Synthesis of Groundnut Shell/ Rice Husk Hybrid Composite –A Review

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Abstract. In this new era natural fiber composite is being manufactured for economic purpose. The natural fiber hybrid composite is beneficial to the environment as it balances the ecosystem. It is not harmful to the environment and is biodegradable. Various types of natural fibers are used to make composites as they are easily available and their cost is low. Mostly rice husk and groundnut shell are used to make the composite because they are easily achievable and have good properties. Other natural fibers like jute and cotton also have good properties. The rice husk and groundnut shell are used to make acoustical board as it has good sound absorption property. Jute and cotton are used to enhance the mechanical property of composite board. Various properties of natural fiber hybrid composites are enhanced by the amalgamations of natural fiber and resin such as mechanical property, acoustic property and water absorption property. This paper reviews on synthesis of groundnut shell/rice husk hybrid composite. Further the paper also summarizes the past research work done and the different type of combination of reinforcement used. Different techniques for testing of the reinforced composite is also discussed.

1. Introduction
Composite material is produced on large scale in which natural fiber composite is given more significance as it is easily available and does not harm the environment. Natural fiber is helpful in balancing the environment. Now a day’s people are confronting a distinctive kind of pollution one of them is also sound pollution. This types of pollution imbalance the natural frameworks. Numerous such things are being made by natural fibers which are useful for diminishing the sound pollution and furthermore satisfy the need of people. The natural fiber composite board and gypsum board is used for sound absorption. The natural fiber composite is a good source in comparison of gypsum board for sound absorption. Composite board is being used on a large scale in India [1]. Some fiber such as carbon, glasses etc. are imported from other countries. This type of fiber cost and manufacturing cost are more than natural fiber. Many engineers and researchers have tried to replace the synthetic fiber with natural fiber and have achieved success [2]. The natural fibers are like as banana fiber, jute fiber, flex fiber, coir fiber, groundnut shell, rice husk etc. and agriculture wastes such as rice husk, wheat straw and rice straw are used to manufacturing of composites material. More than one matrix or reinforcement is used to obtain
good property of hybrid composites like mechanical property, thermal property, water absorption property and acoustic property etc. Some composite like groundnut shell and rice husk polypropylene hybrid composite has good thermal insulation and water stability [3]. The jute found from jute plant and it has a good role play in manufacturing of composite in textile field because it has good tensile strength. Natural fiber is used to enhance the property of composite according to the requirement of the people. Moisture absorption capacity of natural fiber is more. Plant natural fiber composites have good mechanical properties with low specific mass [4]. The jute is reinforcing material in all natural fiber which is available commercially. It has higher strength and modulus than plastic and has a multi cellular structure which is made up of micro fibrils [5]. Density of natural fiber is lower than synthetic fiber. They offer less density and are beneficial for cementation composites [6]. In this review, the manufacturing method and property of groundnut shell, rice husk, jute, resin, composite material etc. are described which can be beneficial for researchers.

2. Materials

2.1. Natural Fibre

This century has been called as cellulosic century because various plant resources for items are being perceived. Natural fiber plants are commonly classified into two parts namely primary and secondary fiber. Primary fiber plants are usually developed with fiber content whereas secondary fiber plant which have got fiber as byproducts [7]. The classification of fiber on the basis of its origin as plants fiber, animal’s fiber and minerals fiber. All plant fiber contains cellulose as their major basic segment, whereas the proteins are found most part of the animal fiber. The minerals natural fiber exists inside the asbestos group of minerals and was once utilized broadly in composites but now a day’s it is avoided due to health problems (carcinogenic through inhalation/ingestion). These are banned in various countries [8]. Plant fiber is the part of natural fiber and the plant fiber consist of the numerous type origin like baste, wood, fruit, grasses and leaf. It is classified into two parts non-wood and wood fiber. The Non-wood fiber consists of stalk, fruit, seed, and leaf, baste. The Wood fiber consists of hardwood and softwood [9]. Classification of natural fiber is shown in figure 1. The plant fiber which is consists of the groundnut shell, rice husk and jute.

![Classification of natural fibers](image)

**Figure1.** Classification of natural fibers [9]

2.2. Groundnut Shell

Groundnut has a place with Araches hypogaea Linn of leguminous family. Groundnut is a self - pollinated yearly and herbaceous vegetable harvest. A total seed of groundnut is known as pods
and have one to five kermils which grow underground in a needle such as structure called peg which develops into the earth soil and after changes into a pods. Groundnut has tap root framework which has numerous nodules, present in and lateral roots and root. The nodules have Rhizobium bacterial, which are symbiotic in nature and focus on nitrogen of atmosphere. External layer of groundnut is called groundnut shell. The shell comprises around 25 – 35% of the pods. The groundnut seeds are remaining part (65 – 75%) [10]. China is the largest producer country of groundnut and second largest producer country is India. In the terms of production, groundnut is the largest oilseed in India. All aspects of the groundnut are economically helpful. The king of oilseed is the groundnut. Shell is the waste part of the groundnut and it contains lot of energy as a biomass fuel. The groundnut shell is a type of fuel source which is helpful to fulfil the requirement of fuel. Approximately two-fifths of the current biomass energy potential is utilized in overall world [11]. The physical property groundnut shell in the terms of thickness is (0.06-1.2 mm). The thickness varies according to the verity of groundnut shell. The groundnut shell contains 11-11.5 percent moisture [12]. The groundnuts shell is such a plant natural fibre which is used to development of nanofibres product and the groundnut shell contain cellulose, hemicelluloses, lignin etc. The lignocellulosic or agro wastage material is helpful for development of nanofibres [13]. The chemical properties of the groundnut shell like cellulose, hemicellulose and lignin etc. The chemical properties of groundnut shell are in the Table 2.

2.3. Rice husk
Rice husk is widely found in the rice producing country in the form of agricultural wastages. Paddy rice is produced at the world level around 600 million tons in a year. On average, 20% of husk is produced from the paddy rice and the total production is 120 million tons a year. In many rice production countries, rice husk is burnt or thrown away as garbage. Burning of rice husk produces ash. By 1000 kg paddy rice produces at least 200 kg (22%) husk. Burning of rice husk in a boiler furnace produces about 55 kg (25%) of ash which affects the surrounding environment and soil. Rice husk is a non-timber source fibre which is easily available from the agriculture wastage. It is used to economical propose for manufacturing of the composite products [14]. The physical property of rice husk is in terms of thickness (0.5-0.9 mm), length (0.5-2 mm) and density (0.1-0.3 g/cm3) [15]. Plant natural fiber has mechanical and chemical property. The mechanical property consists as Density, Tensile strength, Young modulus and elongation shown in Table 1. The chemical property consists of Cellulose, Hemi cellulose, Lignin and moisture etc shown in Table 2 [16].

2.4. Jute
Jute is a significant agricultural natural fibre. It is common natural plant fibre in India, Bangladesh and China. Jute is the important natural fibre from the point of view of business in India and it is traditional plant fibre. In India, the most economical fibre is jute which is used for commercial and domestic purpose. The importance of jute is on top in the world and next is of cotton [17]. Structural component of various fibres is similar to the structural component of jute. Cellulose plays an important role in forming the structural component of jute fibre. The physical property of jute like density is 1.3g/cm3 [18]. Generally, 1.5-120mm length of jute is used for composites and the mechanical property of jute like tensile strength, young modulus etc. The density of jute is 1.3-1.5 g/cm3, tensile strength is 393-800 MPa, young modulus is 10-55 MPa and elongation of jute is 1.5-1.8 percent [8]. The chemical property of jute consists of cellulose, hemicellulose, lignin and moisture contains in weight percentage. The cellulose of jute is 61-71.5 wt (%) and moisture contains 12.6 % [19] and other chemical property of jute shown in the Table 2.
Table 1. Mechanical property of fiber [8,16,18]

| Mechanical properties       | Rice husk | Jute    |
|-----------------------------|----------|---------|
| Density (g/cm³)             | 0.9-1.01 | 1.3-1.5 |
| Tensile strength (MPa)      | 25-75    | 393-800 |
| Young modulus (MPa)         | 2.5-3.7  | 10-55   |
| Failure strain (%)          | -        | 1.5-1.8 |

Table 2. Chemical property of fiber [12, 15,19-20]

| Chemical properties       | Rice husk | Groundnut shell | Jute    |
|---------------------------|----------|-----------------|---------|
| Cellulose wt (%)          | 35       | 38.9            | 61.0-71.5 |
| Hemi cellulose wt (%)     | 21       | 15.41           | 13.6-20.4 |
| Lignin wt (%)             | 31       | 30.62           | 12.0-13.0 |
| Moisture wt (%)           | 1.1      | 11-11.5         | 12.6    |

2.5. Epoxy

Epoxy is a thermosetting polymer comprising of different epoxide groups. The epoxide occurs in terms of oxirane or ethoxyline groups. Epoxies are amalgamated with a large range of hardener or curing agents. The ratio of epoxy and hardener is 1:1 or 2:1 because huge amount of curing agent is required for epoxy. Other type of epoxy resin like Novolac based epoxy resin which is used in industries [21]. The epoxy (Araldite - LY 556) and hardener is (HY-951) is used as a proper ratio. The ratio of epoxy and hardener is 10:1. It has good toughness, appreciable resilience and effective strength. The chemical resistance property and electrical resistance property of epoxy is better. The bonding quality of epoxy to the natural fiber is effective. Properties of epoxy resin are in Table.3 [22]. The ratio of curing agent to epoxy is affected the mechanical property of epoxy resin and the amalgamation ratio is very important. The epoxy is used as the adhesive material for the fabrication of fiber. It consists of the various verities on the basis of physical property. The mechanical property of Nololac epoxy is better than Bisphenol-A epoxy [23]. If the equal tensile stress is applied, the deformation of bisphenol-A type epoxy is more than novolac and if compressive stress is applied, the deformation of bisphenol-A is gradually increasing more than novolac type epoxy as shown in the figure 2.
Figure 2. Mechanical properties of epoxy resin: (a) tensile test; and (b) compressive test. [23]

Table 3. General property of epoxy [22]

| Properties                          | Epoxy                        |
|-------------------------------------|------------------------------|
| Appearance                          | A clear pale yellow liquid   |
| Specific gravity at 25° C (g/cm³)   | 1.12                         |
| Tensile strength (MPa)              | 31                           |
| Flexural strength (MPa)             | 67                           |
| Impact strength (Kg/m²)             | 9                            |
| Solid content (%)                   | 84                           |

3. Natural fiber composite

The natural fiber composite consists of various type of natural fiber. The natural fibers are jute, rice husk, groundnut shell, cotton and bamboo etc. The composites are made by the natural fiber and resin. The composites such as jute-epoxy composite, rice husk-epoxy composite, groundnut-rice husk-epoxy composite, cotton-polyester composite and groundnut shell-rice husk-polypropylene composite. Various types of composites have different type of property such as tensile property, flexural property, water absorption property and sound absorption property. The natural fiber based composite have improved property than gypsum board. In the GNS/RH/PP composite suitable ratio is (20/60/20). The maximum tensile strength and flexural strength of this composite is 15.6 MPa and 37.6 MPa respectively. The comparison of tensile property, flexural property, sound absorption coefficient, thermal property and water absorption of gypsum and GNS/RH/PP composite is shown in the Table 4. The summary of different work performed on
composite along with its manufacturing techniques and property of various composite is listed in Table 5.

Table 4. Comparison of composites properties [3]

| Properties                        | Commercial Gypsum board | GNS/RH/PP Composite |
|-----------------------------------|-------------------------|---------------------|
| Tensile property (MPa)            | 9.6                     | 12.5-15.6           |
| Flexural property (MPa)           | 7.16                    | 27.2-37.6           |
| Sound absorption coefficient      | 0.42-0.56               | 0.11-0.48           |
| Thermal conductivity (w/mk)       | 0.170                   | 0.156-0.270         |
| Water absorption (%)              | -                       | 9-24                |

Table 5. Summary of experimental work done by various researchers on composite material.

| Author            | Material                        | Resin         | Size (Thickness of composite) | Manufacturing method     | Property of composite | Result               |
|-------------------|---------------------------------|---------------|-------------------------------|--------------------------|-----------------------|----------------------|
| Kang et al.[1]    | Rice husk, sawdust              | Phenol        | 14 mm                         | Hand lay-up technique    | Sound absorption coefficient | 0.2-0.55            |
| Suresh et al.[2]  | Rice husk, Coconut shell, Bagasse | Vinyl ester   | 3 mm                          | Compression molding process | Tensile strength, Flexural strength, Impact strength | 35-54 MPa, 40-62 MPa, 0.55-0.69 MPa |
| Guna et al.[3]    | Groundnut shell, Rice husk       | Polypropylene | 10 mm                         | Hand lay-up              | Tensile strength, Flexural strength,               | 15.6 MPa,          |
| Researchers          | Reinforcement                  | Matrix       | Thickness | Fabrication Method             | Thermal Properties          | Sound Properties                      | Water Properties                        |
|----------------------|--------------------------------|--------------|-----------|---------------------------------|-----------------------------|----------------------------------------|------------------------------------------|
| Pakravan et al. [6]   | Silica sand, Rice husk, PVA fiber | Portland cement type I | 9 mm      | Casting process                 | Thermal conductivity 37.6 MPa, | Sound absorption coefficient 0.156-0.270 W/mk, | Water absorption 0.11-0.48, lower than gypsum board |
| Olaitan et al. [10]   | Groundnut shell | Epoxy        | 4.5 mm    | Hand lay-up technique           | Flexural strength 6.01-6.48 MPa, Compressive strength 40-50 MPa |
| Mohamed et al. [14]   | Rice husk | Polypropylene | -         | Extrusion process               | Ultimate tensile strength 25 MPa |
| Santhosh et al. [15]  | Rice husk, Prosopis juliflora | Epoxy        | 5 mm      | Via book press molding          | Flexural strength 34.51-56.34 MPa, Tensile strength 53.51-106.2 MPa |
| Adeosun et al. [13]   | Groundnut shell | Polylactic Acid | -         | Explosive reaction              | Ultimate tensile strength 0.85 MPa |
| Seddeq et al. [24]    | Wool, cotton | Polyester    | 3.7 mm    | Needle punched technique        | Sound absorption coefficient 0.67 |
| Mishra et al. [25]    | Jute | Pure epoxy | -         | Hand lay-up technique           | Tensile strength 43-110 MPa, Flexural 55.8 |


| Author    | Material                  | Epoxy Type       | Board Thickness | Technique         | Strength          |
|-----------|---------------------------|------------------|-----------------|-------------------|-------------------|
| Potadar et al. [26] | Groundnut shell, coir     | Ly556/Hy951      | 12 mm           | Hand lay-up       | Tensile strength, Flexural strength, Moisture contain % |
|           |                           |                  |                 |                   | 16-20 MPa, 60-80 MPa, 8-10% |
| Antonio et al. [27] | Rice husk, Recycled rubber | TDI based polyurethane pre polymer | 17 mm           | Hand lay-up technique (Thermal press) | Maximum Sound absorption coefficient |
|           |                           |                  |                 |                   | 0.96              |

4. Different Testing Techniques

4.1. Sound Absorption Testing

The Sound absorption testing is performed by impedance tube method. In the impedance tube system generally large diameter of tube is 100 mm and small diameter of tube is 29 mm. The sample holder and extension tube varies 29 mm to 100 mm.

The sound source is kept on one end of the impedance tube and at the other end, the sample is placed in sample holder as shown in Figure 3. The loudspeaker produces propagate zigzag motion wave. The wave incident on the face of sample and reflect from the sample. The propagation sound wave forward and backward hence analysis the result. The sound absorption and the normal acoustic impedance of the material are determined. The range of frequency depends on spacing between the micro phone positions and tube diameter. For the sound absorption test the instrument are used like as sound source, sound signal processor, sound level meter, sound signal amplifier, sound chamber, material sample holder etc. The result analysis of sound absorption is done by computer in which software is installed [24].

![Figure 3. Schematic diagram of the impedance tube for the two-micro phone transfer-function method [24](image)](image)

4.2. Mechanical Testing method

The mechanical testing performs in particular standard. The sample is prepared like as dumbbell shape for tensile test. The tensile test is performed to determine the sustainability of the sample to with stand force that pull and to stretch prior to failure. Testing is done by the universal testing
machine. In the flexural test the sustainability of sample to withstand bending force applied in longitudinal axis [28].

4.3. Water Absorption Testing method
The sample is cut in specific standard size for water absorption test and weight the sample. The testing sample is immersed in distilled water at room temperature. The sample removes from the water after 24 hours or according to time. The weighting processes proceed in which the weight difference of the sample is calculated. The difference of weight is noted before the sample immersion in water and after the immersion of water as in equation (1). Weight percentage is found by the equation [29].

\[
\text{w\%} = \frac{w_f - w_i}{w_i} \times 100 \tag{1}
\]

\(w_f\) = Final weight of sample after immersion
\(w_i\) = Initial weight of sample before immersion

4.4. Flammability Testing method
The flammability test is performed horizontal and vertical. The sample is ignited through the burner and during the vertical flammability the sample is observed for the length of time and after some time the igniting flame is removed. It is again observed how much the sample is burnt or not. In opposite, horizontal flammability tests observe if the sample continues to burn after the test flame is removed, and then calculate the rate at which the sample burns. This test can perform in hours or day.

5. Literature Review
The progressive work of natural fiber is done in this new era by the skilled researchers. The quality of composite material is improved like mechanical characteristics, chemical characteristics or good surface finishing of the product. The past work done in this field of reinforced composite are discussed.

Kang et al. [1] investigated the mechanical property and sound absorption of natural fiber composite by the use of different natural fiber like rice hull and saw dust. The powder type phenol resin is used to bind the fibers. The manufacturing parameter is taken in the terms of density (400, 500, 600 and 700) kg/m3 and the weight percent of rice hull/saw dust/phenol resin (10/80/10, 20/70/10, 30/60/10 and 40/50/10) respectively. The composite is manufactured in comparison of gypsum board. The sound absorption coefficient of the composite in terms of the density of sawdust board and rice hull contained in different percentage as (400kg/m3 and 10%, 500kg/m3 and 30%, 500kg/m3 and 40%). The range of sound absorption coefficient is 0.2 to 0.55 which is better than 11 mm thickness of gypsum board. The maximum bending strength of the board is 9.3 MPa by 700kg/m3 density of board and 10% of rice hull contains. In order to get best sound absorption board, the rice hull content is to be increases and the density of fiber board is to be decreases.

Guna et al. [3] worked on the tensile, flexural and water absorption property. Two natural fiber materials are used as rice husk and groundnut shell. The polypropylene resin is used as a binder for preparation of rice husk and groundnut shell based composite. Enhanced property is found by the amalgamation of proper ratio of groundnut shell, rice husk and polypropylene. The ratio of groundnut shell, rice husk and polypropylene is 20/60/20. The tensile and flexural strength is 15.6 MPa and 37.6 MPa respectively. The sound absorption coefficient of this composite is 0.48 and thermal insulation is 0.156-0.270 W/mk. Most important property is water absorption property which is 85% lower than gypsum board. The rice husk/groundnut shell and polypropylene based composite is better than gypsum board.
Pakravan et al. [6] experimented on the cementitious composite to improvement of property by the use of agriculture wastes. This investigation is done on the flexural property of composite. This type of property improved by the use of materials like as rice husk and polyvinyl alcohol fibers. For the preparation of composite the different proportion of rice husk (2.5, 5.0, 7.5 and 12.5% in weight of cement) are amalgamated to the concrete. The calculated amounts of rice husk are added to poly vinyl acryl so the tensile and flexural strength can be improved of cementitious composite.

Khan et al. [9] reviewed on mechanical property like tensile property and flexural property of the natural fibers. They reviewed in terms of size of fiber, geometry, surface treatment and fiber weight fraction. The tensile property and flexural property can be achieved by the use of natural fiber length 20-50 mm and weight fraction 30-40% of the natural fiber. The natural fiber is treated 5 % wt alkali which improves the good tensile strength and flexural strength. The natural fibers which are not harmful for the environments and the natural fiber like as jute, rice husk, groundnut shell, sisal, glass fiber and bananas fiber.

Maduako et al. [12] investigated on the physical property of the groundnut natural fiber. The various type of groundnut is taken for the achievement of the physical property. The groundnuts verities vary in the form of shell, seeds and pods. The physical property of groundnut shell is determined on the basis of size, weight, shape and coefficient friction etc. The groundnut shell parameter are varied such as moisture contents is 11.5-11.0 % wt, the angle of repose varies 0.79-0.11, the size varies 1.20-0.06 and weight varies 0.05-0.01 gram.

Gassan et al. [18] investigated to improve the mechanical property of jute and epoxy based composites. The jute is treated by the NaOH with proper concentration and shrinkage, 25% NaOH is used for treatment and time taken is 20 minutes. The treatment temperature is 20⁰ C. The natural fiber is treated by the NaOH under the isometric condition which improves the composite stiffness and strength. The tensile strength and modulus of jute can be increased by the alkali treatment. The jute yarn modulus about 150% and tensile strength about 120% are increased by the treatment under isometric condition.

Saba et al. [21] research on natural fiber and advance epoxy resin based composites. The applications of composites are investigated and this type of composite is used for the electronic component and circuit board. The epoxy which is used for manufacturing of composite that has low impact strength. By the modification of epoxy property, the composites property can be changed. The modification property of composite is fire resistance, brittleness and toughness. The epoxies which are used in the different natural fiber and the manufacturing technique are applied as hand lay-up technique and extrusion technique.

Seddeq et al. [24] worked on the recycle fibrous material. In this research the natural fiber is used and the sound absorption property is investigated. According to the variation of frequency the sound absorption coefficient is varies and at the lower frequency (100-400 HZ) the sound absorption coefficient is 0.06. At the higher frequency (200-6300 HZ) the sound absorption coefficient of wood-cotton - polyester composite is 0.67, cotton-polyester based composite is 0.58 and sound absorption of cotton-wool-polypropylene based composite is 0.61. By increasing thickness of nonwoven sample, the sound absorption coefficient can be enhanced. The sound absorption at medium frequency and lower frequency are improved by the adding air space behind the specimen.

Usman et al. [29] investigated to improve the mechanical property in comparison of treated and untreated groundnut shell powder. For the treatment of groundnut shell powder, alkali is used as it
can improve the mechanical property of the composites. The manufacturing of the composite by
the use of the recycle polyethylene and groundnut shell powder. In various weight percentage of
the groundnut shell such as 5%,10%,15%, 20%,25%,30% and the particle size of groundnut shell
such as 0-300,300 - 600 μm are used. The fiber properties are improved by using 10% NaOH
solution for 5 hours. The mechanical property and biodegradability improve on the basis of size
and weight percent of groundnut shell powder. The treated sample does not absorb the high rate
of water.

Parbin et al. [30] review on the natural fiber and epoxy based composites. In this the mechanical
property of composites are reviewed. The natural composite has better properties by the
amalgamation of natural fiber and epoxy resin. The tensile properties depend upon the treatment
of natural fiber. The NaOH treatment fiber has better tensile property. The epoxy based
composites gives the better flexural property and the bamboo based composite is better than jute
fiber composite in reference of flexural property. Various composite is manufactured by the
epoxy and natural fiber which has good property because the epoxy has good mechanical and
chemical property. For the example epoxy-jute fiber (5% NaOH) based composite has tensile
strength 12.46 MPa and flexural strength 39.8 Mpa but 10% NaOH treatment of jute fiber and
epoxy based composite has tensile strength 10.5 MPa and flexural strength 32.5 MPa. The
variation of NaOH percentage varies the property of fiber and composites.

Mishra et al. [25] investigate the different type of mechanical property and physical property.
Jute-epoxy based composite are taken for the finding of property of composites. The jute is used
bi-directional. The fabrication of composite is performed by hand lay-up technique. If the natural
fiber loading occurs after 12wt%, the flexural strength and modulus of composite is enhanced. By
the enhancement of 48wt% of fiber loading is enhanced the flexural strength as 55.8 MPa and
modulus of composite as 3.02 GPa.

Potadar et al. [26] investigated the moisture property and mechanical property on the basis of
size of the natural fibers. The groundnut shell and coir fiber materials are used for manufacturing
of composites. The particle size of groundnut shell is taken as 1mm, 1.5 mm and 2 mm. The
proper ratio of epoxy and fiber is 70:30 which is amalgamated each other. Different type of
particle size of groundnut shell is used. The fiber is treated by NaOH for the improvement of
property. The 1mm, 1.5mm and 2mm size of the groundnut shell have used for the tensile
strength, so that the tensile strength of composite is found 16-17, 12-14, 12-13 N/mm2
respectively. For the flexural strength the size is taken as 1mm, 1.5mm and 2mm of the groundnut
shell and the flexural property of composite is found 60,40,45-50 N/mm2 respectively. A
composite is made of a particle size of 1mm groundnut shell and has 8% moisture absorption
which is less than the composite is made of particle size of 1.5mm and 2 mm. The size of
groundnut shell can be taken as 1 mm for best mechanical property, flexural property and water
absorption of composite board.

Karthi et al. [31] investigated the sustainability of the concrete asbestos and jute- polyurethane
based composites. The jute-polyurethane based composite which is used for roofing purpose. The
asbestos has good thermal insulation. The asbestos roofing sheets can sustain 400-500° C
temperature. In reference of asbestos the jute and polyurethane based composite withstand the
atmospheric temperature. Jute-polyurethane based composite trying to replace the concrete
asbestos as asbestos possess heavy weight and low stiffness. Jute-polyurethane based composite
has non-toxic property with high strength and better bending strength.

Marques et al. [32] experimented to improve the mechanical property and acoustic property of
composite. The rice, expanded cork and the polyurethane are used to preparation of composite.
The size of rice husk and expanded cork is taken as 1-3, 3-5 mm respectively. The composite is produced under high pressure. The use of expanded granules in the composite formulation is beneficial to improve the mechanical behavior and reduce the thermal conductivity. The composite is manufactured without any chemical or physical treatment. For the improvement of sound absorption of composite, the ratio of rice husk can be increased. This type of composite applicable for building material based application.

Antonio et al. [27] investigated the acoustic property of the composites. The composite is prepared by the use of rice husk, expanded cork or recycled rubber granules and TDI based polyurethane. Two types of composite are prepared first is 50% of rice husk and 50% of the additional filler (cork or rubber granule) and second is 75% of rice husk and 25% of additional filler (cork or rubber granule) based composites. The fillers are amalgamated with TDI based polyurethane in the ratio of 20% of the solid mass of the cork or rubber granule. First composite thickness is 17mm and second composite thickness is 25 mm. The maximum sound absorption property of composite is 0.96 by the amalgamation of 50% rice husk and 50% recycled rubber. The 0.91 sound absorption coefficient is found by the amalgamation of 75% rice husk and 25% of recycled rubber.

Elanchezhian et al. [33] reviewed the mechanical property of natural fiber like as jute, sisal and abaca. The natural fibers are available in India and it has the low cost and good mechanical properties. The natural fiber composites board uses in different area according to their properties. For the improved flexural strength of the composite board, jute fiber can be used in the processing. The natural fiber is used for composites because that fiber is eco-friendly and biodegradable. The application of natural fiber composite board is beneficial in the building and construction industries. The jute, sisal and abaca based composite are used in different application like transportation, electrical device and furniture.

Wei et al. [34] research on durability of the sisal fiber in cement composite by the use of rice husk ash. The flexural property is improved by the little replacement of rice husk in the sisal fiber reinforced cement composite. The durability of sisal fiber reinforced cement composites is determined by means of flexural properties of sisal fibre reinforced cement composite beams exposed to aggressive conditions. The durability of natural fibre reinforced composite determine by the mean of mechanical property. The reduction of mechanical property of natural fibre reinforced mortar beam is help to determine of durability of the sisal fibre reinforce cement composite. 20% rice husk ash is used for improvement of ductility behaviour of sisal fibre reinforced cement mortar. If more rice husk ash is added for durability that is not beneficial for improvement.

Matei et al. [35] investigate the mechanical property of the short fiber reinforced epoxy based composite. Two types of fiber as glass fiber and Kevlar pulp fiber are used for the manufacturing of the composite. The four types of epoxy resin are used like as T19-38/500, T19-38/700, L50-54, and A19-00. The production method of composites is injection method. The property of composite reinforcement with glass fiber is much better than Kevlar based composite. The mechanical property of glass fiber-T19-38/700 epilox resin composite is better than other composites. The tensile strength and flexural modulus of glass fiber-T19-38/700 epoxy composite is 78.67 MPa and 11.5 GPa respectively. The tensile strength and flexural modulus of Kevlar-T19-38/700 epoxy composite is 32.6 MPa and 4.25 GPa respectively.

Wang et al. [36] studied on flame retardation of the epoxy. The flame retardation resin is created by the proper ratio of mixture of the phenolic melamine and Hyperbranched polyphosphate ester (HPPE). The in situ Fourier-transform infrared spectroscopy and Thermo-gravimetric analysis is
used for analysis of the thermal decomposition mechanism of their cured items. The various methods are followed for evaluation of kinetic of thermal decomposition. The methods are Flynn-Walle Ozawa method, Kissinger method and Horowitz-Metzger method. Flame retardation increases at higher degree of degradation of activation energy and decreases at lower degree of degradation of activation energy. The flame retardation component is decomposition temperature, weight loss rate and degradation of activation energies.

Gowda et al. [5] investigated the mechanical property of woven jute fabric reinforced composite. Jute and polyester are used for manufacturing of composite and the hand lay-up technique is applied. The tensile strength of composite material depends upon the modulus and strength of the fiber. The tensile strength of jute fiber is 120MPa and the strength of jute fabric is 85MPa.

Naeem et al. [37] worked on the commercial epoxy resin based composites. The different filler was used to investigate the different mechanical property of the composites. The composites are made to determine the different impact strength. The proper composition of epoxy and hardener as 10:5 is to improve the mechanical characteristics. According to investigation for best mechanical property of composite the epoxy is added 15% with the fillers.

6. Conclusions
Various scientist and researchers are have worked on the natural fiber. Most of the natural fibers have better property. There are some such fibers in natural fiber like as groundnut shell, rice husk, jute which is very efficient for enhancing the property of composites as it possesses good property and is easily available. The sound absorption property, mechanical property and water absorption property are dependent upon the specific ratio, weight percent of natural fiber and density of natural fiber. Groundnut shell, rice husk and jute are the best natural fiber which is used for enhancement of acoustic property, mechanical property and water stability. The jute increases the strength of the composite material. The alkali treated groundnut shell improves the lower ratio of water absorption. As the weight percentage of jute increases, the tensile strength of the composite increases. As the weight percentage of rice husk increases, the acoustic property of composite is also increased.

7. Future Scope
Based on the literature studied following work can be performed in future studies.

- Further improvement in the sound absorption property in reference of gypsum board and GNS/RH/PP composite can be done.
- Replacement of the resin by epoxy in place of polypropylene.
- Provision of changing the fiber length according to property of the natural fiber.
- The different fabrication method can be applied as hand lay-up technique in comparison of injection molding process.

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