP. A lower combustion rate is desirable as it implies a longer burning duration, which enhances fuel efficiency. According to Aryani (2019), this is partly due to the open-pore structure of activated charcoal, which supports better oxygen diffusion and controlled burning. Moreover, the combustion rate is inversely correlated with briquette density and directly influenced by both ash and moisture contents (Idrus et al., 2013). Denser briquettes with lower moisture and ash levels tend to burn more slowly and steadily.

Overall, the findings of this study underscore the significance of raw material composition in influencing the physical and chemical properties of charcoal briquettes. A balanced combination of kapok fruit husk and rice husk, particularly in the 45% AKBR + 45% ASP ratio, appears optimal for producing briquettes with stable density, acceptable moisture and ash content, high calorific value, and efficient combustion characteristics. These insights offer valuable contributions to the development of sustainable biofuels using agricultural waste, in alignment with circular economy principles and energy conservation goals.

CONCLUSION

Fundamental Finding: Based on the research findings and data analysis, it can be concluded that an increase in kapok fruit shell charcoal (AKBR) content and a decrease in rice husk charcoal (ASP) content tend to increase the calorific value. **Implication:** The highest calorific value was obtained from the briquette composition of 90% AKBR + 0% ASP, yielding a calorific value of 8,632 calories. In contrast, the lowest calorific value was observed in the briquette composition of 0% AKBR + 90% ASP, producing a calorific value of 7,428 calories. Thus, AKBR and ASP materials significantly influence both the calorific value and the combustion rate. The highest combustion rate was achieved with the 90% AKBR + 0% ASP composition, reaching 0.57 grams per minute. Meanwhile, the 0% AKBR + 90% ASP composition resulted in the lowest combustion rate of 0.39 grams per minute. **Limitation:** This research was only conducted with a limited sample so that data acquisition was not optimal. **Future Research:** Future research should explore the production of briquettes by combining kapok fruit shell as a raw material with other supporting materials to enhance briquette quality. The preparation, production, and testing processes of biobriquettes should be conducted simultaneously while ensuring uniform treatment. This approach aims to minimize the impact of environmental factors such as temperature and atmospheric humidity, which may vary during the study due to reliance on sunlight.

ACKNOWLEDGEMENTS

We extend our sincere gratitude to all parties who have continuously offered their prayers, support, and financial contributions, enabling the successful completion of this research. We also express our appreciation to those who have assisted in the completion of this article.

REFERENCES

Alfi, A., Pangga, D., & Ahzan, S. (2023). Optimasi pembuatan briket bioarang dari bahan cangkang kemiri dan sekam padi terhadap nilai kalor dan laju pembakaran. *Jurnal Penelitian dan Pembelajaran Fisika Indonesia, 5*(2), 2. https://doi.org/10.29303/jppfi.v5i2.211

Aljarwi, M. A., Pangga, D., & Ahzan, S. (2020). Uji laju pembakaran dan nilai kalor briket wafer sekam padi dengan variasi tekanan. *Orbita: Jurnal Pendidikan dan Ilmu Fisika, 6*(2), Article 2. https://doi.org/10.31764/orbita.v6i2.2645

Aziz, M. R., Siregar, A. L., Rantawi, A. B., & Rahardja, I. B. (2019). Pengaruh jenis perekat pada briket cangkang kelapa sawit terhadap waktu bakar. *Prosiding*

Semnastek, 0, Article 0. https://jurnal.umj.ac.id/index.php/semnastek/article/view/5256

Azkiya, N. I., Udjiana, S. S., Irangga, A. R., & Febiyanti, A. T. (2023). The potential of cassava peel waste as a material of biodegradable plastic using calcium silicate filler. *Jurnal Teknik Kimia dan Lingkungan, 7*(2), 85-91. https://doi.org/10.33795/jtkl.v7i2.1721

Faizal, M., Andynapratiwi, I., & Putri, P. D. A. (2014, April 25). *Pengaruh Komposisi Arang dan Perekat terhadap Kualitas Biobriket dari Kayu Karet.* https://www.semanticscholar.org/paper/Pengaruh-Komposisi-Arang-Dan-Perekat-Terhadap-Dari-Faizal-Andynapratiwi/fc781294f5c94019a74a900f9b2eab4389e93a8e

Fatmawati, D. (2014). Pembuatan biobriket dari campuran enceng gondok dan tempurung kelapa dengan perekat tetes tebu. *Jurnal Teknik Mesin, 3*(02).

Idrus, R., Lapanporo, B. P., & Putra, Y. S. (2013). Pengaruh suhu aktivasi terhadap kualitas karbon aktif berbahan dasar tempurung kelapa. *Prisma Fisika, 1*(1). https://doi.org/10.26418/pf.v1i1.1422

Jannah, B. L., Pangga, D., & Ahzan, S. (2022). Pengaruh jenis dan persentase bahan perekat biobriket berbahan dasar kulit durian terhadap nilai kalor dan laju pembakaran. *Lensa: Jurnal Kependidikan Fisika, 10*(1), 16–23. https://doi.org/10.33394/j-lkf.v10i1.5293

Lestari, L., Variani, V. I., Sudiana, I. N., Sari, D. P., Ilmawati, W. O. S., & Hasan, E. S. (2017). Characterization of briquette from the corncob charcoal and sago STEM alloys. *Journal of Physics: Conference Series, 846*(1), 012012. https://doi.org/10.1088/1742-6596/846/1/012012

Pangga, D., Ahzan, S., Habibi, H., Wijaya, A. H. P., & Utami, L. S. (2021). Analisis nilai kalor dan laju pembakaran briket tongkol jagung sebagai sumber energi alternatif. *Orbita: Jurnal Pendidikan dan Ilmu Fisika, 7*(2), 382–386. https://doi.org/10.31764/orbita.v7i2.5552

Rahmadani, R., Hamzah, F., & Hamzah, F. H. (2017). Pembuatan briket arang daun kelapa sawit (elaeis guineensis jacq.) dengan perekat pati sagu (metroxylon sago rott.) *Journale Riau University, 1*(1). https://www.neliti.com/publications/202380/

Rusman, L. O., Lestari, L., Raharjo, S., Usman, I., & Chrismiwahdani, D. (2023). Pengaruh temperatur aktivasi terhadap kualitas briket arang aktif sekam padi. *Journal Online Of Physics, 8*(3), Article 3. https://doi.org/10.22437/jop.v8i3.23846

Sari, N. M., Mahdie, M. F., & Segah, R. (2016). Rendemen arang sekam dan kualitas asap cair sekam padi. *Jurnal Hutan Tropis, 3*(3), 3. https://doi.org/10.20527/jht.v3i3.2278

Sukowati, D., Yuwono, T. A., & Nurhayati, A. D. (2019). Analisis perbandingan kualitas briket arang bonggol jagung dengan arang daun jati. *Pendipa Journal of Science Education, 3*(3), 3. https://doi.org/10.33369/pendipa.3.3.142-145

***Dwi Pangga (Corresponding Author)**
Departement of Physics Education, Mandalika University of education,
Jl. Pemuda No.59A, Dasan Agung Baru, Kec. Mataram, Mataram, NTB, Indonesia.
Email: dwipangga@undikma.ac.id

Yogi Harti Ningrum
Departement of Physics Education, Mandalika University of education,
Jl. Pemuda No.59A, Dasan Agung Baru, Kec. Mataram, Mataram, NTB, Indonesia.
Email: ningrumyhn043@gmail.com

Sukainil Ahzan
Departement of Postgraduate, Ganesha University of Education,
Jl. Udayana No.11, Banjar Tegal, Singaraja, Kabupaten Buleleng, Bali, Indonesia.
Email: sukainilahzan@undikma.ac.id

Dr. Habibi, S.Si., M.Pd.
Departement of Physic Education, Universitas Negeri Surabaya,
Jl. Ketintang, Ketintang, Kec. Gayungan, Surabaya, Jawa Timur 60231, Indonesia.
Email: habibi@unesa.ac.id

Imam Sya'roni, S.Pd., M.Si.
National Taiwan University of Science and Technology,
No. 43, Keelung Rd., Sec. 4, Taipei 10607, Taiwan
Email: sya39roniimam@gmail.com