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Review Article

Composite Materials and Analysis Techniques: A Review

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Abstract

This review was conducted to study various composite materials and their analysis techniques. A composite material is composed of at least two materials, which combine to give properties superior to those of the individual constituents. Industrial waste and agricultural waste disposal has become a serious problem. Some researchers showed their interest to reuse these waste materials and making the composite materials from waste. Most of the composite materials are used in sound isolation and noise reduction. The aim of this paper is to give an overall literature review on the work done related to composite materials and their analysis techniques. The major issues faced by the industry, domestic uses and environment because the waste materials developed pollution and it is hazardous to human health and environment. So it is need of time to develop alternative solutions for this problem by making the composite materials. The main intention behind the study was to focus on the development of cost-effective, efficient to meet the properties with original materials and environmentally-friendly materials. Therefore, it is very much essential to review on the researcher studies to achieve at the best composite material and analysis techniques for future composite materials.

Keywords: *Recycled rubber, Natural fibers, Noise reduction materials, two microphone method.*

1. Introduction

The aim of researchers is to develop a composite material from industrial and agricultural waste. Most of the composite materials are used in noise reduction. Sound is a common part of everyday life. The sounds can be also unpleasant or unwanted, so called noise. Due to noise pollution in our surrounding, there is need and demand to find alternative materials that are capable to reduce the noise level at various frequency ranges. Research on composite materials and natural fibers were done on acoustical panels. The common acoustical panels made from synthetic fibers that are hazardous to human health and environment and quite expensive for small portion. Therefore, some researchers showed their great interest to make alternative sound absorber from recycled materials, such as textile, foam, rubber or plastic. A composite material is composed of at least two materials, which combine to give properties superior to those of the individual constituents.

Some of researcher doing the great work on materials the analysis of composite material is most important parameter because it shows the acoustic properties, mechanical properties, water absorption coefficient, density, porosity some of the researcher using the different method for analysis of composite materials. Ilaria Papa, *et al*. (2020) ultrasonic inspection method is used for to analyze the failure detection and behavior of composite materials.

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Ulhas Arun Malawade, *et al*. (2020) the research on investigation of the acoustic performance of bagas. The bagas is used a secondary material. The bagas is waste material of sugar industry. Rahmad R, *et al*. (2018) palm coir fiber used for sound absorbing Palm coir fiber, for 40gm weight sound coefficient were good from the medium and low frequency that is from 630Hz to 2000Hz within the range of 0.65db to 0.90db. Ágoston Katalin. (2017) studying noise measurement and analysis by the Sound Level meter and Power Spectral Density. To analyze sound both frequency and amplitude doming, using this type of analysis faults can be detected and localized. Darsana, *et al*. (2016) development of coir fiber roofing tiles for household use. The coir fiber is by product of industry. It is eco-friendly, light in weight. It has good water absorption coefficient. The researcher doing lots of work on composite material and natural fibers and its analysis techniques more brief information of composite materials on the literature review

A lot of research has been done on developing and analyzing composite materials from waste some of that is mentioned below;

Matrix material Recycled Rubber.

1. Tyre Rubber
2. Tyre Tube Rubber
3. Belts
4. Shoes

5. Mat

Secondary Material

1. Coco Peat
2. Coco coir fiber
3. Rice straw
4. Rice husk
5. Bamboo
6. Jute
7. Stalk
8. Bagase

2. Literature Review

Much of the research work has been done in the field of decision making and conceptual design evaluation. Following is the literature review of some papers giving more information about their contribution in decision making and conceptual evaluation

Ilaria Papa, *et al*. (2020) they tested the different composite laminates for the application of aerospace with the help of ultrasonic testing. Materials used for inspection like glass fiber reinforced polymers (GFRP), carbon fiber reinforced polymers (CFRP) and basalt fiber reinforced polymers (BFRP). They inspected failure detection and dynamic by the Non destructive testing, Ultrasonic testing and Pulse-echo method. They got results when the epoxy resin was used the damage image was released brighter and more defined the same analysis was done on CFRP and BFRP laminates. The BFRP composite material shows the penetration energy higher than CFRP and GFRP once results in a good compromise between the traditional composites tested.

K.Hariprasad, *et al*. (2020) they determines the Acoustic and Mechanical properties tensile strength, hardness and water absorption for the composite materials. The composite material prepared by milkweed, kusha grass, sisal and banana and they are mixed with polypropylene 10.90(wt %). The properties measured by ASTM standard method and Impedance tube method. They found the results like the PP hardness value is 73 milked composite and kusha grass fiber composite have significantly higher hardness of all specimens. The kusha grass fiber absorbs more water and the milkweed fiber absorbs less water. For 10mm thickness specimen absorption coefficient is less than 0.30 and between 0.87 and 0.97 is 500Hz and 2000Hz respectively and for the sample 20mm thickness only milkweed fiber and they show a constant increases in the value from 500Hz to 2000Hz comparing two thickness the use of natural fiber at 500Hz is efficient.

Ulhas Arun Malawade, *et al*. (2020) the bagas is a byproduct of sugar industry. The main attraction of researcher is to minimize effects of environmental air and noise pollution. They have made the bagas panels with the different thicknesses like 10mm, 20mm and 30mm. They have suggested the acoustic performance of bagas investigation on acoustic absorption coefficient and airflow resistivity. The method was used to found out the above parameters is airflow resistivity setup and impedance tube method. The results from the test show absorption coefficient and flow resistivity increases with increase in bagas material thickness. The material has high acoustic absorbing coefficient near about (0.7-0.8).

Nurul Izzati Raihan, *et al*. (2020) they uses a coal ash on concrete as a sound absorber in a building. The research on acoustic and non-acoustic performance of coal bottom ash with parameters compressive strength, sound, siere analysis test, gravity test, and density test. The method was used to find out above parameters is compressive test BSEN 12390-3(2009) and reverberation room test. CBA mixture is used as the raw material replacing they conventional fine aggregate and also sound absorber in the market. According to BSEN ISO 11654; 1997 standard class D absorber can absorbs more than 30% of sound while class E absorber is capable of absorbing between 15-25% of sound.

Panfeng Baia, *et al*. (2019) they have prepared five samples like original porous metal, compressed porous metal, compressed and micro perforated porous metal panel, micro perforated spring steel panel, micro perforated uncompressed porous metal made by the fabrication. They want to reduce the noise pollution by the porous metal. They check the performance of sound absorption coefficient and porosity by the Absorber AWA6128A detector and Fabrication by the comparison and micro performance. For 20mm cavity absorber frequency 100-6000Hz was 59.69% which was superior to that 25.70% of the original porous metal absorber and that 31.49% of the micro perforated spring steel panel absorber.

Kelly C. de Lira Lixandrao, *et al*. (2019) in this work they use rubber tire powder and polypropylene composite materials for the application of engine encapsulation of commercial vehicles. They want to reduce the external noise of engine. They have suggested research of waste tire management for making the composite materials. The parameters Temperature, Heating rate, X-Ray Diffraction, tensile strength, Young's modulus, Elongation, Impact test, Sound transmission loss, External noise. The above parameters measured by Differential scanning calorimeter, Thermo gravimeter, Universal testing machine, Pendulum test machine, Impedance tube, Pulse lab shop soft. It shows good thermal stability and good impact resistance as well as decreases value of tensile strength, young's modulus and elongation compared to virgin polypropylene. Reduction both waste tire in the environment and the emission of gases generated by the flues. 30% of reduction cost. Sound level of the vehicle tested did not exceed by more than 1.0 db

Wenjie Yana, *et al*. (2019) they investigate the Simulation and Experimental analysis of cylindrical shells. Noise Reduction performance of cylindrical shells and SPL, With Thickness (2mm, 4mm and 6mm) calculated by FEM(soft LMS virtual lab) and SPL-Curve. The comparing the experimental and simulation results

and it shows that the amount of noise reduction increases as the laying thickness increases, Noise reduced by 8.97db. The noise reduction under three modes of lateral laying, longitudinal laying and oblique lying are 3.7dB, 3.79dB and 3.91dB, respectively. When butyl rubber is placed in the cylindrical cavity, the noise reduction in the cavity increases with the increase of the thickness of the laying. For every 2mm increase of butyl rubber, the noise reduction increases by 4.09dB.

Macro Marconi, *et al*. (2018) they want to reuse of tire rubber on a composite material. It's need to find out the life cycle, plasticity, environmental sustainable, tensile and Impact, vicat test by the LCIA Environmental impact is ReCiPe midpoint - Hierachist (H) version Europe and vicat test ISO 306:2004 standard. The result shows that it is not possible to identify the best scenario for the reuse of tires. Lower impact for the reuse or the energy recovery scenarios. Landfill scenario is currently most common and less expensive for the STECA Company.

R.Kalavari, *et al*. (2018) the oil palm trunk used as natural fibers for acoustic sound absorption. The acoustic sound absorption coefficient measured by the impedance tube method. It was good acoustic properties. The sound absorber range from 0.5-0.85 for the frequency 500Hz. The panel thickness 12mm is found to have the highest sound absorption coefficient 0.99 at frequency of 3000Hz to 6000Hz and 6400Hz hence oil palm trunk is a very promising natural fiber to be used as a sound absorbing material.

Kareem Fatly, *et al*. (2018) they study the reuse of waste tire rubber to get properties of PP composite material. The properties like water absorption, compressive yield strength, hardness and thermo mechanical analysis measured by According to ASTM D570, RPC WDW -10KN UTM according to ASTM695, Hardness ASTMD2240, Thermo mechanical analysis Q400TA and Universal according to ASTME831. The results show that Compressive strength decreases when rubber traded or rubber particle weight. Chemical treatment of recycled rubber H2SO4 resulted better adhesion. Hardness decreases when recycled rubber weight increases. Recycled rubber absorbs more water than untreated rubber.

Rahmad R, *et al*. (2018) the research was conducted to study the acoustic properties of palm coir fiber. It has high potential to be use for sound absorbing material. They measured sound absorption, porosity and density of palm coir fiber by Impedance Tube, Porosity and Density test m/c (ASTM D792). Palm coir fiber, for 40gm weight sound coefficient were good from the medium and low frequency that is from 630Hz to 2000Hz within the range of 0.65db to 0.90db

Agoston Katalin. (2018) they study noise measurement for different application like noise measurement of machines in industry nowadays it becomes noise pollution and another one the noise measurement for fault detection. The noise measurement and analysis by the Sound Level meter and Power Spectral Density. To analyze sound both frequency and amplitude doming, using this type of analysis faults can be detected and localized

Andrei.A Guser. (2017) study on design of coated sphere filled viscoelastic composites for structural noise and vibration damping application. Measured the Effective viscoelastic stiffness and Vibration by Galerkin time doming FEM and Damped free vibration of viscoelastic Bernoulli-Euler beams. Efficient noise and vibration damping control is highly desirable in various technological and societal situations.

Darsana, *et al*. (2016) they study on development of coir fiber roofing tiles. The engineer always lookout alternative products for developing a building, he always consider reducing the cost of construction, light roofing, minimum maintenance cost and labour to install. The work proceeds on composite material compressive strength, casting, water absorption test and load test by using methods. Compressive strength standard IS 654:1992, Manufacturing of tiles with the help of casting and Load test UTM. The paper concluded that Eco friendly product. Addition of fibers will results in reduction in self weight and cost.

Wencheng Guoa, *et al*. (2015) the aim of researcher is to minimize the noise effects for the indoor application of commercial and industrial buildings. The study on sound isolation and sound analysis with the parameters sound absorber coefficient and absorber architecture design measured by using Analytical method, FEM Simulation and QRD(Quadratic Reduce diffuser) Result shows that the presented MPP absorber can have normal incidence sound absorption coefficient higher than 0.5 over the frequency from 370Hz to 2520Hz with maximum value of 0.9. This indicates that the MPP absorber provide good alternative for indoor sound absorption application.

Danny santoso mintorogo, *et al*. (2015) they want to reduce the indoor temperature of buildings. They used the coconut fiber for insulation of building walls. The temperature measured by HOBO data logger was adjusted to record all temperature for every 10min. The use of coconut fiber as outer insulation on horizontal rooftop can be concluded. Lower surface heat fluxes at day time and faster release heat due to natural performing material of coconut fiber. Lower indoor temperature. It reduces average indoor air temp up to 1.2degree c and indoor room temp up to 3.1 degree c at 2pm

Y.Y. Lee. (2015) they have study on sound vibration analysis of a nonlinear absorber panel. It contains noisy machinery like chillers and fans, enclosure panels can be used to developed a soundproof space such as offices and meeting rooms. Sound absorber, amplitude, radiated sound absorber and Excitation level cavity depth and damping factor measured by multilevel residue harmonic balance method, Structural acoustic formulation and Numerical analysis. It is reasonably good agreement although small deviation between them can be observed in peak values on the frequency amplitude curves. It can be concluded that from some of the numerical results that the nonlinear resonance of a

panel absorber can increase the degree of sound radiation

Colin Campbella, *et al*. (2015) this research was developed in a classroom for teaching and learning activity. The work on sound absorption in two identical rooms. The parameters reverberation time and sound level measured by room acoustic measurement method. The sound level drop of over 5db and speech clarity increase of 7db which is over a 20% in PSO. Short reverberation time, Low sound level, High Speech clarity.

Lamyaa Abd ALRahman, *et al*. (2014) the study on comparison of date palm fiber and oil palm fiber. The date palm fiber is thin and smooth filaments whereas oil palm fiber is a thick and rough filament. The quantities acoustic sound absorption and density measured by impedance tube method. The palm fiber has higher acoustic absorption coefficient for high and low frequency than does oil palm fiber both fibers are promising for use as sound absorber material.

Robert Macku, *et al*. (2014) they used matrix for this study is a vinyl ester, polyester and epoxy polymer based on bisphenol a resin. The study on emission and excess noise analysis by Agilent 35670A two channel FFT dynamic spectral analyzer and EME national instrument sampling unit PCI 6111 in continual acquisition mode and the EME signal was detected by the capacitance sensor. Carbon and copper contacts are poor in view of noise generation. All samples produce white like Johnson -Nyquist noise. It proves assumption of the negligible polarization noise and the Johnson-Nyquist noise was confirmed.

O.S Chathuram, *et al*. (2013) they used coconut coir fiber mixed with sawdust and making tiles by the casting method. The samples prepared in varying thicknesses. They do work on noise reduction coefficient of composite material by experimental setup of impedance tube. NRC Increases with increasing tile thickness, surface roughness, and mix proportion sawdust practical.

Bahruddin, *et al*. (2012) they used palm based fly ash is byproduct of palm oil processing industry which contains silica components. This component is used to improve the mechanical properties of rubber based product. So that study on morphology and mechanical properties of composites materials, the typical parameters are tensile strength, morphological study, water absorption test, thermoplastic vulcanization sample preparation. Measured by UTM (500Kgf load), Electron microscope model JEOL JSM -73304, With the help of comparing the weight of dry and wet sample measured the water absorption, thermoplastic vulcanization samples prepared by roll mill. Tensile properties TPV (NR/PP/70/30) good. Low water absorption rate. Higher tensile strength (9.6MPA).

S. Mahzan, et al. (2010) Study on sound absorption properties of coconut coir fiber reinforced composite with added recycled rubber. The parameters SPL, Density and Porosity measured by two microphone, impedance tube, porosity and density test. The composition of composite boards with 25 percents polyurethane and 75 percents fillers is recommended for sound absorption applications. The optimum composition of 40 percents coconut coir and 60 percents recycled rubber is of interest. The superior performance that is high absorption coefficient and wider frequency range enables this composite board to be employed in various sound absorption applications.

Rozli Zulkifli, *et al*. (2010) they used main raw material is coconut coir fiber is treated with latex during the forming in order to coat the coir fiber and maintain the structure of the coir fiber sheet. The noise control using coconut coir fiber composite material SPL with varying thickness of panel. The SPL measured by impedance tube method. The composite material is good sound absorber. It has good acoustic properties at low and high frequency and can be used to be an alternative replacement of synthetic based commercial product. Its sound absorption coefficient increases at low and high frequency.

Lindawati Ismail, *et al*. (2010) the study on sound absorption by using arenga pinnata natural fibers. The thickness of arenga pinnate was varied in 10mm, 20mm, 30mm and 40mm. The sound absorption coefficient measured by Impedance tube method (ASTME 1050-98) and two microphone and digital frequency analysis. The sound absorption coefficient good from 2000Hz to 5000Hz within the range of 0.75-0.90 for 40mm thickness. The material has Low cost, light and biodegradable

3. Result and Discussion

From above literature review, it is observed that nowadays there is more demand in the composite materials for a noise reduction application in industry and other areas. The common acoustical panels made from synthetic fibers that are hazardous to human health and environment and quite expensive for small portion. Composite materials are cost effective, easily available, light in weight, more efficient than other products. It is suitable for small portion, and it has good damping and noise absorbing capacity. Some of the composite materials give the good results as expected.

Conclusions

The paper presented a literature review concerning the studies on composite materials and its analysis techniques. Review found that especially in domestic use it is need to develop such type product for noise reduction and other application. It is beneficial for domestic applications as well as from environment point of view. It acts as best disposal techniques for pollutant products. Some of the composite products are in use for daily life products. From above literature review it is observed that most of the researcher use the same primary material is a recycled tire rubber because it has good damping, isolation, sound absorption, water absorption properties. And the secondary material like

coconut coir fiber, rice straw, rice husk, bamboo, jute, stalk, bagas this materials are mostly used for developing composite materials. The coco peat is a secondary material less used so it has a scope for developing composite material. It has fulfilled the conditions like sound absorption, water absorption, and light in weight, easily available, cost effective. Impedance tube and two microphone method is mostly used for analysis of sound absorption in composite materials. So that the conclusion of this paper is found the some materials and analysis techniques and this has a bright future scope.

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