Asian Journal of Engineering and Applied Technology
ISSN: 2249-068X (P) Vol.10 No.1, 2021, pp.1-7

DOI: https://doi.org/10.51983/ajeat-2021.10.1.2720

Mechanical Properties for Elephant Dung and its Utilization as a Raw Material Composites Sheet: A Study

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(Received 3 December 2020; Revised 23 December 2020; Accepted 25 January 2021; Available online 4 February 2021)

***Abstract* - Elephant dung is an excellent source of cellulosic fiber that is a basic requirement for paper making. But they contributed to very small percentage production of elephant dung. So, researchers are trying to find a new area of utilization of elephant dung fiber pulp as in reinforcement's polymer composite. In this experiment element dung fiber pulp in the natural fiber component chemically treated with alkaline and soda AQ solution in this study, it has been aimed to use elephant dung fiber pulp in composite material and to study mechanical properties of the produced material. The produced composite samples were then characterized using tensile test, Izod impact test, thickness test. The fracture surface of the polymer composite sample was also inspected with the help of SEM. The content of elephant dung fiber pulp is varied (35%, 45%, 55%) weight percentage whereas the epoxy resin is varied (50%, 40%, 30%) percentage is kept constant 15% in hardener. The entire sample has been tested in a universal testing machine as per ASTM standard for tensile strength and impact strength. It is observed that composite with 35% fiber pulp is having the highest tensile strength of 4mm 6.445 Mpa and 8mm 11.80 Mpa. The impact strength of composite with 35% fiber pulp washes highest than 45% to 55% dung fiber pulp. This produces composite sheet will be used for the surfboards, sporting goods, building panel this not only reduces the cost but also save from environmental pollution.**
***Keywords:* Elephant Dung, Fiber Pulp, Polymer, Tensile Strength, Impact Strength, FESEM**

I. INTRODUCTION

Economic use of agricultural by product is very limited and the good example of the elephant dung fiber. Elephant excrete as much as 50 percent of what they eat. That experts say, is normally between 200kg to 250kg of food a day, since their diet is all vegetarian, the waste produced is basically raw cellulose [1-2]. The large amount of elephant dung generated and disposal of elephant dung are the serious problems faced today. Normally, it is left over to dried and burned causing air pollution in the surrounding area. Moreover, during the rainy season, the waste from the camp will be washed into the main river resulting in a wide spread water pollution [3-4]. It might cause the long-term ecological problem since more elephant dung is dumped into the river. So, there is a need to propose a proper way to manage the elephant dung in order to prevent further damage to the surrounding environment [5-9]. Therefore, the aim of this study is utilized agricultural waste which may be profitable, pollution free and economically viable for the industries and herding. The bio waste has to solve environmental related issues and increase the income of herding. The bio waste has become interesting material to be used as resin forcement in polymer to develop green composite. Composite material depends on the properties of constituent material the fiber and resin used [10-15]. At present day, the advance composites material has been broadly used composite in the engineering field due to their noble mechanical properties. Advantages of this like as corrosion resistance, electrical insulation, more stiffness and strength, fatigue resistance lesser in weight than metal, easy process ability at less energy requirements in tooling and assembly costs widely acceptable in structure application. Which do not have a negative effect on the environment and they are biodegradable, full sustainable, environment friendly in nature. The composites produced today with the incorporation of natural fiber as resin forcement. In epoxy matrix are used for boat hulls, surfboards, sporting goods, building panel this not only reduces the cost but also save from environmental pollution.

II. MATERIAL AND METHOD

A. Elephant Dung to Composite Sheet Process

Cleaning and boiling are important stage in the composite sheet process. All non fiber materials such as pebbles, dirt, mud, leaves etc are removed as much as possible at this point so that all that remains is actual fiber material. Therefore, it needs to be cleaned in order to get pure pulp. After cleaning with water and put in the cooking pot. Make a solution of sodium hydroxide and soda anthraquinone pour the solution in the pot with fiber and boil 3 to 4 hours. The boiling process occurs at 90 to 100-degreecelsius in order to ensure that the protein-based cells of any bacteria are destroyed by extreme heat. After that, it will become pulp and we will wait for it to cool down and wash him with water three or four times, after that we will blend with the help of blending machine and then we will be squeeze with help of cotton fabric. After that the polyester resin and hardener mixed in a container and stirred well for 3 to 5 minutes. The elephant dung fiber pulp was then added gradually and stirred to allow proper dispersion of fiber within the gel like mixture. Before the mixture were poured inside the mould. The mould was initially polished with a release agent to prevent the composites from sticking to the mould upon removal. Finally, after the mixture has been poured into mould. It was left at for 3 to 4 day for fully cured and hardened [10].

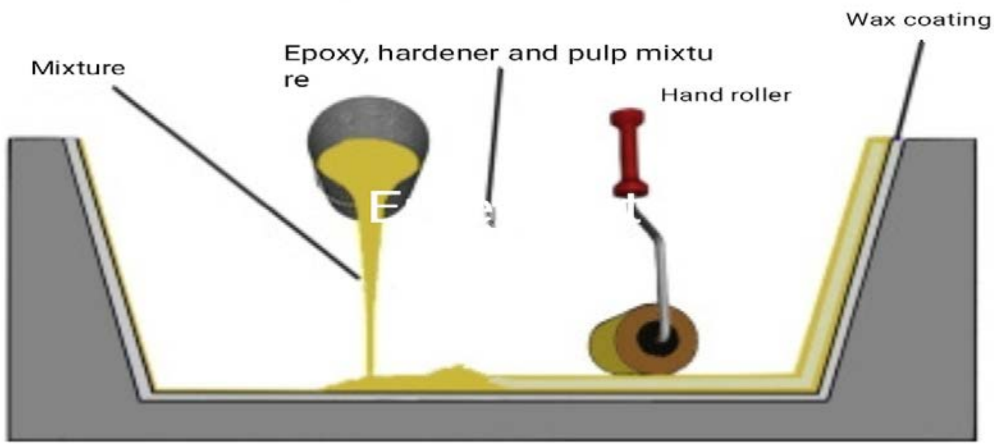

Fig. 1 Mould assembly

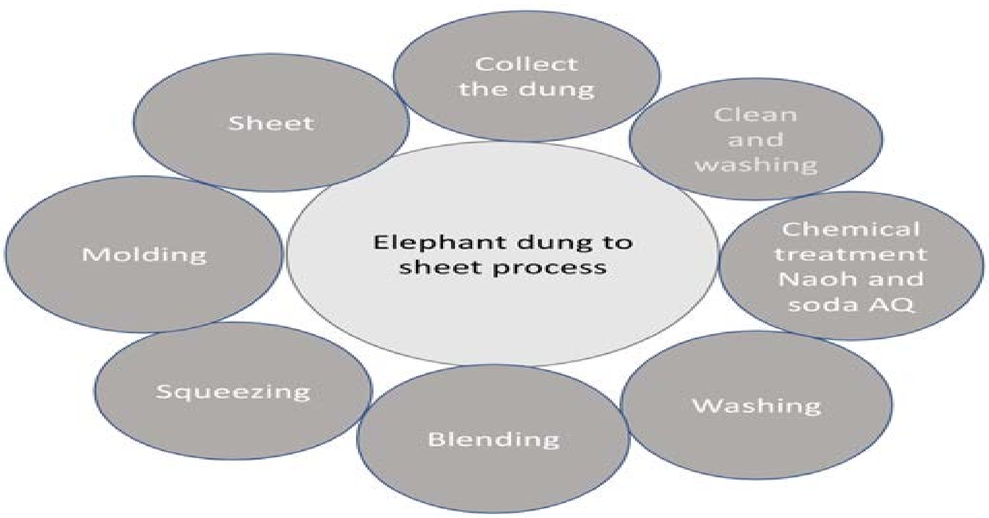

Fig. 2 Elephant dung to sheet process

Epoxy Resin: Epoxy refers to any of the basic components or cured end products of epoxy resins as well as a colloquial name for the epoxide functional group. Epoxy resins, also known as poly-epoxides, are a class of reactive prepolymers and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homo-polymerization or with a wide range of co-reactants including poly-functional amines, acids (and acid anhydrides), phenols, alcohols and thiols (usually called mercaptans). Epoxy-based materials are extensive and include coatings, adhesives and composite materials such as those using carbon fiber and fibreglass reinforcements (although polyester, vinyl ester, and other thermosetting resins are also used for glass-reinforced plastic).

The chemistry of epoxies and the range of commercially available variations allow cure polymers to be produced with a very broad range of properties. In general, epoxies are known for their excellent adhesion, chemical and heat resistance, good-to-excellent mechanical properties and very good electrical insulating properties. Many properties of epoxies can be modified (for example silver-filled epoxies with good electrical conductivity are available, although epoxies are typically electrically insulating). Variations offering high thermal insulation, or thermal conductivity combined with high electrical resistance for electronics applications [11].

Hardener: To convert epoxy resin to epoxy plastic a reaction takes place with a suitable substance.

B. Reason to Choose Elephant Dung

Burning dry elephant dung emits lots of carbon dioxide into the atmosphere causing environmental problem. Various attempts were made time to time to use this dung for giving villagers tangible benefits from the wild elephants which will ultimately help to mitigate the human. Elephant dung fiber pulp reinforced biodegradable polymers are the category of the composites in which dung fiber pulp is used as reinforcements.

There are lot of biodegradable polymer are available as polylaticacid (PLA), poly hydroxyl butyrate (PHB). A lot of research work has been done with the help of all these is a wide scope of research is there in future specially on the machining of these biodegradable polymer composites. Elephant dung pulp superior on light weight and environmentally friendly. After completing of usable life of product made up from green composite .Green composites are a renewable, environmentally friendly and biodegradable in nature [15].

Fig. 3 (a) Elephant Eating (b) Elephant Dung

Fig. 4 (a) Washing and Dry Elephant Dung (b) Composites Sheet

TABLE I SPECIMEN COMPOSITION

Sl. No.	Pulp ratio (%)	Thickness (mm)	Epoxy resin (%)	Hardener (%)
1	35	4	50	15
2	45	4	40	15
3	55	4	30	15
4	35	8	50	15
5	45	8	40	15
6	55	8	30	15

III. METHOD

Mechanical characteristics of composites sheet:

A. Thickness Testing: For measuring the thickness of a wire or a plate, calipers micrometer is used. Principal of the measurement of sheet thickness, the sample is kept between two plane parallel plate and a known arbitrary pressure is applied between the plates than the distance between the plates is measured precisely (figure 5).

Fig. 5 Thickness Tester

B. Tensile Strength Test: Tensile strength is the ability of material to resist the forces that pulls it apart or it is the resistance of material to breakage under tension. The tensile test was performed as per ASTMD- 638 standards. The test process involves placing the test specimen in the testing machine and slowly extending it until it fractures.

During this process, the elongation of the gauge section is recorded against the applied force. For tensile testing the specimen was cut as per the dimensions, detailed dimensions for this are shown in figure 6. The test was conducted using a universal testing machine (UTM). Two sample of each composite were tested and their mean values are taken.

Tensile strength = maximum load /Area of specimen

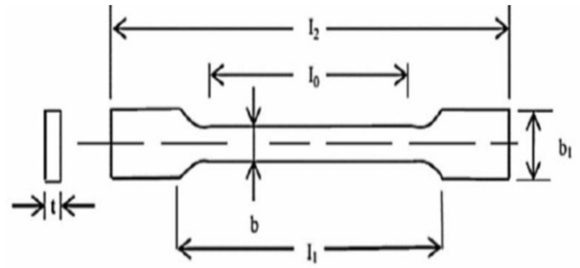

Fig. 6 Tensile Specimen Dimensions Shape

Fig. 7 Tensile Strength Specimen

Fig. 8 After Tensile Strength Testing

C. Impact Strength Test: Impact strength is the ability of a material to absorb impact energy without breaking. Impact test are performed to know the toughness of material. The specimen was subjected to a large amount of force for a small interval of time. A material with more impact energy will have more toughness. The impact was performed as per ASTMD – 256 standards. Impact strength testing the specimen was cut as per the dimensions; detailed dimensions for this are shown in figures 9-10.

Fig. 9 Impact Strength Instruments

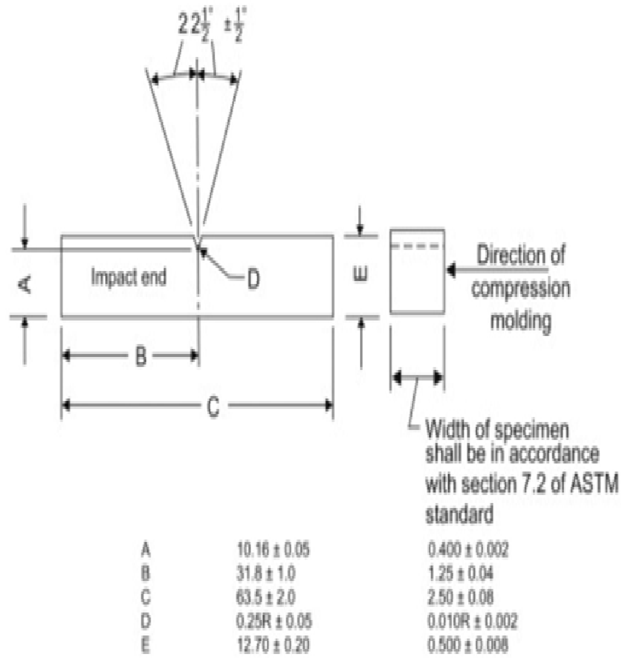

Fig. 10 Specimen Dimension Size

IV. RESULTS AND DISCUSSIONS

TABLE II TENSILE SPECIMEN DIMENSIONS

Sl. No.	Symbol	Description	Dimension(mm)
1	I0	Gauge length	145
2	I1	Grip distance	160
3	I2	Overall length	240
4	b	Width of narrow	15
5	b1	Width ends	30
6	T	Thickness	4,8

TABLE III SHEET THICKNESS TEST

Sl. No.	Dung Fiber Pulp Ratio (%)	Mean	Thickness (mm)
1	35	5.40,5.25,4.37,4.84,4.87, 4.64,4.23,5.13,4.15, 3.98	4.68
2	45	4.04,4.12,4.35,4.18,4.40, 4.52,4.97,4.30,4.44,5.11	4.44
3	55	3.97,4.02,4.11,4.09,4.26, 4.32,4.54,4.76,4.84,4.65	4.35
4	35	8.12,8.32,8.28,8.22,8.42, 8.65,8.77,8.56,8.58,8.90	8.48
5	45	8.11,8.80,8.76,8.42,8.24, 8.32,8.10,8.24,8.02,8.09	8.31
6	55	8.95,8.72,8.00,8.32,8.08, 8.07,8.02,8.04,8.37,8.12	8.26

TABLE IV SAMPLE GSM

Sl. No.	Thickness (mm)	Pulp Ratio (%)	Weight (gm)	GSM (g/m2)	Density(g/m^3)
1	4	35	137	4566	1.141
2	4	45	132	4400	1.100
3	4	55	126	4200	1.050
4	8	35	238	7933	0.991
5	8	45	229	7633	0.954
6	8	55	227	7566	0.945

TABLE V TENSILE STRENGTH RESULT

Sl. No.	Pulp Ratio %	Thickness (mm)	Tensile Strength 1(Mpa) ASTMD 638	Tensile Strength 2(Mpa) ASTMD 638	Mean Tensile Strength
1	35	4	6.915	5.980	6.445
2	45	4	5.421	4.460	4.940
3	55	4	3.150	2.900	3.025
4	35	8	12.90	10.70	11.80
5	45	8	10.59	11.13	10.86
6	55	8	5.690	7.920	6.805

A. Density for the Composite Sheet

1. The density testing was done on six composite plates and the results are noted in form of table IV.
2. As we can see that as pulp to resin ratio, when the percentage of pulp is decrease, we have increase in density of composites.
3. As per shows (figure 11) analysis of composite plate of density module of composites.
4. The decreases in pulp percentage give higher density as analyzed by the graph.

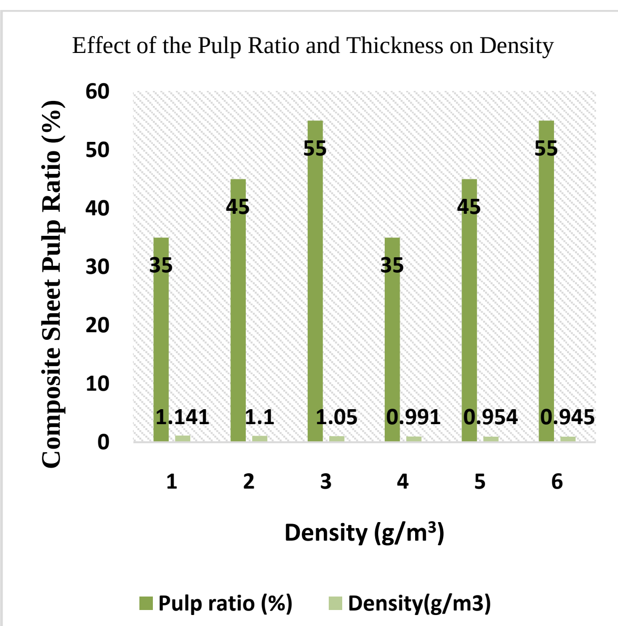

Fig. 11 Comparisons between Composite sheet pulp ratio & Density

B. Tensile Strength for the Composite Sheet

Six different types of composites sample are tested In DAK series 7200 machine name universal testing machine. Samples are lift to break till the ultimate strength occurs. In this table V is shown variations in tensile strength of different samples. The tensile testing was done on six composite sheets and results are noted in form of table 5. As per shown the below figure 12. It clearly analyzes the data which lead to highest tensile strength of composite sheet having composition of 35% pulp and 50% resin.

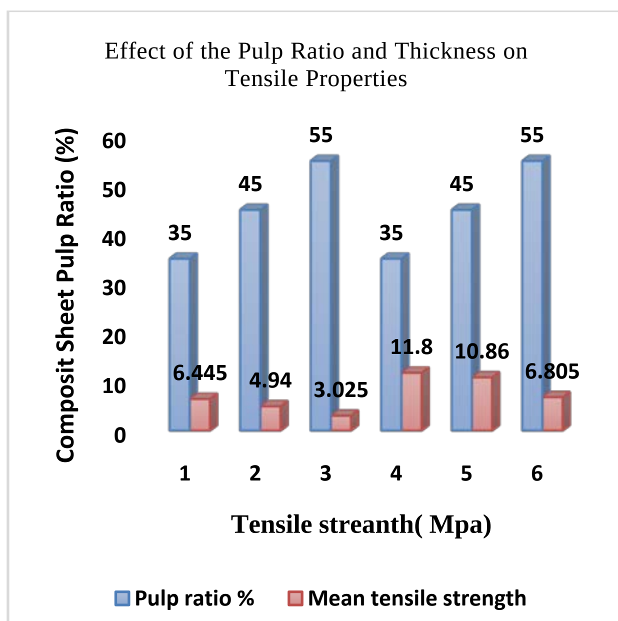

Fig. 12 Effect of the pulp ratio and thickness on tensile properties

TABLE VI IMPACT SPECIMEN DIMENSION

Sl. No.	Description	Dimension(mm)
1	Length of Specimen	63.5
2	Centering of notch	2.54
3	Radius of notch type V	0.25
4	Angle of notch	45°
5	Width	12.70
6	Thickness	4,8

TABLE VII IMPACT STRENGTH RESULTS

Sl. No.	Pulp ratio %	Thickness (mm)	Impact 1(kj/m^2) ASTMD 256	Impact 2(kj/m^2) ASTMD 256	Mean impact energy
1	35	4	1.88	1.90	1.89
2	45	4	1.55	1.45	1.50
3	55	4	1.27	1.22	1.24
4	35	8	3.07	3.02	3.04
5	45	8	2.05	1.89	1.97
6	55	8	1.83	2.52	2.17

C. Impact for the Composite Sheet

The impact capability of sample impact test is carried out using Izod – charpy digital impact testing machine. Absorbed energy obtained for six different composite samples from the machine. The table VII shows the variation in impact strength of different samples.

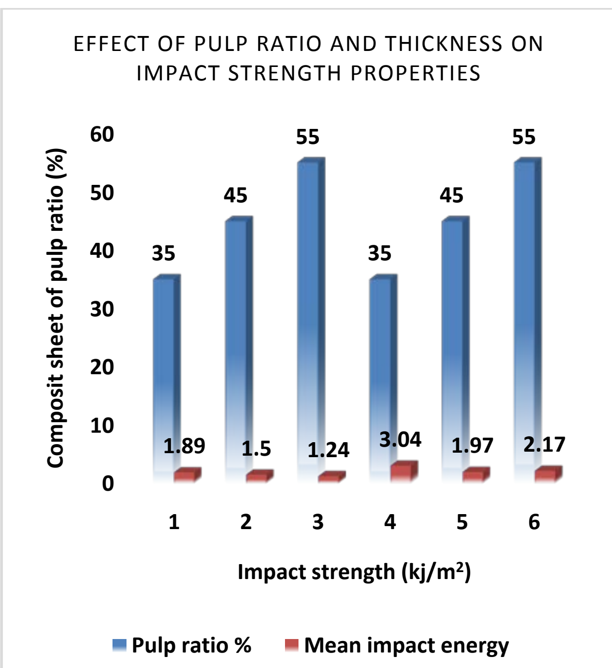

Fig. 13 Effect of pulp ratio and thickness on impact strength properties

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster scan pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image. The signals produced by SEM result from interaction of the electron beam with atom at or near the surface of the sample SEM can produce very high-resolution images of a sample surface revealing details about less than 1 to 5 min in size due to the very narrow electron beam. SEM micrographs have a large depth of field yielding a characteristic three-dimensional appearance. It is useful for understanding the surface of a sample shown below figures 14 (a, b).

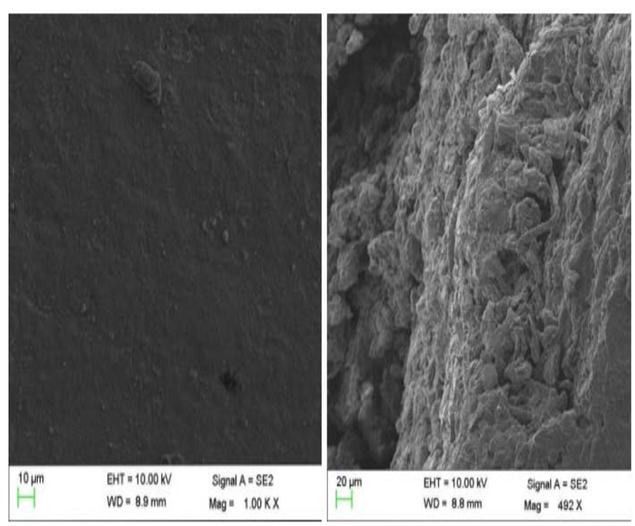

Fig. 14 (a) SEM image of elephant fiber pulp reinforce epoxy composites image

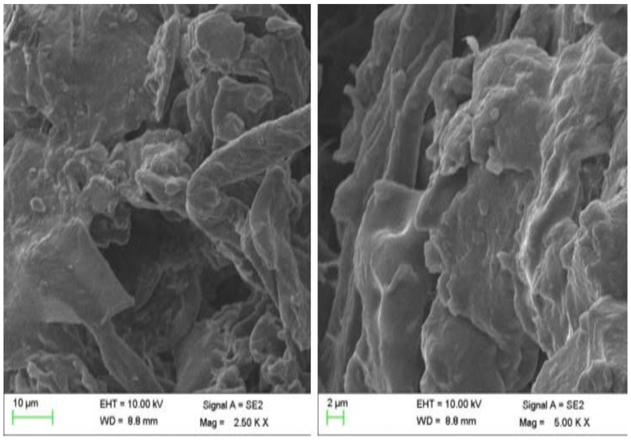

Fig. 14 (b) SEM image of elephant fiber pulp reinforce epoxy composites image

V. CONCLUSION

The results of the work show that a useful composite with good properties could be successfully development using elephant dung pulp as reinforcing agent for the polymer of composites tensile strength and impact strength. This process leads to finding the optimum composition and methodology to manufacture such a composite material. This study involves mechanical characterization of properties of elephant dung pulp epoxy resin composites. Experimental and analytical observation of pulp or resin composites leads to following.

1. The decrease in pulp percentage gives higher density of composites sheet.
2. As we can see that as pulp to resin ratio, when the percentage of pulp is increasing, we have decrease in tensile strength.
3. The decrease in pulp percentage gives higher impact strength of composite sheet.

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