i-SPiKE 2023

INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

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Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality . I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH

WELCOME MESSAGE (i-SPiKE 2023 CHAIR)

We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPiKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPiKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail
Chair
3rd International Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023)

BASALT FIBRE REINFORCED POLYMER COMPOSITE FILLED WITH NANO SILICA FOR GREEN TRUCK BODY PANEL

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ABSTRACT
The truck body panel industry ensures commercial vehicles' structural integrity and safety within the automotive sector. The composites are manufactured using manual lay-up and vacuum silicon mould techniques. These composites utilise basalt/glass fibres for reinforcement and polyester resin as the matrix. The primary aim is to assess the benefits of incorporating nano-silica to enhance the impact properties of these materials at varying concentrations (1%, 3%, and 5% by weight) of nano silica. Experimental tests were conducted to evaluate impact properties, and the results were compared with those of Carbon Tech Global (CTG), an industrial reference sample. The visual impact findings indicate that adding 1% nano-silica to basalt and glass fibre-reinforced composites (BFRPC/GFRPC) improves impact characteristics by showing the most samples that absorbed energy. These promising outcomes suggest potential practical applications in the automotive sector. These enhancements underscore their suitability for increased utilisation in commercial vehicles and establish them as viable choices for truck body panel materials.

Keywords: nano-silica, basalt fibre, ductility index, polyester, vacuum silicon mould

1. INTRODUCTION

Granite waste refers to the leftover materials produced during the extraction, cutting, and processing of granite stone. These waste components encompass granite dust, slurry, and smaller unused fragments from making countertops or tiles. Repurposing granite waste offers possibilities for conserving resources, economic benefits, and innovative construction practices (Nayak et al., 2022). Yet, managing environmental, health, and safety issues linked to waste disposal and processing remains pivotal.

Nano silica, or nano silicon dioxide, has garnered substantial attention across industries and research domains due to its distinct attributes and potential uses. It shows promise in enhancing various materials' mechanical qualities, durability, and sustainability. Nevertheless, health, safety, dispersion, expenses, and long-term performance challenges need careful attention for nano silica's successful adoption (Kaka et al., 2021). Continuous research is dedicated to optimising the integration of nano silica into diverse composite systems. Ensuring proper safety measures during handling and processing is crucial to minimise potential health and environmental risks tied to nanoparticles (Quadflieg et al., 2023).

Basalt fibre composites offer multiple benefits, such as strength, durability, corrosion resistance, and thermal stability (Plappert et al., 2020). Ongoing research aims to address challenges and enhance production and processing techniques for these composites, influencing their broader application across industries.

Using composite materials for truck body panels presents both prospects and hurdles. While these materials offer advantages like weight reduction and corrosion resistance, concerns arise regarding manufacturing complexity, repair, material costs, and recycling (Nasution et al., 2020). Manufacturers must carefully evaluate these factors before adopting composites for truck body panels.

2. MATERIALS AND METHODS

The manufacturing process involved creating composite materials using basalt and glass and varying percentages (1%, 3%, and 5% by weight) of nano silica as a filler. The components utilised in this research included woven glass fibre, woven basalt fibre, and a polyester resin known as CRYSTIC® 272E Isophthalic Polyester Resin. The resin and hardener, supplied by Carbon Tech Global Sdn Bhd in Rawang Selangor, were mixed at a ratio of 100:2. Weight percentages were incorporated during mixing to ensure even distribution of the filler in the resin. A mechanical stirrer was employed for around 120 minutes at a rotational speed of 400 rpm to mix the components thoroughly. A silicon mould was used to encase the specimen, facilitating the combination of the composite material. After sealing the fibre-reinforced polymer (FRP) specimen, it was removed from the mould and left to cure for about 8 hours under normal conditions. Completing the procedure involved using a circular saw device and strict adherence to established testing protocols using the provided specimens.

2.1 Drop weight Low-Velocity Impact

The research adhered to the ASTM D7136 standard and employed the Instron Dynatup 8250 Drop Weight Impact Tester for testing. The specimens used in the experiment had dimensions of 50 mm x 50 mm x 5 mm. The drop tower included a hemispherical tip impactor with a diameter of 13 mm and a weight of 13.24 kg. The weight was dropped from a height of 0.78 m, resulting in a kinetic energy of 101.3 J, and the gravitational acceleration remained constant at about 9.81 m/s. To ensure accuracy, the scientists tested five identical specimens for each system. This experiment facilitated the evaluation of the composite laminates' energy absorption and impact strength.

3. RESULTS AND DISCUSSION

The findings obtained in this study align with the mean values acquired through the analysis of five separate samples for each category of composite laminate. The present study extensively examined the impact of various characters in the subsequent subsection.

3.1 Effect of nano-silica on visual impact properties of Basalt Fibre Reinforced Polymer Composites (BFRPC) and Glass Fibre Reinforced Polymer Composites (GFRPC)

Analysing Figure 1 provides a comprehensive insight into the impact responses of each sample system. The frontal perspective reveals the presence of circular and cross marks across all samples, accompanied by a circular mark on the reverse side of each sample. Notably, the indenter's penetration through the sample material is strikingly evident from the lateral view.

Directing our attention to the 0wt%NS-BFRPC sample, a notable delamination feature is discernible from the side profile.

Transitioning to the 1wt%NS-BFRPC sample, a distinct cross mark is visible alongside a frontal hole that has successfully penetrated the sample's surface, albeit without extending through the bottom. Notably, the side view reveals a penetration depth of approximately 2cm.

Turning our focus to the 3wt%NS-BFRPC sample, a faint cross mark is present, accompanied by a subtle jig mark and delamination at the sample's rear. From the side perspective, a penetration depth of about 1.8cm becomes apparent.

For the 5wt%NS-BFRPC sample, a faint cross mark is evident on the front, while a subtle jig mark adorns the bottom. The side profile also unveils a penetration depth of approximately 1.7cm.

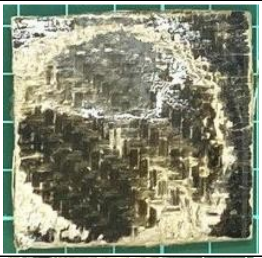
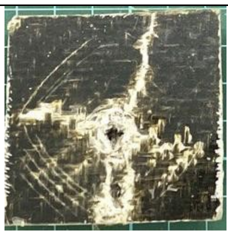
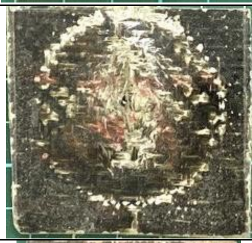
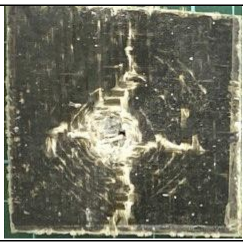
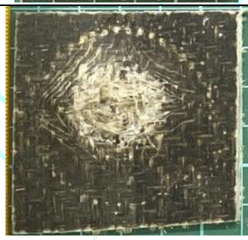
System	Front/Top	Back/Bottom	Side
0wt%NS-BFRPC			
1wt%NS-BFRPC			
3wt%NS-BFRPC			
5wt%NS-BFRPC			

Figure 1. Visual impact properties of basalt fibre reinforced polymer composite, BFRPC

Observing Figure 2, a comprehensive insight into the impact behaviour of each sample system becomes apparent. A distinct line intersects the indenter mark on the frontal side, accompanied by a jig circle impression on the sample's reverse face. An explicit penetration of the indenter through the sample material is evident from the lateral view.

For the 0wt%NS-GFRPC sample, discernible features include the line intersecting the indenter, a minor depression on the front surface, and delamination occurring at the sample's rear. The side profile indicates a penetration depth of approximately 1.1cm.

In the case of the 1wt%NS-GFRPC sample, a conspicuous frontal hole is visible, penetrating the sample's surface, albeit without extending to its underside. Delamination and a subtle jig mark are evident as well. A penetration depth of about 1.5cm along the lateral view is noticeable.

Moving to the 3wt%NS-GFRPC sample, a distinct hole created by the indenter on the front side is prominent, complemented by scatter marks and delamination on the rear. The lateral perspective indicates a penetration depth of around 0.7cm.

Regarding the 5wt%NS-GFRPC sample, a frontal hole is observable, accompanied by a jig mark located at the bottom. The side profile displays a penetration depth of roughly 0.5cm.

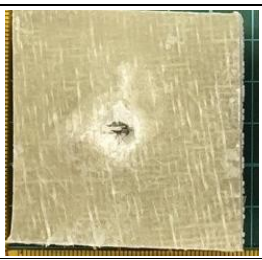
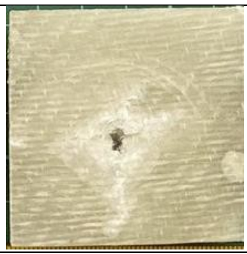
System	Front/Top	Back/Bottom	Side
0wt%NS-GFRPC			
1wt%NS-GFRPC			
3wt%NS-GFRPC			
5wt%NS-GFRPC			

Figure 2. Visual impact properties of glass fibre reinforced polymer composite, GFRPC

In the case of the CTG sample, a circular indentation mark from the indenter is visibly present on the front surface, accompanied by delamination on the reverse side. A penetration depth of 0.9cm becomes apparent upon closer inspection from the lateral perspective.

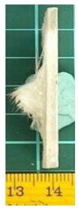
System	Front/Top	Back/Bottom	Side
CTG			

Figure 3. Visual impact properties of the industrial sample, CTG

4. CONCLUSION

Based on the outcomes of the visual impact tests, it is evident and can be inferred that integrating nano silica will augment the impact characteristics of the composite material by increasing the energy absorbed by the composite. The most notable impact strength and energy absorption were observed in the case of 1wt% nano silica in both composite materials. These metrics surpassed the values recorded for the conventional test group (CTG). Consequently, including nano silica can enhance the properties, and the values exhibited by basalt fibre are superior to those of glass fibre and applying nano silica will contribute to an elevation in impact strength and energy absorption.

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