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2023 JIICaS

JOHOR INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2023

" Innovation Inspires a Society to be Critical and Creative"

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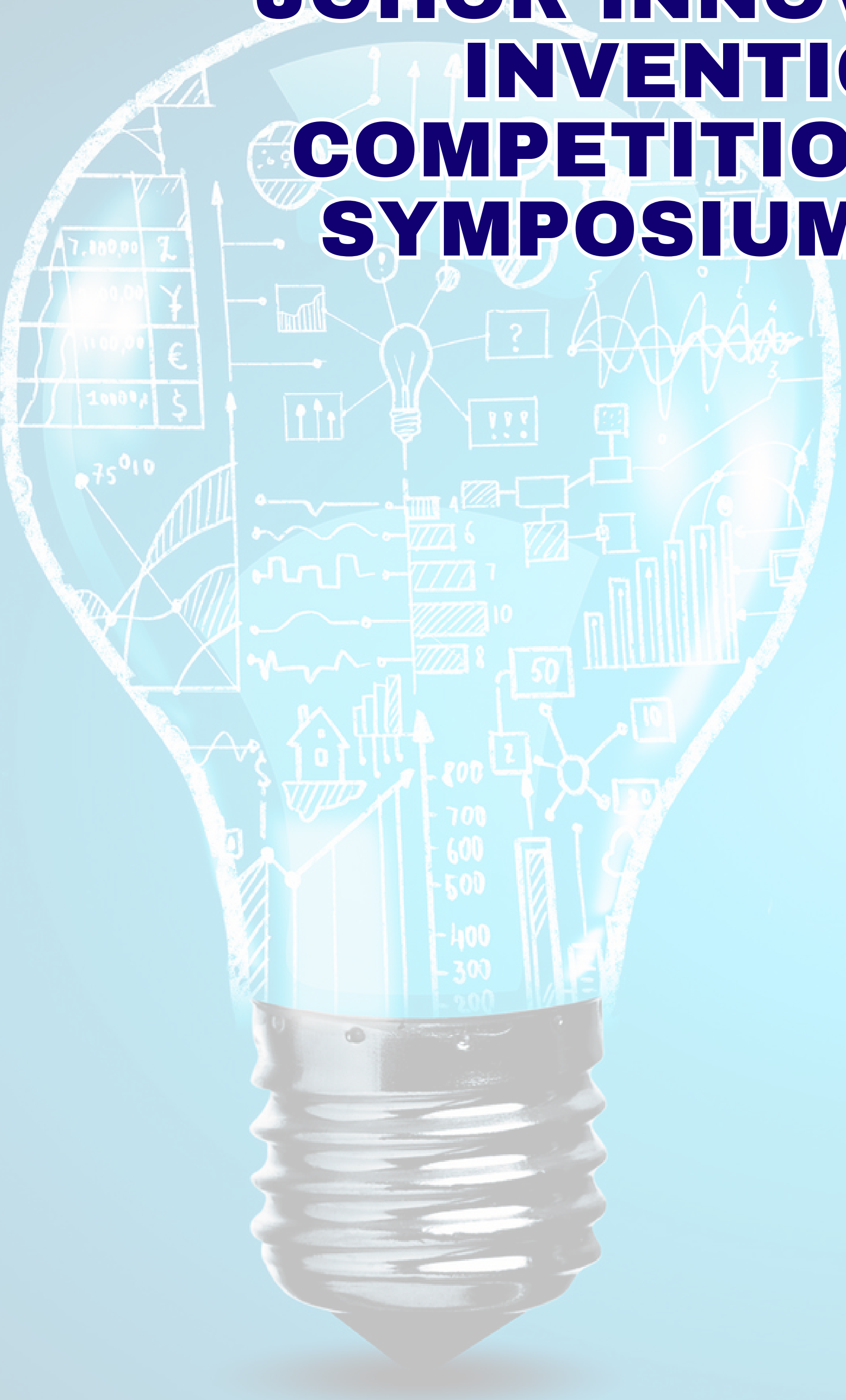

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Editors-in-Chief

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor Innovation Invention Competition and Symposium 2023 (JIICaS2023), where JIICaS2023 is a virtual platform for all creative minds to share and present their invention and innovation. The extended abstracts are divided into two categories, which are Category A (Higher Educational Student/ Any Recognized Institutional Students in Malaysia) and Category B (Primary/ Secondary School Students / Special Education School Students in Johor). Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students from both categories and get some ideas to develop future innovation products.

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MOLD MAKING FOR COMPOSITE TENSILE TEST

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ABSTRACT

This innovation mostly on simple shape composite mold, with one-piece molds made from nylon plastic. During this mold fabrication, consideration given to use the recyclable materials but yet provides durability. High flow rates of thermoplastic or thermoset resin are considered as the main medium to be cured in the mold along with the fibres. These high flow rates may interfere with the casting process and result in a non-uniform cast layer thickness along the part. Therefore, the mold or die design is an important part and is closely related to possible problems of the heat treatments and dimensional accuracy. Regions with abrupt variation in the cross-section and sharp corners are points that can lead to cracks or warpage during heating and mainly during quenching. Rough machining marks can act as notch and cause fracture of the mold or die during the heat treatment. The initial idea was innovate using CAD program to simulate the exact dimension following the ASTM D3039 (Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials). The most common specimen for ASTM D3039 is a constant rectangular cross section. These molds are machined using CNC, laser cutting and grinding. This mold or die may act as an educational aid apparatus in preparing samples of composites for tensile test.

Keywords: mold, resin, machining,composite.

1.0 INTRODUCTION

Plastic waste is a major environmental problem. Every year, millions of tons of plastic end up in landfills and oceans, where it can take hundreds of years to decompose. The mold is used to create the shape of the final product. There are many different types of molds that can be used, depending on the desired shape and size of the product. The first step in mold making is to create a prototype of the desired product. This can be done by hand or using computer-aided design (CAD) software. Once the prototype is created, it can be used to make a mold.
There are many different materials that can be used to make molds, including silicone, urethane, and epoxy. The choice of material will depend on the desired properties of the mold, such as its durability and flexibility. The resin is poured into the mold, where it cools and hardens. The finished product is then removed from the mold. Mold making for single fiber is a complex process, but it is a promising way to reduce plastic waste and create sustainable items.The benefits of using recycled plastic waste to create single-fiber sample , such as reducing pollution and conserving natural resources. The different types of molds that can be used to create single-fiber samples.The steps involved in the mold making process, from creating a prototype to injecting the molten resin into the mold. There is limited mold in market for mold based on ASTM D3039. Mold must be in perfect shape according to ASTM standard.

2.0 OBJECTIVE

The objective for this innovation is specific, measurable, achievable, relevant, and time-bound. It is specific because it clearly states what will be done (design and fabricate a mold, prepare specimens, and identify mechanical characteristics). It is measurable because it specifies the ASTM standard that will be used (ASTM D3039). It is achievable because the tasks involved are within the skills and resources of the person or team who will be doing the work. It is relevant because it is directly related to the goal of understanding the mechanical characteristics of single fibre sample preparations. And it is time-bound because it specifies that the work will be completed in a specific timeframe.

3.0 DESCRIPTION OF INNOVATION/METHODOLOGY

In the realm of advanced manufacturing, the process begins with the meticulous creation of a preliminary design, or mold draft, utilizing cutting-edge Computer-Aided Design (CAD) software like Catia. This digital blueprint serves as the foundation for the subsequent stages. The CAD drawing is then seamlessly translated into actionable instructions for a CNC (Computer Numerical Control) machine, which meticulously carves the mold with unparalleled precision. The resultant mold is characterized by an open cavity, a critical feature in the production of high-performance materials.

Within this mold, an intricate dance of materials takes place. First, the fibers are thoughtfully positioned, securely anchored in place to maximize their stiffness. To forge a resilient composite, a precisely measured blend of resin and hardener is then introduced. In a testament to the artistry of craftsmanship, the composite is laid by hand, layer by layer, in a method known as "manually hand lay-up." This labor-intensive process imbues the composite with unique qualities.

The heart of this innovation lies in the integration of single rattan fibers within the polymer matrix, creating a remarkably strong and lightweight material. To ascertain its mechanical prowess, rigorous testing is conducted, following the stringent ASTM D3039 standard. These tests reveal the composite's tensile properties, ensuring that it meets or exceeds industry benchmarks for strength and durability. In the convergence of cutting-edge technology and traditional craftsmanship, this methodology yields a material of exceptional performance, poised to redefine the boundaries of composite engineering.

Figure 1: Single fibre mold made from plastic after machining by CNC

Figure 2: Compound used made of resin and hardener

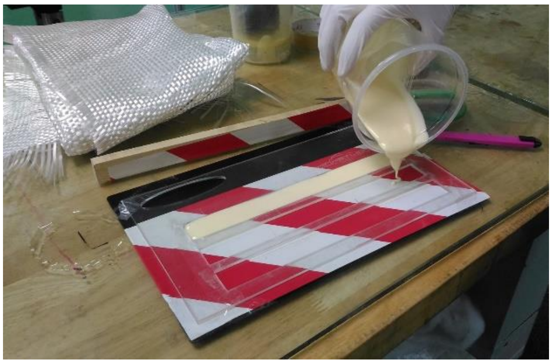

Figure 3: Pouring process of compound into cavity

Figure 4: Compound hardened at surrounding temperature

Figure 5: Sample for composite is ready for tensile testing

4.0 ADVANTAGE/IMPACT/RESULTS/NOVELTY

Mold making for single fiber presents a promising paradigm shift in composite material manufacturing. Its advantages are evident, from the significant reduction in material waste to the enhanced precision that ensures impeccable accuracy in the final product. This precision extends to the realization of the full potential of the fiber's properties, endowing the resulting parts with superior strength, stiffness, and overall performance. Moreover, the versatility of this technique empowers designers with unparalleled flexibility, allowing them to cater to specific performance and aesthetic demands. Beyond the tangible benefits, the environmental impact is substantially reduced, a vital consideration in today's eco-conscious manufacturing landscape. Higher product quality, reduced rejects, and the potential for entirely new product developments underscore the transformative potential of mold making for single fiber. Its novelty lies in its continual evolution, with ongoing research exploring innovative materials and techniques. This technology is steadily infiltrating diverse sectors, from aerospace to medical devices, and as costs decrease, its accessibility to manufacturers widens. In summary, mold making for single fiber is poised to reshape composite material manufacturing, offering a myriad of advantages, substantial impacts, and exciting opportunities for innovation.

5.0 CONCLUSION

In conclusion, the primary objective of this work was to design and manufacture a mold suitable for tensile tests using various materials, including nylon plastic or acrylic plastic. Through our experiments and analyses, several key conclusions have been drawn, shedding light on the significance and potential applications of this research. Firstly, the utilization of CAD software in conjunction with Computer-Aided Manufacturing (CAM) techniques has proven to be an effective means of optimizing mold design and production. This process not only enhances the precision and efficiency of the mold fabrication but also streamlines the entire production workflow. Secondly, the fabrication of molds using both nylon plastic has proven to be versatile, accommodating different curing functions. This adaptability allows for the creation of a wide range of composite specimens tailored to specific testing requirements, expanding the applicability of the mold design. Furthermore, it is noteworthy that the specimens produced in this study adhere to the ASTM D3039 standards, ensuring the reliability and compatibility of the obtained results with established industry benchmarks. This standardization adds credibility to the research findings and facilitates comparisons with other studies in the field. Lastly, a compelling conclusion emerges from the comparison between this innovative mold design and previous applications. It is evident that this product has the potential to significantly increase the production of samples, thereby enhancing the efficiency of testing processes. Moreover, the economic advantages associated with the manufacturing cost further underscore the practicality and feasibility of implementing this mold in industrial and research settings. In summary, this work represents a valuable contribution to the field of material testing and mold design. The incorporation of CAD/CAM techniques, the adaptability of mold materials, adherence to established standards, and the cost-effectiveness of the product collectively affirm its potential to revolutionize the way composite specimens are prepared and tested. This research sets a promising foundation for future advancements in the field, offering innovative solutions for improved sample production and cost efficiency.