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Design and Development of a Coconut Shell Shaver Machine

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ABSTRACT: This research focuses on the conceptualization and creation of an innovative coconut shell shaver machine, aimed at significantly enhancing the efficiency of shell cleaning for handicrafts while prioritizing safety. The proposed design aims to achieve an elevated level of cleaning proficiency across the coconut shell's surface. This advancement intends to alleviate the labor burden of handicraft artisans, streamline the processing time for coconut shell crafts, and ultimately elevate the overall production rate of coconut shell crafts.

The machine's structure encompasses a motor housed within a protective casing, interconnected through belts and pulleys to a centrally-positioned shaft. This shaft is equipped with circular brushes at both ends. The circular brushes are thoughtfully encased by a steel plate, meticulously engineered to safeguard against dust during operation and ensure operator safety.

The intended outcome of this innovation is to amplify the capabilities of local farmers in the Province of Surigao del Norte, particularly at the village level. The fabrication of the device adheres to standardized measurements, with subsequent phases involving thorough testing and precise adjustments to optimize its operational performance. A comprehensive demonstration of the coconut shell shaver machine is also slated for presentation during the evaluation process.

KEYWORDS: Coconut shaver, shaving, testing, coconut shell and fabrication

BACKGROUND AND RATIONALE

Coconut holds a prominent position within the agricultural landscape of the Philippines, standing as a pivotal crop. With an annual yield of approximately 347 million metric tons, the Philippines ranks as a significant global coconut producer. This agricultural phenomenon spans across 69 out of the country's 82 provinces, with the Davao Region leading the charge by contributing over 50% of the nation's total output. In acknowledgment of its economic impact and versatility, coconut has been included in The Premium 7, a distinguished collection of Philippine commodities endorsed by the Department of Trade and Industry. Notably, the global demand for Philippine coconut products has propelled its exports to contribute up to 3.6% of the nation's gross value added (GVA).

Around 70% of the nation's annual coconut harvest is already dedicated to the production and export of diverse coconut-based commodities, encompassing coconut oil, desiccated coconut, and copra meal. These compelling statistics underscore the widespread allure of Philippine coconut products. Not only do these products bolster the nation's economy and enhance the livelihoods of countless "tree of life" farmers, but they also solidify the Philippines' presence on the international culinary map.

As reported by Ayrilmis et al. (2011), the coconut shell comprises approximately 85% of the fruit's total weight, with its composition encompassing 33.30% lignin, 30.58% cellulose, 26.70% hemicellulose, 8.86% water, and 0.56% ash (Arena et al., 2016). Research has demonstrated the versatile utility of coconut shells in diverse applications, including the creation of semi-crystalline magnetite nanoparticles (Sebastian et al., 2018), biosorbents for Ag ion sorption (Staron et al., 2017), thermal insulation (Arajo et al., 2015), agglomerates (Fiorelli et al., 2012), panels (Ayrilmis et al., 2011), and substrates for cultivating vegetables and fruits such as tomatoes (Ramos et al., 2008) and other innovative uses.

Inggi Priyanata et al. (2022) have highlighted the impact of the ongoing COVID-19 pandemic, coupled with a lack of inventive approaches to utilize coconut waste for valuable products, resulting in challenges for individuals to meet their basic needs. Leveraging coconut waste as an untapped resource for crafting unique and creative souvenirs and decorations—such as trophies, key chains, study lamps, flower pots, and more—has emerged as an alternative solution to bolster local economies.

In light of these considerations, this study embarks on the design and development of a coconut shell shaver machine. This innovative endeavor aims to optimize the process of shell cleaning for handicrafts, ensuring utmost safety. By enhancing the cleaning efficiency on the coconut shell's surface, the designed machine seeks to alleviate the labor burden for artisans, expedite the production of coconut shell crafts, and elevate the overall production rate.

The coconut shell shaver machine comprises a motor encased within a protective housing, intricately

connected to shafts via pulleys and belts. Each shaft is fitted with a circular brush on either end, thoughtfully enveloped by a steel plate to safeguard against dust and ensure operational safety. This ingenious device holds the potential to empower village-level farmers in the Province of Surigao del Norte and contribute to the expansion of their capabilities.

Objectives

The aims of this research encompass the subsequent goals: (a) to conceptualize and fabricate a coconut shell shaver machine tailored for the craft production within village-level coconut shell enterprises; and (b) to meticulously assess the operational efficacy of the pressing apparatus.

MATERIALS AND METHODS

Designing coconut shaver device

Illustrated in Figure 1 are the technical specifications and perspectives of the coconut shaver device, inclusive of its diverse components. Constructed from 50mm x 50mm angle bars for the legs and framework, supplemented by a (1&1/2X1/4) flat bar for structural reinforcement, the machine also incorporates a 2mm-thick steel plate for its cover and housing. The composition further encompasses 1" shafts for the wheel steel, a set of 12-inch wheel steel brushes employed as the shaving mechanism, a pair of 1" pillow blocks, and a dual-pulley configuration with a 2-inch diameter, as depicted in the figure provided below.

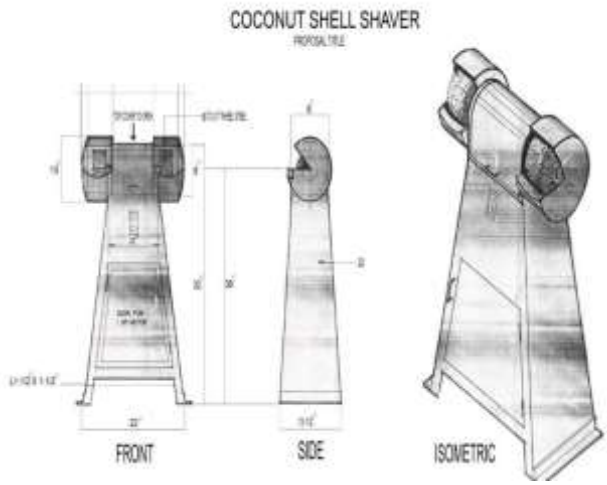

Figure 1: Technical specification and details (includes the views and dimensions)

Fabrication of the Coconut Shell Shaver Machine

The fabrication of the device adhered to established standard measurements. Materials were precisely cut and shaped, then meticulously machined to the specified dimensions, utilizing locally available resources to ensure cost-effectiveness.

The design considerations for the coconut shaving device encompassed a range of factors, encompassing the anticipated coconut shell volume for processing, desired shaving efficiency, user-friendliness, and maintenance requisites. The device's design was tailored to effectively address the unique attributes of coconuts, notably their rugged shells.

Following the machining phase, the diverse components were methodically assembled. During assembly, the shaft underwent precision threading at both ends to accommodate the wire brush. The shaft, crucially supported by dual pillow blocks, facilitated seamless brush rotation during operation, while linkage to a 1.5 Hp motor was achieved through two b-belts. Positioned centrally for convenient access, a switch facilitated device activation and deactivation. Notably, protective measures were instituted to safeguard against potential hazards posed by the round brush. Moreover, each round brush was thoughtfully equipped with a tool rest, strategically positioned to enhance the ease of coconut shell shaving.

Evaluation Testing and Fine-Tuning of the Device

Upon the successful fabrication and meticulous assembly of the Coconut Shell Shaver Machine, a thorough and systematic testing and fine-tuning stage will ensue, aimed at optimizing and enhancing the device's operational performance. The central goal of this phase is to ensure the machine's adeptness in efficiently shaving mature coconut shells while minimizing time expenditure. It is foreseen that minor modifications and enhancements will be iteratively introduced as part of the continuous improvement trajectory prior to the conclusive evaluation.

Performance of the Device

Multiple iterations or trials will be conducted, involving the shaving of mature coconut shells of varying sizes, encompassing both whole shells and half shells. The outcomes of these experiments will be subjected to analysis and scrutiny, engaging in discussions regarding their efficacy.

Results and Discussion

The Coconut Shaving Device

The photograph depicted in Figure 2 provides a visual representation of the coconut shaving device's actual setup. The wire brush is firmly secured at both ends through threaded connections, ensuring its stability. A protective cover is in place to shield the operator from dust and extraneous particles while the device is engaged. Positioned at the central point of the configuration, a dual pulley arrangement is attached to the shaft, which is linked to a 1.5 Hp single-phase motor. The motor is equipped with an integrated pulley situated on the spindle, with a belt used to transfer power and propel the wire brush. For maintenance purposes, the shaft cover can be easily opened when required. The machine incorporates start and stop buttons, facilitating the initiation and cessation of its operation. To mitigate vibrations during use, the base is thoughtfully designed in a rectangular form. Furthermore, the tool rest of the machine is ergonomically shaped in a semi-circular manner to effectively accommodate the contours of the coconut shell.

Figure 2. The Coconut Shaving Device

Figure 3. Actual Photos during testing

Figure 4. Results during testing (Whole and half coconut shell)

Evaluation of the Performance of the Machine

Figure 3 illustrates the live process of coconut shell shaving utilizing the machine's pair of circular wire brushes. The complete and half coconut shells undergo shaving within a coconut shell shaving machine that operates at a speed of 1700 RPM. As evidenced in Figure 4, the shaved coconut shell effectively eliminates one hundred percent (100%) of the fiber from both the whole and half coconut shells. This serves as a clear demonstration of the rapid shaving capability achieved through the use of superior shell shaving techniques.

The Comparative Performance of Manual and Motorized Coconut Shell Shaver

	Half Coconut Shell	**Whole Coconut Shell**
Manual Shaver	15 minutes per shell	30 minutes per shell
Motorized Coconut Shell Shaver	3 minutes per shell	7 minutes per shell

The composite performance of the Motorized Coconut Shell Shaver

Category	**Manual**	**Coconut Shell Shaver Machine**
Manual Shaver	15 minutes per shell	30 minutes per shell
Motorized Coconut Shell Shaver	3 minutes per shell	7 minutes per shell

CONCLUSION

The research centered on creating and crafting a Coconut Shell Shaver tailored for application within the farm-level industry, with the aim of addressing the challenges and requirements of handicraft producers and exporters in the CARAGA Region. The device has been meticulously designed to efficiently eliminate coconut fiber from the shell, employing a straightforward approach that ensures a heightened production rate of top-notch end products, while also emphasizing user-friendliness and ease of maintenance. By revolutionizing the conventional cleaning process and expediting the shaving process, the equipment significantly elevates production capacity, ultimately resulting in the creation of vastly improved, high-quality coconut shells.

REFERENCES

1. Ali, M., Liu, A., Sou, H., & Chouw, N. (2012). Mechanical and dynamic properties of coconut fibre reinforced concrete. Construction and Building Materials, 30, 814-825.
2. Araujo, P., Felix Filho, L. F., & Barbosa, J. J. (2015). Estudo das propriedades termofísicas da fibra de coco minimamente processada visando aplicação como isolante térmico. Revista Interdisciplinar de Pesquisa e Inovação, 1(1), 134-142.

3. Asasutjarit, C., Hirunlabh, J., Khedari, J., Charoenvai, S., Zeghmati, B., & Shin, U. C. (2007). Development of coconut coir-based lightweight cement board. Construction and Building Materials, 21(2), 277-288.
4. Ayrilmis, N., Jarusombuti, S., Fueangvivat, V., Bauchongkol, P., & White, R. H. (2011). Coir fiber reinforced polypropylene composite panel for automotive interior applications. Fibers and polymers, 12(7), 919-926.
5. Das, G., & Biswas, S. (2016, February). Physical, mechanical and water absorption behaviour of coir fiber reinforced epoxy composites filled with Al2O3 particulates. In IOP conference series: materials science and engineering (Vol. 115, No. 1, p. 012012). IOP Publishing.
6. Fiorelli, J., Curtolo, D. D., Barrero, N. G., Savastano Jr, H., Pallone, E. M. D. J. A., & Johnson, R. (2012). Particulate composite based on coconut fiber and castor oil polyurethane adhesive: An eco-efficient product. Industrial Crops and Products, 40, 69-75.
7. Ramos, S. (2008). Cancer chemoprevention and chemotherapy: dietary polyphenols and signalling pathways. Molecular nutrition & food research, 52(5), 507-526.https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Ramos+et+al.%2C+2008&btnG=
8. Sivakumar Babu, G. L., & Vasudevan, A. K. (2008). Strength and stiffness response of coir fiber-reinforced tropical soil. Journal of materials in civil engineering, 20(9), 571-577.
9. Staroń, P., Chwastowski, J., & Banach, M. (2017). Sorption and desorption studies on silver ions from aqueous solution by coconut fiber. Journal of Cleaner Production, 149, 290-301.
10. Sudirman, R., Baharuddin, A. S., & Ghani, M. A. A. (2020). Development of Coconut Shell Shaver Machine for Coconut Husk Processing. Journal of Physics: Conference Series, 1529(5), 052040.
11. Petchkongkaew, N., & Loryuenyong, V. (2017). Design and Fabrication of a Coconut Shell Shredder Machine. In AIP Conference Proceedings (Vol. 1791, No. 1, p. 020064).
12. Siripattanakul-Ratpukdi, S. (2008). Effects of coconut shell as aggregate on properties of lightweight concrete. Construction and Building Materials, 22(4), 555-560.
13. Baskar, C., Jayabalan, M., & Sivakumar, P. (2012). Utilization of coconut shell as coarse aggregate in concrete. International Journal of Innovative Research in Science, Engineering and Technology, 1(1), 130-135.
14. Pawar, S. B., & Padhye, A. B. (2014). Utilization of coconut shell powder as replacement of conventional coarse aggregate in concrete. International Journal of Innovative Research in Science, Engineering and Technology, 3(3), 10316-10323.
15. Raghavan, V., & Ramachandran, T. (2017). Study of coconut shell as a partial replacement of coarse aggregate in concrete. International Journal of Civil Engineering and Technology, 8(7), 755-762.
16. Singh, S., & Singh, R. (2017). Experimental study on coconut shell as coarse aggregate in concrete. International Research Journal of Engineering and Technology, 4(1), 331-336.
17. Staron, P., Cojocaru, C., Parvulescu, V. I., & Su, B. L. (2017). Coconut shell activated carbons for heavy metals removal from waters: adsorption equilibrium and kinetics. Journal of Environmental Management, 203, 867-877.
18. Ganesan, K., & Rajkumar, R. (2017). Study on Mechanical Properties of Concrete Using Coconut Shell as Coarse Aggregate. Materials Today: Proceedings, 4(2), 1951-1956.
19. Prajitno, D. H., Suharyanto, H. R., & Suhendra, A. S. (2018). Properties of coconut shell particle reinforced epoxy composites. IOP Conference Series: Materials Science and Engineering, 349(1), 012019.