International Conference on Intelligent Technologies & Science - 2021
(ICITS-2021)

Optimization of Mechanical Properties of Shisham Wood Natural Fiber Composite

Ayaz Mahmood[1], Sadiq Husan[2]
Mechanical Engineering,
A.I.E.T., Lucknow, India
ayazm92@gmail.com, sdkans9@gmail.com

Abstract: In the current work, an effort has been made to fabricate the natural fibre hybrid polymeric composites using shisham wood powder, and talc powder. The hot press moulding process is employed to fabricate the different polymer composites by varying the fibre weight %. These fabricated composites have been named as , hybrid-filler polypropylene composites which are separately containing wood powder and talc powder. These fabricated specimens are further tested for their tensile, flexural, and impact properties. The experimental results have revealed that the fabricated polymeric composites can successfully be employed to produce stable and strong hybrid polymeric composites for their further industrial applications. The microstructure study of the tested samples has also been undertaken to study the behaviour of the material.

Keywords: Composites, Hybrid , Microstructure , Moulding , Natural Fibres , Talc , Wood.

1. Introduction:

A key factor driving the expanded utilizations of composites over the new years is the improvement of new progressed types of fiber built up materials. Fiber built up composites are lightweight, no-destructive, show great explicit strength and great firmness, are effectively developed, and can be custom fitted to fulfill execution necessities. Aside from these attributes regular filaments are as yet costly today as contrast with customary materials due to less request of items made from these fiber materials on account of less information on these strands applications. In any case, in present situation request is expanding because of expanded applications which will lead towards its less expense. Mechanical improvement generally relies upon headways in the field of designing materials. Alternately, in any field of attempt, the last obstacle, confronting consistent progressions, is with materials. Composite materials in such manner address nothing not exactly a monster step in the consistently steady exertion toward enhancement in materials.

Presently, the lightweight of composites that takes into account lower fuel utilization has expanded their utilization in a wide scope of 3 applications, remembering for the aviation, car, and rail areas. In the avionic business, the current accentuation on eco-friendliness favors the utilization of polymer network composites (PMCs) rather than aluminum and its compounds. Likewise, the creation of another class of airplane - miniature planes – has required a broad utilization of lightweight composites. In the car business, makers are perceiving the upsides of weight decrease, parts union, and plan opportunity that PMCs bear, So far, a large portion of the PMC materials utilized in various areas are chiefly manufactured utilizing thermosetting lattices. Be that as it may, thermosets have intrinsic hindrances like weakness, long fix cycles, and hard to fix and reuse harmed parts. These restrictions prompted the advancement of the thermoplastic grid composite framework. Contrasted and thermosets, composites created from thermoplastic materials normally have more time span of usability, more noteworthy strain to disappointment, fast union, amazing substance opposition, better damping qualities, low commotion discharge, and are repairable. Polypropylene (PP) is perhaps the most broadly utilized thermoplastic in industry because of its high substance and wear opposition, minimal expense, simple cycle capacity and magnificent mechanical properties. Regular strands become predominant options of engineered filaments as fortifications for polymeric composites because of their high flexural modulus and effect strength. Furthermore, normal strands are harmless to the ecosystem, biodegradable, richly accessible, inexhaustible with low thickness and modest. The biodegradability of regular strands can add to a sound environment while their minimal expense and elite satisfies the financial advantages of businesses. Uses of regular fiber based polymeric composites are found in such items as lodging development materials, furniture, and car parts. Pineapple leaf, oil palm fiber, hemp, sisal, Jute, kapok, rice husk, bamboo, and wood are a portion of the regular strands most ordinarily utilized as support materials in polymer composites.

2 Methodology:

The Dalbergia Sissoo tree is responsible for producing the popular sheesham wood that is commonly used in woodworking projects. Some people refer to this tree only as the sheesham tree, but others may know it as the tree that produces Indian rosewood. In other parts of the world, this tree is given many different affectionate nicknames, including the Himalaya Raintree, the Indian Dalbergia, and even the penny leaf tree. This deciduous tree is native to the Indian subcontinent and can be found in areas including Punjab, West Bengal, and Assam. The sub-Himalayan regions are home to the vast majority of these trees. However, you can also find it in other parts of the world, including Africa, Australia, and even parts of the United States.

When found in nature, this tree can produce beautiful pink and white flowers that are closely related to pea flowers. It also

produces a sort of dry fruit that comes with its own pale brown pod. The tree and its fruit are sometimes used to treat skin disorders and gastrointestinal upset in native lands. Despite these offerings, the most significant thing that the sheesham tree has to offer the world is its lumber. When found in nature, this tree can produce beautiful pink and white flowers that are closely related to pea flowers. It also produces a sort of dry fruit that comes with its own pale brown pod. The tree and its fruit are sometimes used to treat skin disorders and gastrointestinal upset in native lands. Despite these offerings, the most significant thing that the sheesham tree has to offer the world is its lumber.

Many woodworkers have been drawn in by the beauty of sheesham wood, but they aren't sure exactly how to incorporate it into their projects. The good news is that it is easier than ever to use sheesham for your next project. The durability of this hardwood species makes it ideal for building musical instruments, furniture, cabinets, desks, and so much more .

While sheesham is technically classified as a hardwood, most woodworkers will tell you that it is pliable. Once the wood has been dried and transformed into lumber,the boards tend to be resilient and have a great deal of flexibility. This is one of the many advantages of selecting sheesham wood.

Fig. 1: Shisham wood powder

3. Manufacture of Composite Fiber:

Assembling of Composites Hybrid composite of polypropylene lattice and shifting measure of coir and jute fiber were fabricated utilizing hot press strategy in a 2.54cm X 18.8cm X 0.8cm bite the dust as referenced in the past area. A water powered sort machine having greatest heap of 35kN and most extreme temperature of 3000C was used. The fiber stacking was differed at 5, 10,15, and 2 wt% with the proportion of jute to coir of 1:1. Fiber went slice to 3-5mm length. Initially required measure of fiber and PP were said something an equilibrium. Then, at that point to permit the expulsion of dampness, fiber and polypropylene were dried in a stove at 800C for 2 minutes prior to setting up every composite. for some situation they were blended appropriately in a compartment by applying heat from a hot plate. The use of warmth (much beneath the softening reason behind PP) during blending empower the fiber to follow with the PP granules. Since no extra glue had been utilized. The fiber and PP blend was then positioned inside the pass on. The fiber grid combination was permitted to press at 30kN pressing factor. The temperature was at first raised to 160oC and hold there for around 12-15 minutes, after that the temperature was raised to (180-185)0C relying upon the thickness required. The kick the bucket was cooled to room temperature, pressure was delivered and the composite were removed from the pass on. Since pressure temperature was higher than the softening mark of PP (1600C), the grid liquefied yet the fiber (dissolving point>2200C), the network softened yet the fiber (liquefying point>2200C) stayed flawless.

Fig. 2: Hot hydraulic press machine.

Table 1: Designation of Composites

S. no.	Composites	Natural Fibre Size (µm/ mm)	Composition
1	SWPPC -1	**300/0.3**	**Polypropylene (80%) +Talc powder (10%) +shisham wood (10%)**
2	SWPPC -2	**300/0.3**	**Polypropylene (75%) +Talc**

			powder (10%) +shisham wood (15%)
3	SWPPC -3	**300/0.3**	**Polypropylene (70%) +Talc powder (10%) +shisham wood (20%)**
4	SWPPC -4	**300/0.3**	**Polypropylene (65%) +Talc powder (10%) +shisham wood (25%)**
5	SWPPC -5	**300/0.3**	**Polypropylene (60%) +Talc powder (10%) +shisham wood (30%)**
6	SWPPC -6	**300/0.3**	**Polypropylene (55%)+Talc powder (10%) +shisham wood (35%)**

4. Result and Discussion:

All the obtained experimental results of hybrid filled PP composites for different properties are presented in the Table3 . The tensile strength and tensile modulus of the composites lie in the range of 32.78–37.30 MPa, and 940–1120 MPa, respectively. It has been perceived that the tensile characteristics of the SWPPC-1 hybrid polymer increased up to 10% of the volume fraction then gets decreased up to a certain limit and then further gets increased (from 33.60 MPa to 35.11 MPa) as the volume fraction increased.For sample SWPPC-2 the tensile strength increase.Maximum Tensile Strength for sample SWPPC-5 for composition **Polypropylene (60%) +Talc powder (10%) +shisham wood (30%) and** Minimum for sample SWPPC-6.

Fig. 3: Tensile specimen before and after testing

Table 2: Tensile strength of the samples

S.NO.	Composites	Trials	Tensile strength (MPa)	Avg.Tensile Strength (MPa)	Tensile Modulus (MPa)
1	SWPPC-1	1 2 3	33.26 33.58 33.97	33.60	960
2	SWPPC-2	1 2 3	35.54 34.80 35.00	35.11	1092
3	SWPPC-3	1 2 3	37.21 36.33 36.44	36.66	1015
4	SWPPC-4	1 2 3	37.23 36.56 38.12	37.30	1120
5	SWPPC-5	1 2 3	34.33 35.22 34.56	34.70	1060
6	SWPPC-6	1 2 3	32.11 33.78 32.45	32.78	940

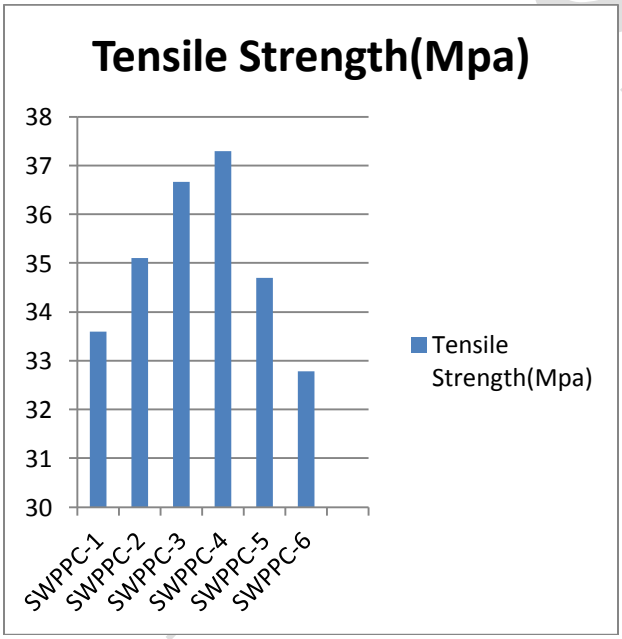

Fig 4: Tensile Strength Variation Graph Of The Samples

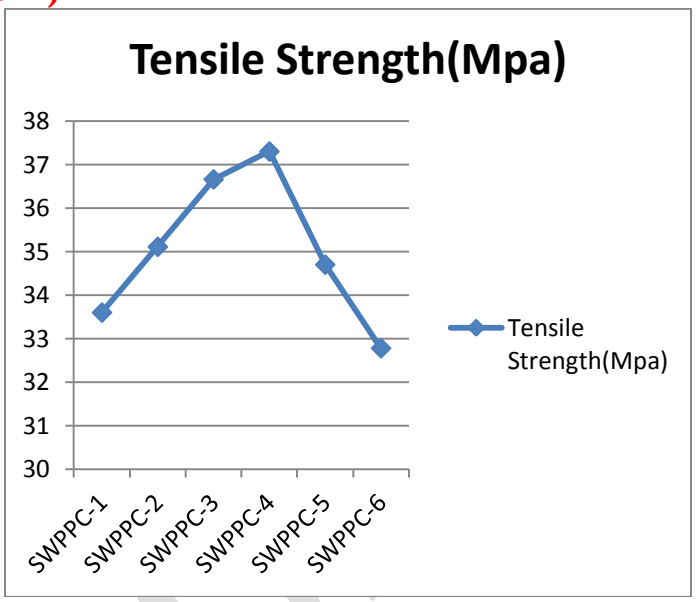

Fig 5: Tensile strength variation graph of the samples

5. Conclusion:

The tensile strength gets improved with the Shisham wood fiber for hybrid filled PP composites. Tensile strength increase with increase fiber loading from 10 to 25 wt% after than as fiber loading increase then tensile strength of composite decrease. For the tensile modulus of hybrid increase with fiber upto 25 wt% after that this decrease. Therefore, the surface of the talc structure comprises oxygen atoms, lacking the polarity of hydrophilic filler. Due to this surface nature, talk was more likely to have a better interfacial interaction with the PP matrix.

References:

[1].Bax, B. and Mussig, J. (2008) 'Impact and tensile properties of pla/cordenka and pla/flax composites', Composites Science and Technology, Vol. 68, No. 7, pp.1601–1607. Biswas, S. (2010)

[2].Processing, Characterization and Wear Response of Particulate Filled Epoxy Based Hybrid Composites, PhD thesis, NIT Raurkela, India. Fahim, I.S., Elhaggar, S.M. and Elayat, H. (2012)

[3]. Experimental investigation of natural fiber reinforced polymers', Materials Sciences and Applications, Vol. 3, No. 2, pp.59–66. Jawaid, M., Khalil, H.P.S.A. and Bakar, A.A. (2011)

[4]. 'Woven hybrid composites: tensile and flexural properties of oil palm-woven jute fibres based epoxy composites', Materials Science and Engineering: A, Vol. 528, No. 15, pp.5190–5195

[5]. Chawla K. K. Composite Materials: Science and Engineering: Springer, 1998.

[6]. Krevelen D.W. Properties of Polymers: Their correlation with chemical structure; their numerical estimation and prediction from additive group contributions: Elsevier, 2009.

[7]. Kutz M. Mechanical Engineers Handbook, Third Edition, John Wiley and Sons Inc., Hoboken, New Jersey, 2000.
[8]. Ashby M. F. Engineering materials and processes: Desk Reference.
[9]. Navas, S.C., Reboredo, M.M. and Granados, D.L. (2015) 'Comparative study of agroindustrial wastes for their use in polymer matrix composites', Procedia Materials Science, Vol. 8, pp.778–785
[10]. Malik P. K. Fiber reinforced Composites: Materials, Manufacturing and Design.
[11]. Chandra R, Singh S. P, Gupta K. Damping studies in Fiber reinforced composites: A review, pp. 41-51.
[12]. Malik P. K. Fiber reinforced Composites: Materials, Manufacturing and Design. 8. Lubin G. Handbook of Composites.
[13]. Kellenher P. G. Reinforced Thermoplastics: composition, processing and applications, 1993.
[14]. Biswas S, Satpathy A, A review on the natural fiber composites and their erosion wear characteristics.
[15]. www.engineeringtoolbox.com/polymer-composite-fibers-d-1226.html/01-05- 2012.
[16]. Nabi Saheib D, Jog J. P, natural fiber polymer composites: A review, Advances in polymer technology, 18(4), (2004), pp 351-363.
[17]. Kozlowski R and W-Pryzbylak M, uses of natural fiber reinforced plastics, Institute of Natural Fibers, Poznam, Poland.