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Development of Coir Based Composite Application

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***Abstract*: A composite material is created when two materials are mixed that have different physical and chemical properties. A substance that is specifically created to perform a particular duty, such as becoming stronger, lighter, or electrically resistant, is created when they are joined. They can also improve stiffness and strength. They are chosen over traditional materials because they improve the properties of the underlying material and can be applied in a number of settings. Generally, the coir was used in various application, some of the substances are get wasted. Collecting the waste substance are treated and get into recycled. The recycled coir fibre was taken into the composite material. Polyester resin was used as an adhesive material, it has adequate resistance to water. The final outcome was taken to several test parameters according to the standards.**

***Keywords*: Coir, polyester resin, composites, tensile strength, impact value.**

1. Introduction

When two materials with disparate physical and chemical properties are combined, a composite material is produced. When they are combined, a substance is produced that is specifically designed to carry out a specific function, such as becoming stronger, lighter, or electrically resistant. They can also increase strength and rigidity. They are preferred to conventional materials because they enhance the underlying material's qualities and can be used in a variety of contexts. Natural fibres have been widely used to reinforce polymers due to their sustainability, excellent stiffness-to-weight ratio, biodegradability, and low cost compared to manufactured fibres such as carbon and glass fibres. Although it is beneficial to be able to recycle thermoplastic composites after they have served their intended purpose, there are still opportunities and challenges in recycling natural fibre-reinforced polymer composites. Coconut fibre is obtained from the shell of the coconut fruit. Coconut fibre is the thickest of all-natural fibre. Coconut palms are mainly grown in tropical regions. Most of the commercially produced coir comes from India, Sri Lanka, Indonesia, the Philippines and Malaysia. Coconut fibre in particular is a light and strong fibre that has gained scientific and commercial importance due to its specific properties and availability. Coconut fibre is obtained from the shell of the coconut fruit. Coconut fibre is the thickest of all-natural fibre. Coconut palms are mainly grown in tropical regions. Most of the commercially produced coir comes from India, Sri Lanka, Indonesia, the Philippines and Malaysia. Coconut fibre in particular is a light, strong fibre that has gained scientific and commercial importance due to its specific properties and availability. Compared to other typical natural fibre, coir has a high lignin content, low cellulose and hemicellulose content, and a high micro fibril angle, which contributes to elasticity, strength, cushioning, abrasion resistance, and weather resistance. It offers a variety of valuable properties such as durability and weather resistance. High elongation at break, padding, abrasion resistance, weather resistance, high elongation at break.

2. Natural Fibre

Natural fibres are a type of renewable resource and a new generation of materials that reinforce and complement polymer-based materials. The development of natural fibre composites or eco-friendly composites is a hot topic these days due to the growing environmental awareness. Natural fibres are one such high-performance material, replacing synthetic materials and related products for weight reduction and energy-saving applications. The application of natural fibre reinforced polymer composites and natural-based resins to replace existing synthetic polymer or glass fibre reinforced materials is vast.

A. Waste of Natural Fiber

Recycled fibres are used in the manufacture of various products. By producing yarns from recycled fibres, it is possible to produce knitted or woven fabrics directly from these fibres or obtain non-woven surfaces. Recycled pre-consumer textile waste is used in the construction, automotive, furniture, paper, and clothing industries. Regenerated fibres have different properties than raw fibres. The processes that fibres undergo during the recycling process damage them and shorten their length. Fibre length is an important factor when processing regenerated fibres into yarns or non-woven fabrics, and sufficient fibre length is required.

B. Coir Fibre

Coconut fibre, seeds extracted from coconut husks or husks. Coarse, hard, reddish-brown fibres. A micron is about 0.00004 inches and is made up of tiny filaments and is made up of lignin.

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Woody plant matter and cellulose. India and Sri Lanka are the top producers of coconuts. The processed fibres are about 10 to 30 cm (4 to 12 inches) long, light, brittle, strong and resilient, and tend to curl. Hand processing often yields superior fibres. They are wear resistant and can be colour. They are used to make brushes, woven into mats, and spun into yarn for marine ropes and fishing nets. Coir is often touted as a greener alternative to peat in gardening. As a soil amendment, it aids in soil moisture retention and aeration. It is also used as a medium for hydroponics in the garden.

3. Material and Methods

The microscopic particles, known as coir, were gathered from the industry. With the necessary quantity of thickener and catalyst, polyester resin was produced. The fibres for the Coir were manually removed from the coconut husk after the Coir had been sun-dried. By soaking the coir in hot water, the outermost wax layer was removed, ensuring optimal contact between the fibre and matrix material. The mould was prepared having the diameter of twenty-one * five cent meter. That is capable for the coir composition.

Fig. 1. Mould 21*5 cm

A. Safety Precautions

Generally, the polyester resin can emit chemical substances, which give halitosis to the nature to prevent from that proper prevention equipment is to be used. Like surgical gloves, face covering masks that can prevent from the bad smell's substances.

Fig. 2. Precaution material

B. Process Methodology

The preparation of the resin mixture came after the coir had been ready. Polyester is regarded as the primary component in the manufacture of resin. Polyester often has a high density and reacts visibly at room temperature. Thinking about the spark and thinker being introduced. The ratio of the combination is 10:2, thus if 100 ml of polyester were used, 20 ml of thickener and 20 ml of catalyst would have been added.

Fig. 3. Polyester resin

Fig. 4. Thickener and catalyst

In order to make the composite, a compression mould measuring 21*5 is to be used. 3 grammars of coir were collected and added to the mould's requirements before being placed in a dryer to absorb moisture. Up to 15 milli litres of polyester resin were used for that amount. The total volume needed was 30 ml, but since polyester reacts quickly at room temperature, it was divided into two layers. The first layer was made with 15 ml of polyester, 3 ml of thickener, and 3 ml of catalyst, and it was poured into the mould. The dried coir was then sprinkled with the resin in a special arrangement. The coir must effectively react with the resin; thus, the arrangement needs to be snug. After that, a second layer was produced and poured in the same manner as the first layer.

Fig. 5. Compressing moulding

Fig. 6. Compression mould with zero degree Celsius

Fig. 7. 70 psi

The procedure used to manufacture thermoset and thermoplastic polymer composites is compression moulding. It is typically employed to create composite parts for automobiles in large manufacturing volumes. There are essentially two different compression moulding techniques: cold and hot. Moulding compound, a semi-cured composite intermediate material, is utilised with thermoset polymers. The thermosetting-based moulding compounds bulk moulding compound (BMC) and sheet moulding compound (SMC) are two of the most popular types. The most common moulding compound for thermoplastic polymers is a glass mat thermoplastic (GMT). Composite materials are blended internally in a twin screw extruder and internal mixer before being compressed at a laboratory scale. The essential thing to pay attention to was whether any air bubbles had developed or not, as doing so would have an effect on how well the coir and polyester would connect. The mould must set at 80 psi for 48 hours at room temperature. The sample was prepared with five alignments.

C. Prepared Samples

Fig. 8. Polyester resin composite

Fig. 9. Random arrangement

Fig. 10. Zig zag sample

Fig. 11. Short fibers

4. Test Results

The samples were cut into 14 cm* 2.6 cm with the help of band saw cutting machine which were taken into for the testing process.

Fig. 12. Band saw machine

Fig. 13. Cutting the sample

A. *Tensile Test*

Tensile strength refers to the breaking strength of a material when applying a force that can break many strands of the material at once, at a constant rate of extension or load. Tensile strength is the capacity of a material to endure a pulling tensile force. It is often expressed in units of force per cross-sectional area. The amount of load or stress that a material can withstand before stretching or breaking is known as its tensile strength. Tensile strength, as its name suggests, refers to a material's ability to withstand tension brought on by mechanical loads. One of the most significant and frequently measured qualities of materials used for structural purposes is the capacity to resist breaking under tensile stress. The greatest tensile stress that a material can withstand before failing is known as its tensile strength such as breaking or permanent deformation. The point at which a material transitions from elastic to plastic deformation is defined by its tensile strength. The minimal tensile stress (force per unit area required to separate the material is how it is represented.

Fig. 14. Tensile test machine

Tensile test devices, sometimes referred to as tension test devices, tensile testers, or pull testers, are common testing apparatuses that are especially designed to assess the tensile strength of specimens. The parameters of our tensile testers will be measured, including ultimate tensile strength, yield strength, elongation, and modulus. Each tensile testing device is customised by our application engineers to meet your testing requirements, including the proper controller, grips, and accessories.

Fig. 15. Digital value convertor

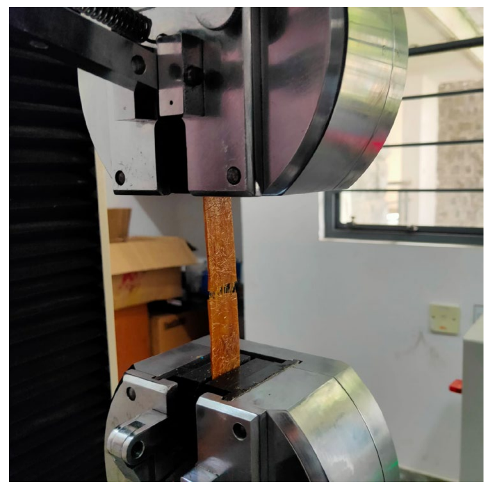

Fig. 16. Weakest breakage point of the composite

B. *Graph Description for Each Sample*

1) *Empty sample*

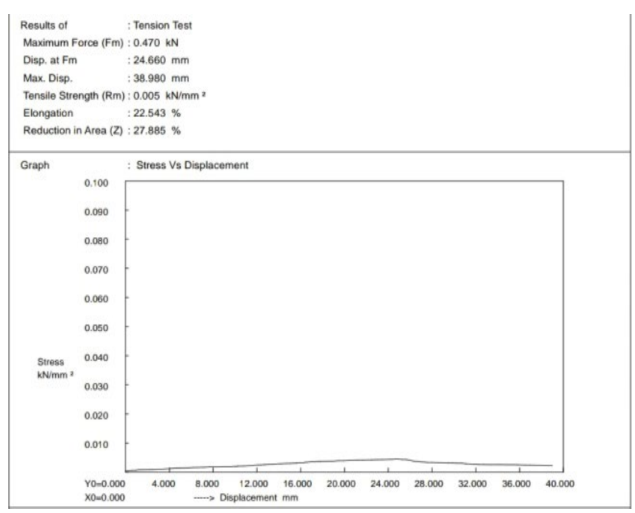

Fig. 17. Stress vs. Displacement

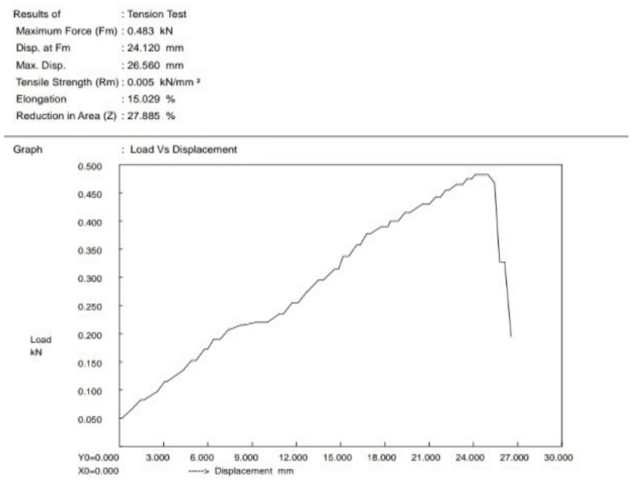

Fig. 18. Load vs. Displacement

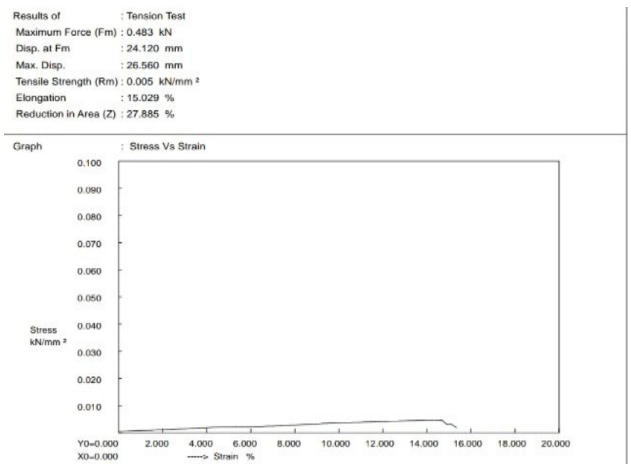

Fig. 19. Stress vs. Strain

2) *Short fibers*

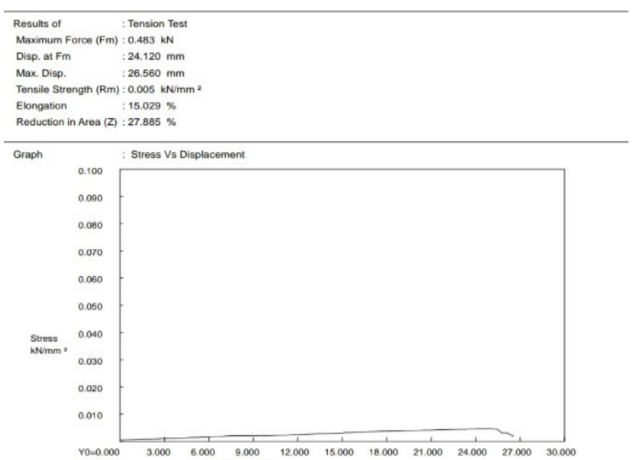

Fig. 20. Stress vs. Displacement

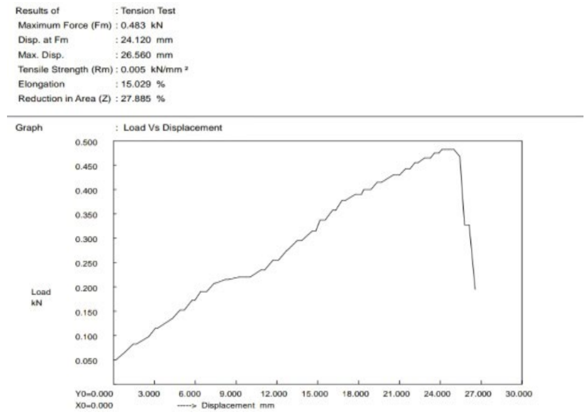

Fig. 21. Load vs. Displacement

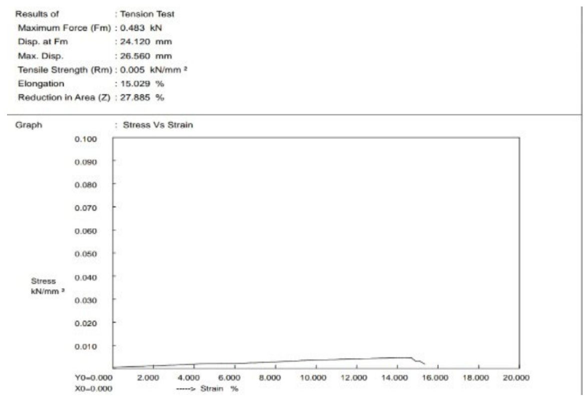

Fig. 22. Stress vs. Strain

3) *Random alignment*

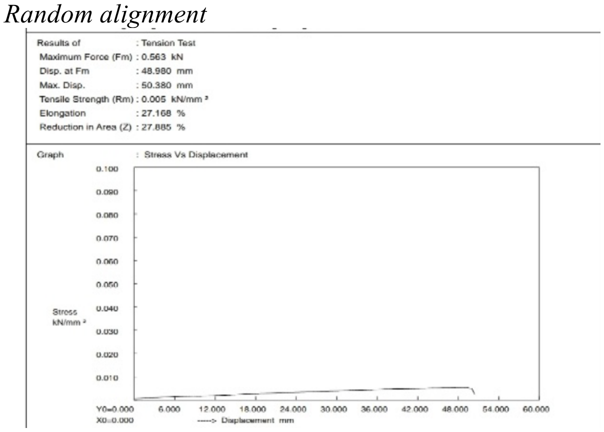

Fig. 23. Stress vs. Displacement

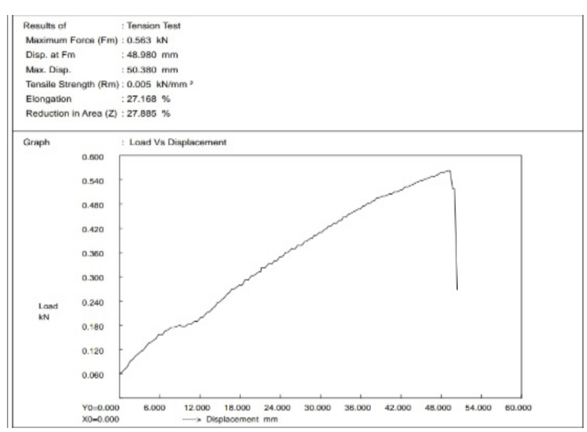

Fig. 24. Load vs. Displacement

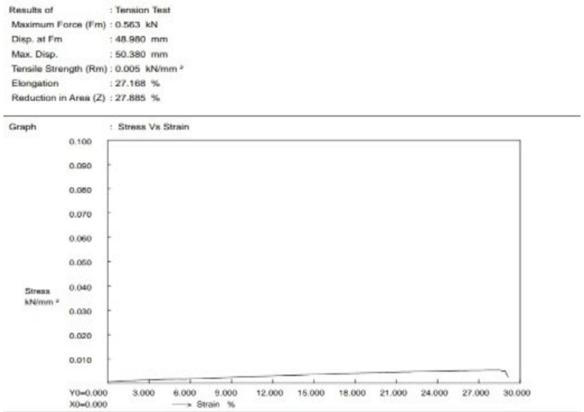

Fig. 25. Stress vs. Strain

4) *Zig zag alignment*

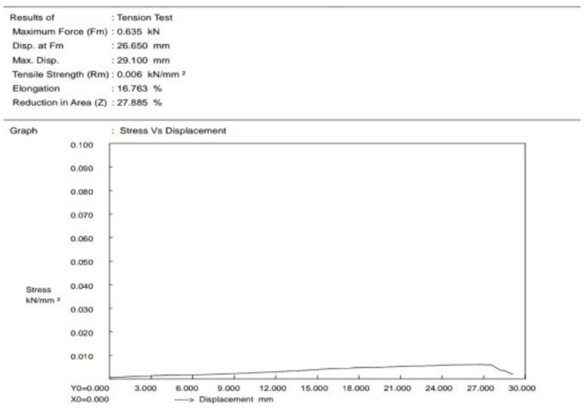

Fig. 26. Stress vs. Displacement

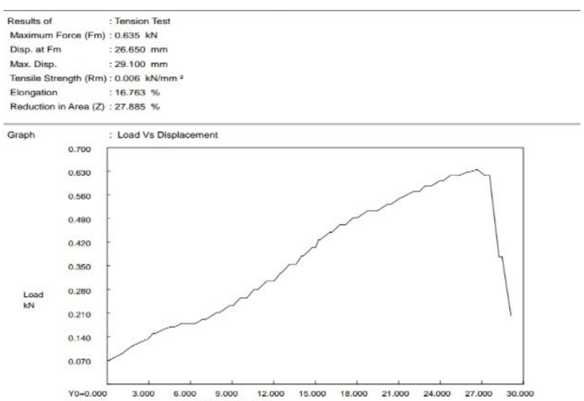

Fig. 27. Load vs. Displacement

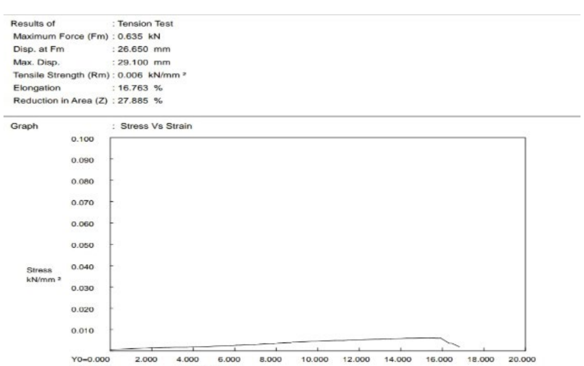

Fig. 28. Stress vs. Strain

5) *Straight fibers*

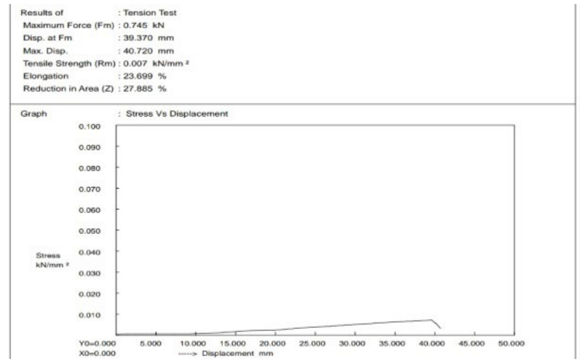

Fig. 29. Stress vs. Displacement

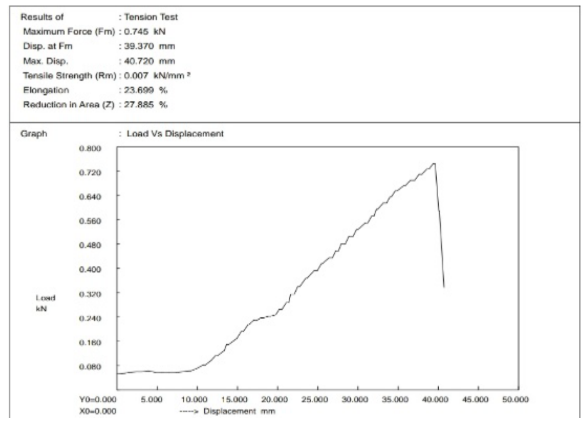

Fig. 30. Load vs. Displacement

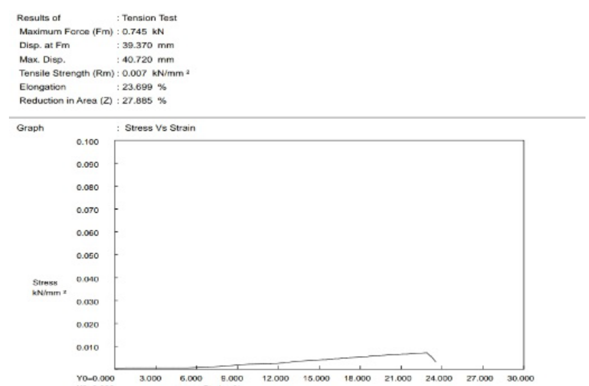

Fig. 31. Stress vs. Strain

C. *Maximum Range Reach by Each Sample in Tensile Test*

Table 1
Maximum range reach by each sample

S.No.	Alignment	Stress vs. Strain	Stress vs. Displacement	Load vs. Displacement
1	Empty	0.004	0.003	0.470
2	Random	0.004	0.005	0.580
3	Short	0.002	0.006	0.480
4	Zig-Zag	0.006	0.007	0.630
5	Straight	0.006	0.008	0.780

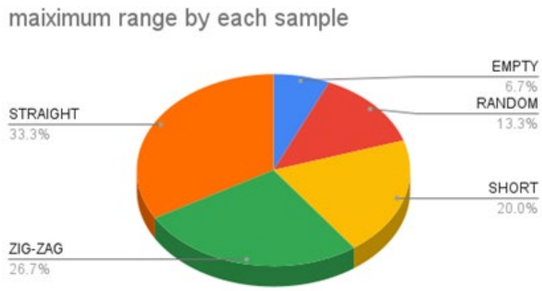

Fig. 32. Maximum range by each sample

D. *Impact Test*

Engineering materials' toughness, impact strength, and notch sensitivity can all be assessed using the impact testator forecast a material's behaviour under real-world circumstances, engineers test a material's capacity to withstand impact. On impact, at flaws/cracks, or at notches, many materials collapse abruptly. The most popular impact tests use a swinging pendulum to strike a notched bar; heights before and after impact are used to calculate the energy required to fracture the bar. The test item is held between two vertical bars while undergoing the Chirpy test. The test subject stands straight up like a fence post during the Izadi experiment.

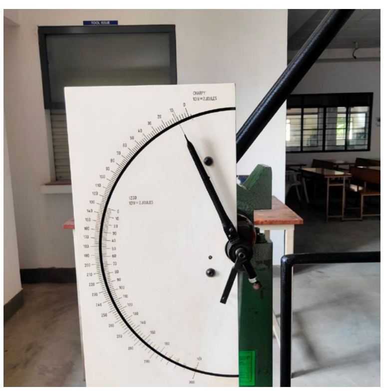

Fig. 33. Impact test machine

Tensile testing is a destructive testing method that provides information on the tensile strength, yield point, and ductility of metallic materials. It measures the force required to break a composite or plastic sample and the extent to which the sample stretches or stretches to its breaking point.

E. *Impact Test Results*

Table 2
Impact test results by each sample

S.No.	Alignment	Result Value
1	Zig-Zag	10
2	Random	8
3	Empty	5
4	Straight	19
5	Short	6.5

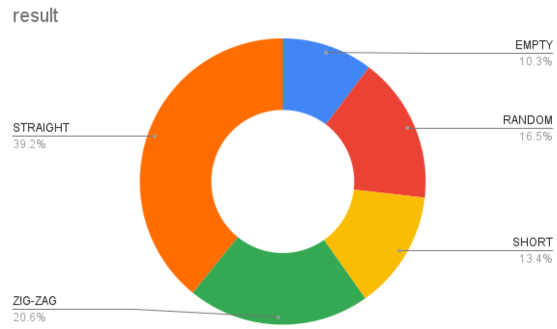

Fig. 34. Comparison of impact result of each sample

5. Conclusion

By arranging the coir with various alignment, the straightened coir has good impact level and also maintain good level with the stress and strain. So, the strength of the composite is comparatively good with other arrangements. The polyester is one of the lightest polymers. when compared to other natural fibre, coir fibre has very good tensile strength as well as flexural rigidity is very high which makes it more compatible for the fabrication process that helps in the application of the rubberize coir. The coir fibre is relatively waterproof and is the only natural fibre resistant to damage by salt water. Polyester act as a preventive material with metals. The fibre composite act as a covered material in submersible pump which increase the life time inside the water.

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