International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Proposing a Hot Pressing Process in the Mold by Hand to Create a Sample of Sugarcane Bagasse - Polypropylene Composite

Nam Hoai Nguyen[1], Long Nhut-Phi Nguyen[1*], Tai Nhat Nguyen[1], Nam Phan Nguyen[1], Trang Thi-Huyen Nguyen[2], Ngan Ngoc-Huyen Nguyen[3]
[1]Faculty of Mechanical Engineering, Ho Chi Minh City University of Technology and Education (HCMUTE), Ho Chi Minh City, Vietnam, 720100
[2]Information - Technology Group, Di An Secondary School, Di An City, Binh Duong Province, Vietnam, 825063
[3]Information - Technology Group, Trinh Hoai Duc High School, Thuan An City, Binh Duong Province, Vietnam, 824430
Email address: namnh@hcmute.edu.vn, longnnp@hcmute.edu.vn, 19143008@student.hcmute.edu.vn, 19143148@student.hcmute.edu.vn, nguyenthihuyentrangspkt@gmail.com, huyennganspkt@gmail.com

***Abstract*—** *Currently, the demand for products made from materials using raw materials from post-harvest and processed agriculture (sugarcane bagasse (SCB), coffee grounds, rice husks, coconut fiber/powder, etc.) that are easily degradable and environmentally friendly is practical in daily life. This paper proposes creating a composite material sample of sugarcane bagasse (SCB) - polypropylene (PP). The sample with PP + 5%wt SCB powder is made by hot pressing in the mold by hand. The results show that, through visual assessment of the surface, the sample has a smooth surface, the tensile strength value achieved is from 7 to 13.4 MPa, and the elongation is from 2 to 3.2 mm.*

***Keywords*—** *Sugarcane bagasse (SCB), polypropylene (PP), composite material, hot pressing*.

I. INTRODUCTION

The sugar industry globally produces substantial quantities of bagasse, an agricultural by-product with a high cellulose content. Bagasse, often considered waste, poses environmental challenges and resource wastage. However, recent years have seen a surge in research on bagasse, revealing its potential as a raw material for many applications across various industries, including composite materials production.

The article [1] comprehensively evaluates the impact of bagasse and alumina microparticles on epoxy composites' physical, mechanical, and thermal properties. The authors employed the central conformance design - response surface methodology (CCD-RSM) to optimize epoxy composites' bagasse and alumina microparticles ratio. The study [2] investigates the mechanical properties of bagasse fiber reinforced composites. The authors discovered that bagasse fibers, being natural polymers, offer several advantages over synthetic polymers, including cost-effectiveness, lightweight, high strength, biodegradability, recyclability, and environmental friendliness. In the research [3], bagasse and Cellulose fractions are utilized as raw materials to produce finished fibers and other bio-products. The study outlines various approaches to conducting bagasse fraction studies. This is a significant agricultural waste in Brazil, with numerous potential applications. The article [4] examined fibers extracted from bagasse for their potential to reinforce polymer matrix composites. Using these composites in technical applications, such as ballistic armor, necessitates information on impact resistance. In the study [5], bio-composites were created from lactic acid, two natural reinforcing agents, natural starch, and bagasse fibers. The interfacial adhesion strength was estimated through model calculations, and the local deformation processes were monitored through sounding tests. The results revealed that the two additives influenced the properties differently. The study [6] enhanced the processing of bagasse-PP biocomposites by utilizing virgin and chemically treated bagasse fibers (20 wt%). The biocomposite was reprocessed five times through extrusion, followed by injection molding. In the paper [7], natural fiber-reinforced polymer composites have garnered more attention due to their properties, including biodegradability, lightweight, low cost of resources, easy processing, high specific modulus, and the call for environmental friendliness. This paper provides an overview of a study demonstrating how bagasse fiber biocomposites, when combined with resin, can replace bagasse composite panels. The paper [8] presents the effect of bagasse fibers (10, 20, 30, 40%) on the mechanical behavior properties of high-density polyethylene (HDPE), which was studied. The cellulose fibers were treated with alkali in a 5% sodium hydroxide solution before being mixed with the HDPE matrix by hot pressing. The paper [9] aims to study the possibility of recycling paper from sugarcane bagasse, a waste product of sugarcane processing, to reduce environmental pollution and resource depletion. The paper describes the methods of data collection, experimentation, quality control, and synthesis analysis for producing paper from sugarcane and its application in daily life. The paper uses sugarcane bagasse as the main raw material and adds aloe vera, corn starch, and $CaCO_3$ as binders to create paper products. The research [10] aims to synthesize and characterize paper sheets from sugarcane bagasse and lemongrass by-products as an alternative material for disposable plastic packaging. This paper also reviews the degradation of paper pulp in soil. The

Nam Hoai Nguyen, Long Nhut-Phi Nguyen, Tai Nhat Nguyen, Nam Phan Nguyen, Trang Thi-Huyen Nguyen, and Ngan Ngoc-Huyen Nguyen, "Proposing a Hot Pressing Process in the Mold by Hand to Create a Sample of Sugarcane Bagasse - Polypropylene Composite," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 3, pp. 38-40, 2024.

paper describes the process of layering, papermaking, and paper testing. The biomass classification is performed with NaOH at different ratios and times.

This article proposes a hand-hot pressing process in the mold to create a sample of sugarcane bagasse (SCB) - polypropylene (PP) composite material.

II. Material and Methods

The SCB material is mainly from some stores that sell ultra-clean sugarcane juice in the Thu Duc area, Ho Chi Minh City, Vietnam.

The plastic used in this study is polypropylene PP 1100N sourced from Saudi Arabia.

The proposed Process was implemented at the Ho Chi Minh City University of Technology and Education (HCMUTE)'s Material Testing Laboratory.

The implementation process includes several basic steps as follows:

Step 1

Cut the SCB into pieces according to size 30÷50 mm

Step 2

Blend the SCB after cutting

Step 3

Dry at about 105^{o}C

Step 4

Blend after drying

Step 5

Sift to get the SCB powder

Step 6

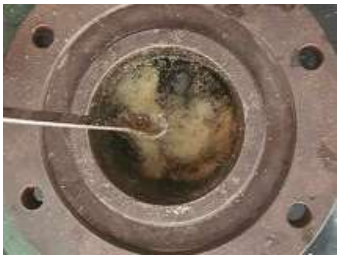
Weigh PP & 5%wt SCB powder

Step 7

Heat PP in a container and stir

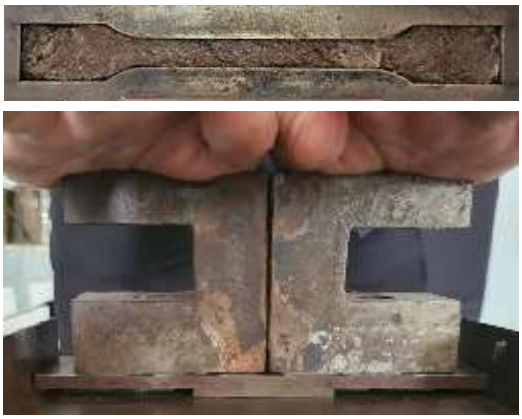
Step 8

Pour in SCB powder and stir well



Step 9

Pour the mixture into the mold and press it by hand



Step 10

Let it cool, and take out the sample

III. Results and Discussion

Below are pictures of some tensile test specimens that have been pressed.

Table 1 shows the results of the tensile strength of the PP + 5%wt SCG sample.

Nam Hoai Nguyen, Long Nhut-Phi Nguyen, Tai Nhat Nguyen, Nam Phan Nguyen, Trang Thi-Huyen Nguyen, and Ngan Ngoc-Huyen Nguyen, “Proposing a Hot Pressing Process in the Mold by Hand to Create a Sample of Sugarcane Bagasse - Polypropylene Composite,” *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 3, pp. 38-40, 2024.

TABLE I. Tensile strength results

No.	Tensile Strength (MPa)	Elongation (mm)
1	7	2
2	11	2
3	13.4	3.2

After hot pressing by hand, the sample's surface is quite smooth. The top sample has a low tensile strength value due to some air bubbles. The next two samples performed better, improving the tensile strength value significantly.

IV. CONCLUSION

The article proposed a manual hot-pressing process in a mold to create a composite material sample. Tensile test specimens with polypropylene (PP) + 5%wt sugarcane bagasse (SCB) were pressed. The results showed that the obtained specimens had smooth surfaces, and tensile strength and elongation improved quite well. This also is the basis for further research with reduced equipment investment costs.

ACKNOWLEDGMENT

This work belongs to the project grant No: T2023-128 funded by Ho Chi Minh City University of Technology and Education, Vietnam.

REFERENCES

[1] Arpitha, G.R., Mohit, H., Madhu, P. et al. Effect of sugarcane bagasse and alumina reinforcements on physical, mechanical, and thermal characteristics of epoxy composites using artificial neural networks and response surface methodology. Biomass Conv. Bioref. (2023). https://doi.org/10.1007/s13399-023-03886-7

[2] Mohd. Khalid Zafeer, Roopa Prabhu, Sithara Rao, GT Mahesha & K Subrahmanya Bhat (2023) Mechanical Characteristics of Sugarcane Bagasse Fibre Reinforced Polymer Composites: A Review, Cogent Engineering, 10:1, DOI: 10.1080/23311916.2023.2200903

[3] Costa, S. M., Aguiar, A., Luz, S. M., Pessoa, A., & Costa, S. A. (2014). Sugarcane Straw and Its Cellulosic Fraction as Raw Materials for Obtainment of Textile Fibers and Other Bioproducts. Polysaccharides, 1–17. https://doi.org/10.1007/978-3-319-03751-6_53-1

[4] Candido, V. S., Silva, A. C. R. da, Simonassi, N. T., Luz, F. S. da, & Monteiro, S. N. (2017). Toughness of polyester matrix composites reinforced with sugarcane bagasse fibers evaluated by Charpy impact tests. Journal of Materials Research and Technology, 6(4), 334–338. https://doi.org/10.1016/j.jmrt.2017.06.001

[5] Józó, M., Várdai, R., Bartos, A., Móczó, J., & Pukánszky, B. (2022). Preparation of Biocomposites with Natural Reinforcements: The Effect of Native Starch and Sugarcane Bagasse Fibers. Molecules, 27(19), 6423. https://doi.org/10.3390/molecules27196423

[6] Correa-Aguirre, J. P., Luna-Vera, F., Caicedo, C., Vera-Mondragón, B., & Hidalgo-Salazar, M. A. (2020). The Effects of Reprocessing and Fiber Treatments on the Properties of Polypropylene-Sugarcane Bagasse Biocomposites. Polymers, 12(7), 1440. https://doi.org/10.3390/polym12071440

[7] Al Bakri, A. M. M., Liyana, J., Norazian, M. N., Kamarudin, H., & Ruzaidi, C. M. (2013). Mechanical Properties of Polymer Composites with Sugarcane Bagasse Filler. Advanced Materials Research, 740, 739–744. https://doi.org/10.4028/www.scientific.net/amr.740.739

[8] S. Sivarao1, Z. Jamaludin, M. S. Salleh1, M. A. M. Ali, K.Kadirgama, U. K. Vatesh, S. Pujari, S. Sivakumar,S. Ramesh, K. Y. Sara Lee, Effects Of Sugarcane Bagasse Fibers On The Mechanical Behaviour Of High Density Polyethylene, Journal of Engineering Science and Technology, School of Engineering, Taylor's University, Vol. 16, No. 5 (2021) 4214 – 4220

[9] Nguyen Thi Xuan Hanh, Nguyen Thi Bich Ngoc, Vo Thi Hai Yen, Research on the process of making paper from bagasse at laboratory scale. (2022). Journal of Thu Dau Mot University, 150–156. Internet Archive. https://doi.org/10.37550/tdmu.ejs/2022.03.316

[10] Ngo Thi Thuong, Tran Thi Thuy Dung, Chu Thi Thanh, Nguyen Thi Hong Hanh, Le Thi Thu Huong, Paper sheets made from sugarcane bagasse and lemongrass by-products: synthesis and properties, Vietnam J. Agri. Sci. 2021, Vol. 19, No. 7: 964-974.

Nam Hoai Nguyen, Long Nhut-Phi Nguyen, Tai Nhat Nguyen, Nam Phan Nguyen, Trang Thi-Huyen Nguyen, and Ngan Ngoc-Huyen Nguyen, "Proposing a Hot Pressing Process in the Mold by Hand to Create a Sample of Sugarcane Bagasse - Polypropylene Composite," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 3, pp. 38-40, 2024.