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A REVIEW ON MECHANICAL PROPERTIES OF SAWDUST WITH POLYPROPYLENE NATURAL FIBER COMPOSITE

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Abstract: In this modern world , there has been a rapid growth in research and innovation in the natural fiber composite area. Natural fibers are being noticed by the reseachers and academician to utilize in polymer composite because of the ecofriendly nature and sustainability. The objective of this review paper is to provide a detailed review of the foremost appropriate natural fiber composite. The natural fiber composite shows various properties and different fiber structure with different fiber types. Maximum effort as gone into increasing the their mechanical properties of NFCs.

Index Terms **- NFC's , sawdust, polypropylene, mechanical properties**

INTRODUCTION

Due to increased environmental awareness, natural fibers have gained importance because of its unique properties like ease of availability, light weight, eco friendly , biodegradeable, renewable, strong, low density, and low cost. Materials such as sawdust can replace and reduce the utilization of plastic which relate with the environment issue and also offer other advantage . Saw dust is obtained from natural resources and in a large amount form wood industry as a waste. A large amount of sawdust are always found as a waste in wood industries like timber and furniture. Mixing sawdust with polymer in order to improve the mechanical properties of the composite can be very useful and valuable because of its high availability and low cost.

The main factors affecting mechanical performance of natural fiber composites are:

- Fiber selection
- Matrix selection
- Interfacial strength
- Fiber dispersion
- Fiber orientation
- Composite manufacturing process
- Porosity
- Weight percentage of matrix material and fiber
- Hybridization of fiber

FIBER SELECTION

Generally, much higher strength and stiffness are obtainable with the higher performance plant fibers than the readily available animal fibers. An exemption to this is silk, which can have very high strength , but is relatively expensive, has lower stiffness and is less readily available. Because of these reasons, plant based fibers the most suitable for the use in composites with structural requirements . The plant fiber can be grown in many countries and can be harvested after short periods.

Table 1:Mechanical properties of a nautral and synthetic fiber

Fiber	Density (g/cm3)	Length (mm)	Failure Strain (%)	Tensile Strength (MPa)	Stiffness/Young's Modulus (GPa)	Specific Tensile strength (MPa/gcm^{-3})	Specific Young's modulus (GPa/gcm^{-3})
Ramie	1.5	900-1200	2.0-3.8	400-938	44-128	270-620	29-85
Flax	1.5	5-900	1.2-3.2	345-1830	27-80	230-1220	18-53
Hemp	1.5	5-55	1.6	550-1110	58-70	370-740	39-47
Jute	1.3-1.5	1.5-120	1.5-1.8	393-800	10-55	300-610	7.1-39
Harakeke	1.3	4-5	4.2-5.8	440-990	14-33	338-761	11-25
Sisal	1.3-1.5	900	2.0-2.5	507-855	9.4-28	362-761	6.7-20
Alfa	1.4	350	1.5-2.4	188-308	18-25	134-220	13-18
Cotton	1.5-1.6	10-60	3.0-10	287-800	5.5-13	190-530	3.7-8.4
Coir	1.2	20-150	15-30	131-220	4-6	110-180	3.3-5
Silk	1.3	Cont.	15-60	100-1500	5-25	100-1500	4-20
Feather	0.9	10-30	6.9	100-203	3-10	112-226	3.3-11
Wool	1.3	38-152	13.2-35	50-315	2.3-5	38-242	1.8-3.8
E-glass	2.5	Cont.	2.5	2000-3000	70	800-1400	29

IMPORTANT PROPERTIES OF WOOD :

- Wood flour is abundantly available in nature.
- Density of wood varies form 1.10 to 1.20 g/cm^3.
- Due to low cost wood is highly attractive.
- Lowest installation costs, good durability, lowest maintenance cost.
- Lowest surface finishing cost, no need for painting, varnishing, polishing.

MATRIX SELECTION

The matrix is an important part of a fiber composite. It gives a barrier against unwanted environment, protects the surface of the fibers from mechanical abrasion and it transfer load to fibers. Commonly used matrix in nfcs are polymeric because they are light weight and can be processed at low temperature. Most of the natural fibers used for reinforcement in natural composite are thermally unstable above 200^{0}C, due to this limitation only thermoplastics that soften below this temperature such as PP, Polyethylene, polyolefin, Polyvinyl chloride and polystyrene and other thermosets.

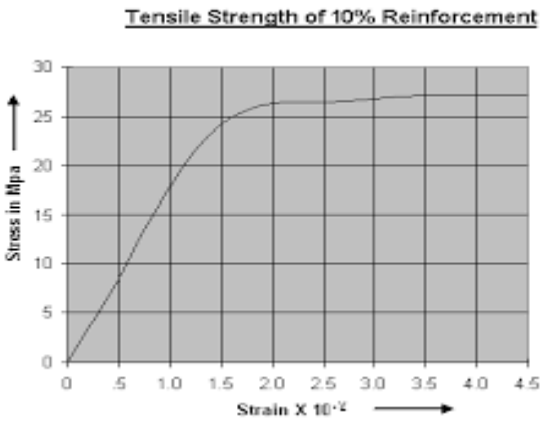
OUTLINE OF OUR RESEARCH WORK:-

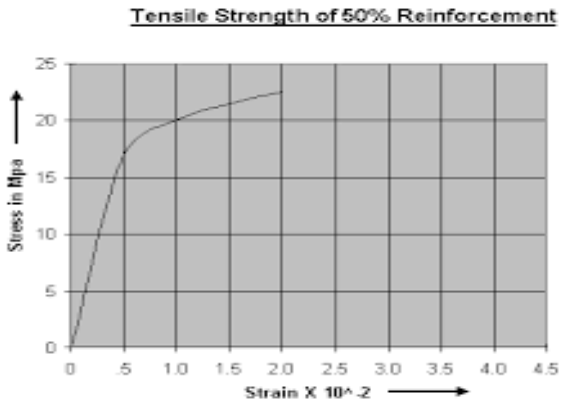
Many researchers have done a lot of research in the field of composite where they had taken many fibers such as sawdust, rice husk, jute fiber and many others. They had also varied base material or we can say matrix material like PP, Epoxy , etc. The main aim of the research work is to enhance the property of the matrix or to get the required property of the composite for the further use. For composite the researcher had varied the fiber weight percentage or the fiber volume percentage according to the requirement or to get the appropriate property. In many of the research the researcher had taken the more than one fiber in their composite material. Taking more than one fiber is called as Hybridization.

REVIEW OUTCOMES

There is a large amount of literature detailing the mechanical performance of NFCs using wood sawdust as a natural fiber.

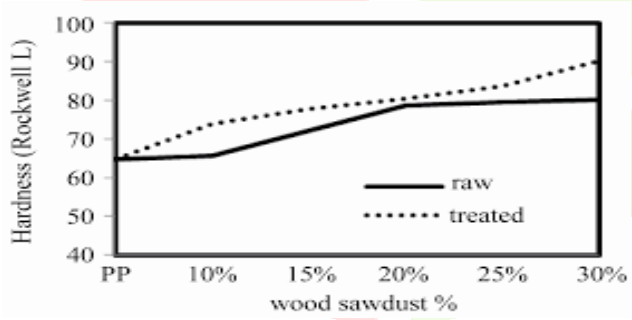
1. **Dr.K.C.Devendrappa , Guruchethan A M, Deviprasad N Mirashi , Suresh K S**: In this paper they had taken wood powder as natural fiber and PP as base material and preparing different composite by varying fiber weight percentage from 10% to 40%. On testing the result shows that the tensile strength of the composite was maximum at 10% fiber loading. On increasing fiber loading the tensile property of the composite start decreasing.

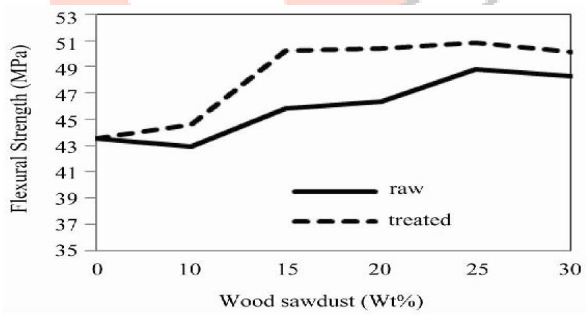




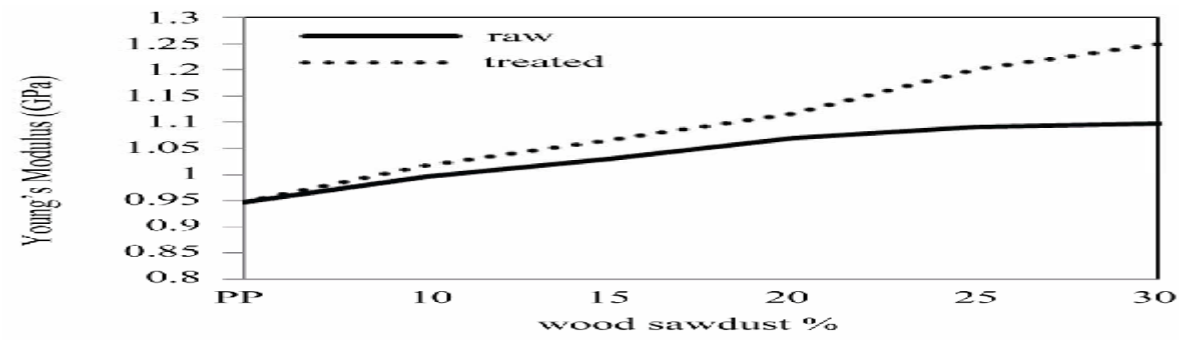
(a) tensile strength of 10 % reinforcement (b) tensile strength of 60 % reinforcement

2. **Muhammad Abdul Mun'aim Mohd Idrus, Sinin Hamdan, Muhammad Rezuar Rahman, Muhammad Saiful Islam :** They had taken different fiber loading percentage (10%,15%,20%,25%,30% by weight) with base material as PP. After mechanical testing , it was found that the properties like Flexural strength, Modulus of composite , Hardness, Water absorption increases with the increase in fiber loading.



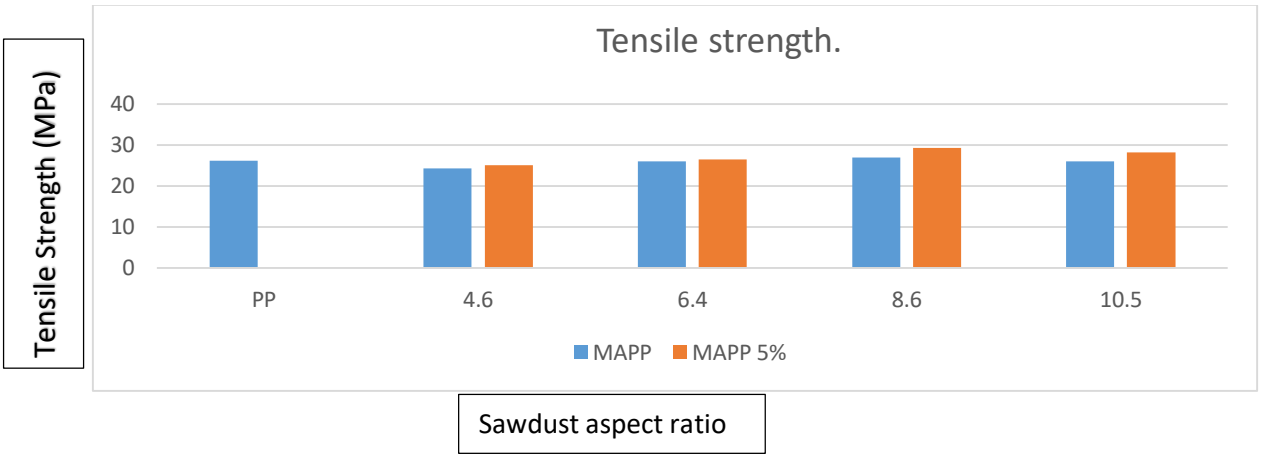


(a) hardness at different fiber loading (b) flexural properties of composite at different fiber loading

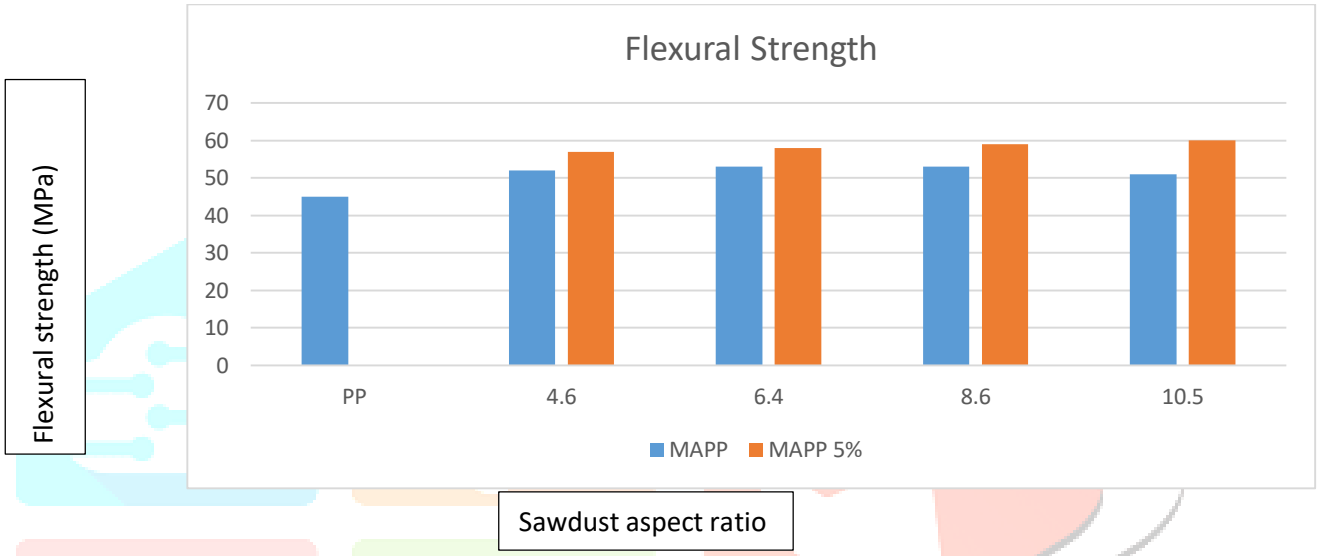


(c) young's modulus at composite at different fiber loading

3. **Jutarat Prachayawarakorn, Kanita Anggulalat, Songklanakarin :** Concludes that the Tensile property, Flexural property and Impact strength of the composite is higher when the aspect ratio (i.e L/D ratio) is higher. On varying fiber loading , the young's modulus of the compsite increases with the increase in fiber loading whereas Impact property of the composite does not influenced by fiber loading.

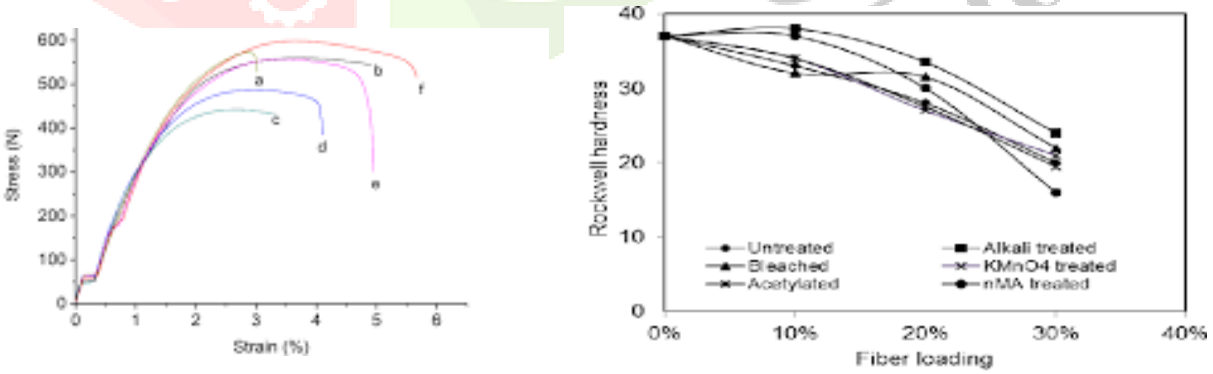


(a) the effect of sawdust aspect ratio at tensile strength



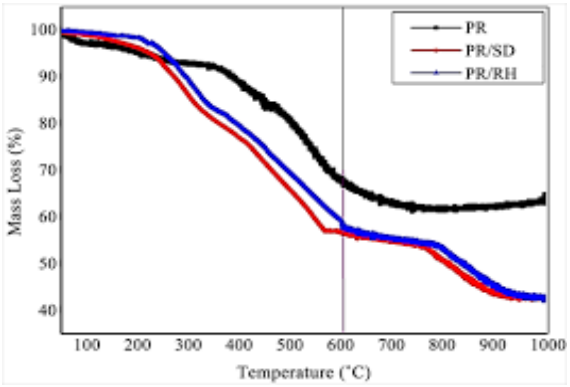
(b) the effect of sawdust aspect ratio at flexural strength

4. **G.M. Arifuzzaman Khan, M.Mahmudur Rahman, M. Islamul Haque, M.Ahsanul Haque , M. Helal Uddin, M.A.Gafur, M.Shamsul Alam :** Found that the Tensile strength of the composite is maximum at 10% fiber loading . On increasing the fiber percentage the tensile strength decreases.

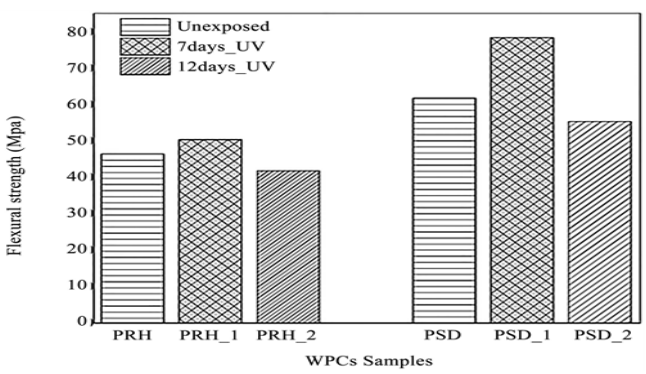


(a)stress strain curve of 10wt%sdf loaded composite (b) rockwell hardness c scale of 10wt% sdf loaded composite

5. Marieme Josephine Lette, Elhadji Babacar Ly, Diene Ndiayne, Akito Takasaki, Toshihiro Okabe: Compares the property of the composite made from the combination of saw dust with phenolic resisns and Rice husk with Phenolic Resins. It was found that both the component are thermally unstable. The tensile strength of the composite containing sawdust was more than the composite containg rice husk whereas the rice husk composite shows better water repulsion property.

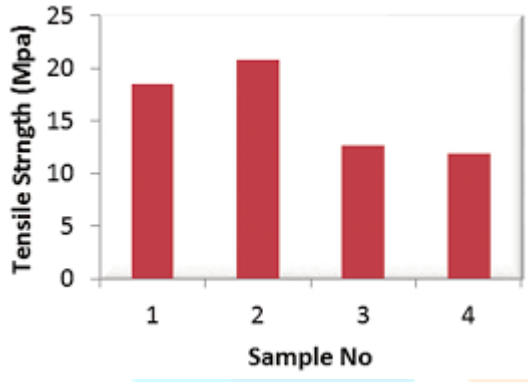


(a) tga curve of pr/sd,pr/rh and pr

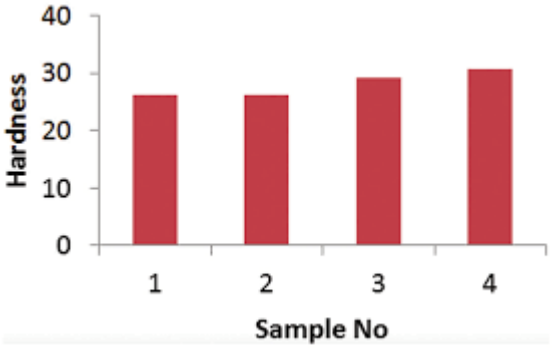


(b) flexural strength of pr/rh and pr/sd before and after 7 and 12 days

6.Moorthy M. Nair , K. Shambhavi Kamath , Nagaraj Shetty: Tested the mechanical property of the Epoxy based sawdust composite , it was found that the tensile strength of the composite drops with the increase in filler loading but the Hardness value is improved with the increase in filler percentage.



(a) Tensile strength of the composite samples



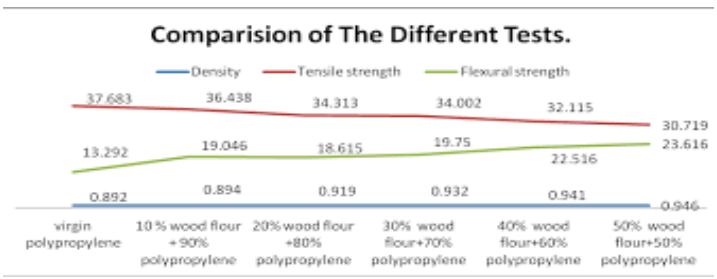
(b) Hardness value of the composite specimen

7. M.Vignesh ,S.Sathispathy ,L.Rubankumar , I.Praveen : Mixes the sawdust ash and PP in clay soil to stabilize the soil . On testing the soil it was found that the compressive strength of the soil increases at 15% of polypropylene and 15% of sawdust ash , Cohesion property is also enhanced at this fiber composition.

Table : 2- UCC test results on soil samples

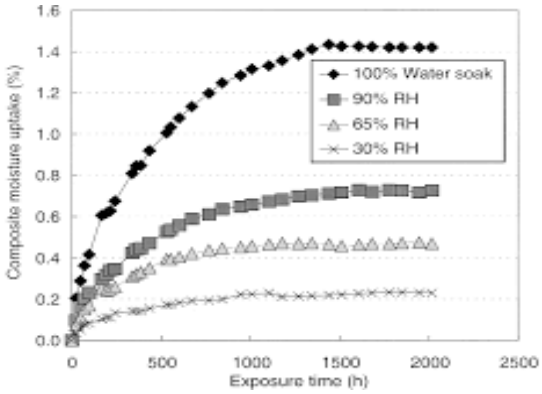
Additives	Compressive Strength	Cohesion
Clay soil (100%)	0.098	0.049
Clay soil (90%) + Polypropylene (10%)	0.114	0.057
Clay soil (90%) + Sawdust ash(10%)	0.103	0.052
Clay soil (70%) + Polypropylene (15%) + sawdust ash (15%)	0.129	0.064

8. Sonal Shireen Ranjan , Paroksh Prabhu Jain , Shubham Agrawal : Compounded the PP with the Wood flour at different fiber loading (10%,20%,30%,40%,50%) and concludes that the Tensile strength of the composite is maximum at 10% fiber loading. Flexural strength and density of the composite is maximum at 50% fiber loading.

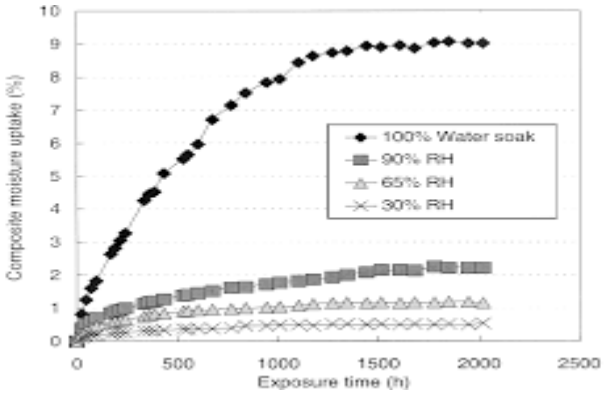


(a) comparision chart of different tests conducted

9. Nicole Stark: The wood four is mixed with the polypropylene at two different fiber loading i.e (20%,40%) . On testing the composite it was found that the composite is absorbing water and contains high moisture because of this property , the composite strength decreases. The tensile modulus also decreases.

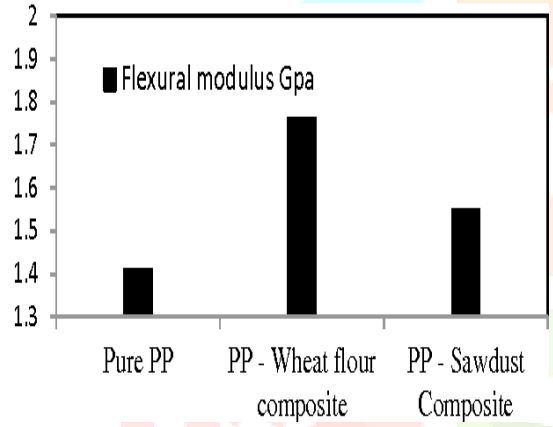


(a)moisture uptake of 20% wf composites

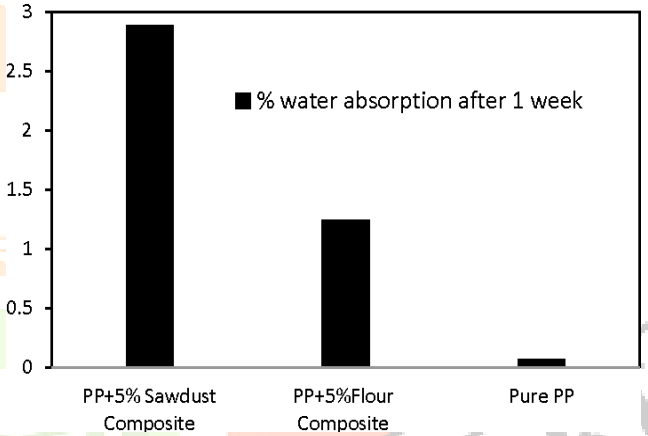


(b) moisture uptake of 40% wf composites

10.Takian Fakhrul, Rubayyat Mahbbub , M.A. Islam: Studied the property of sawdust (5% wt.) when combined with Polypropylene , it was observed that the water absorption by the composite and Flexural modulus of the composite is increased.

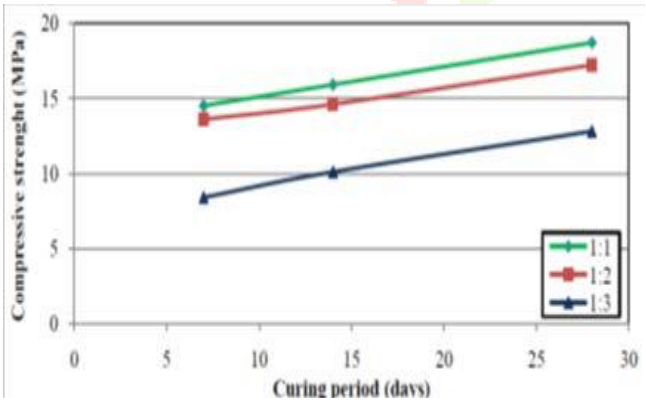


(a) flexural modulus of composite

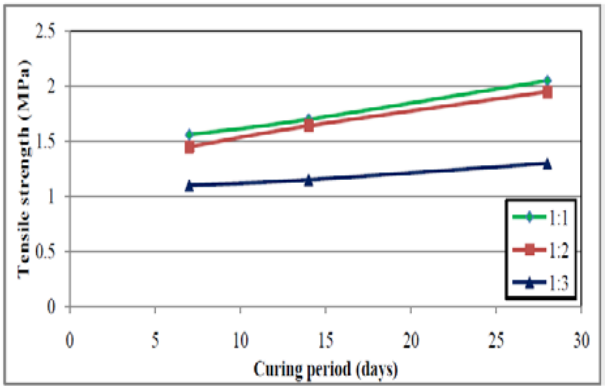


(b) water absorption by the composite

11. A.S.M. Abdul Awal , A.A.K. Mariyana , M.Z. Hossain: Combines sawdust with Concrete , on testing it was found that the water absorption and compressive strength of the composite increases but the tensile strength of the composite decreases.



(a) development of compressive strength of concrete

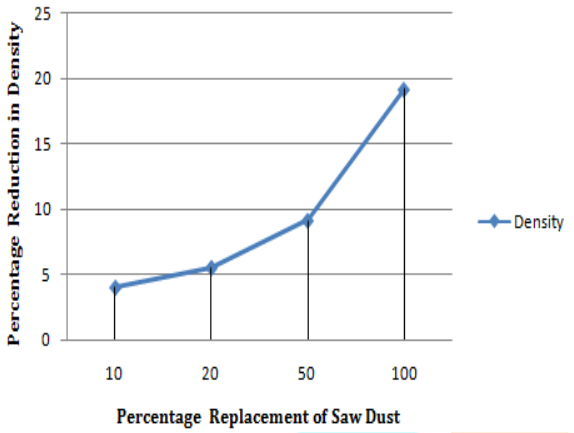


(b) development of tensile strength of concrete

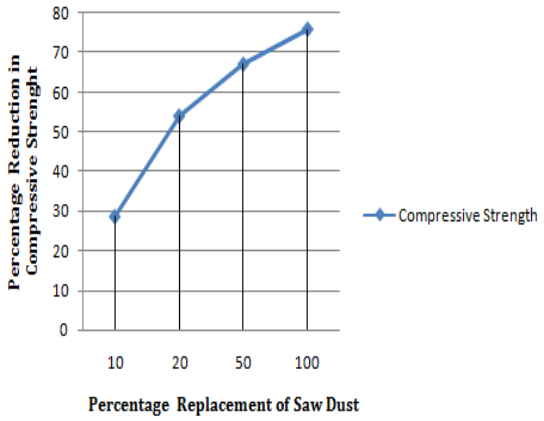
12. Mr. Tilak L.N , Mr. Santhosh Kumar M.B , Mr. Manvendra Singh , Mr. Niranjan : A composite material is prepared by replacing the sand with the sawdust in a concrete mixture at different volume percentage (10%,20%,50%,100% by volume) . When tested , the result shows that the compressive strength of the composite is maximum at 10% replacement , density of the composite is also maximum at 10% replacement and the density of the concrete increases with time.

table : 3- percentage reduction in compressive strength and density

Percentage Replacement sawdust	Density (%)	Compressive Strength (%)
10	4.02	28.54
20	5.54	53.95
50	9.15	67.10
100	19.20	75.92



(a) percentage reduction in density



(b) percentage reduction in compressive strength

CONCLUSION

1. It can be concluded that the Tensile property of the composite is maximum at low fiber loading , as the fiber loading increases the tensile property of the composite decreases.
2. Is has been seen that the flexural modulus and the flexural strength of the composite increases with the increase in fiber loading.
3. The compressive strength of the composite also increases with the fiber loading.
4. It has been found that the moisture content in the composite is higher in those composite which are having higher fiber loading.

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