Experimental Investigation on the Properties of Polymer Matrix Composites Reinforced with Single Use Waste Plastics & Agave Americana Fiber

Mr.A.Balakumaran[1], Mr.N.S.Mohan[2], Mr.M.Logesh[3], Mr.K.Manojkumar[4], Mr.S.Muthukumar[5], Mr.R.Sudharsan[6]

[1,2]*Assistant Professor, Department of Mechanical Engineering, Erode Sengunthar Engineering College, Erode, Tamilnadu, India -638057*

[3,4,5,6] *UG Student, Department of Mechanical Engineering, Erode Sengunthar Engineering College, Erode, Tamilnadu, India -638057*

***Abstract*— Evolution of Biodegradable Plastics had delivered down using non-biodegradable plastics, however nevertheless there's no right answer furnished for the poisonous plastics that we have been using these much of days. The main motive of doing this research is to get rid of the dumping of single use PET bottles. Non-biodegradable plastics are deserted with none reuse, making it as a landfill. The use of Pulverization technique for processing the waste plastics gets rid of the opportunity of pollutants resulting from the heating of plastic. Waste plastics are dropped into the pulverizing machine that converts the plastic bottles into granules or powders. Then those powders are combined with reinforcement material i.e., Agave Americana Fiber together with epoxy resin and hardener. The combination will then be poured right into a space out of which the desired product with required measurement may be obtained. Various samples according to ASTM requirements are pepared and their mechanical properties (tensile, impact, flexural and hardness), and microstructural research can be carried out.**

Index Terms: **Hybrid composites, Mechanical properties, Microstructure, PET bottles, Pulverization.**

1.INTRODUCTION

Natural fiber-strengthened polymer (NFRP) composites are the rising fashion of fabric utilized in automotive, constructing and packaging industries. Natural fibers play an enormous function with inside the improvement of decomposable inexperienced substances which facilitates to clear up ecological and environmental issues. Engineers, scientists, and producers are attracted via way of means of herbal FRP considering that they're biodegradable, non-toxic, light-weight and comparatively stronger. In addition to that herbal fiber composite are cost-effective, have exact thermal insulation properties, plentiful in nature and higher formability.

2. POLYMER MATRIX COMPOSITE

Polymer matrix composites (PMCs) are present in almost all aspects of modern life - from gadget components to a vast selection of automotive accessories. Derived from its name, meaning many repeating units, polymers are often made up of branches of carbon and hydrogen chemically linked together to make a chain.

Polymer matrix composites are materials made up of fibers that are embedded in an organic polymer matrix. These fibers are introduced to enhance selected properties of the material. Polymer matrix composites are classified based on their level of strength and stiffness into two distinct types:

i. Reinforced plastics - confers additional strength by adding embedded fibrous matter into plastics

ii. Advanced Composites - consists of fiber and matrix combinations that facilitate strength and superior stiffness. They mostly contain high-performance continuous fibers such as high-stiffness glass (S-glass), graphite, aramid, or other organic fibers.

3. PROPERTIES OF A PMC

Matrix - This is the polymer, that is a non-stop segment and is assessed because the vulnerable hyperlink in a PMC structure.

Reinforcement - This is a discontinuous segment and is a foremost load-bearing component. It can both be glass, quartz, basalt, or carbon fiber.
place.

Interphase - The interphase among the reinforcement and matrix levels in which load transmission takes

4. MATERIAL USED

a.Agave Americana Fiber
b. single use waste plastic

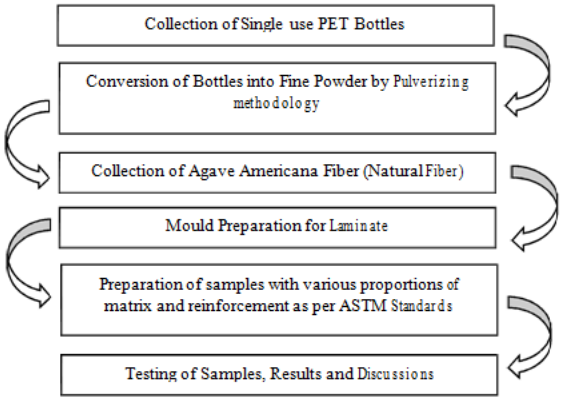
4.1 SINGLE USE WASTE PLASTIC

Single-use plastics are items which can be made in most cases from fossil fuel–primarily based totally chemicals (petrochemicals) and are supposed to be disposed of proper after use—frequently, in mere minutes. Single-use plastics are maximum normally used for packaging and provider ware, including bottles, wrappers, straws, and bags.
Single-use plastics are an obtrusive instance of the issues with throwaway culture. Instead of making an investment in high-satisfactory items with a purpose to last, we frequently prioritize comfort over sturdiness and attention of long-time period impacts. Our reliance on those plastics method we're gathering waste at a brilliant rate. We produce three hundred million heaps of plastic every 12 months worldwide, 1/2 of that is for single-use items. That's almost equal to the load of the whole human population.

4.2 AGAVE AMERICANA FIBER

Agave Americana fibers run alongside the duration of the plant leaves and are a part of the vascular system. These fibers may be extracted from leaves the use of numerous techniques as defined through Zwane and Cloud. Fiber extraction may be performed via mechanical and chemical processing. Agave Americana fibers are characterized through low density, excessive tenacity and excessive moisture absorbency in evaluation with different leaf fibers. These fibers are lengthy and biodegradable. Therefore, we are able to appearance this fiber as a sustainable useful resource for production and technical applications

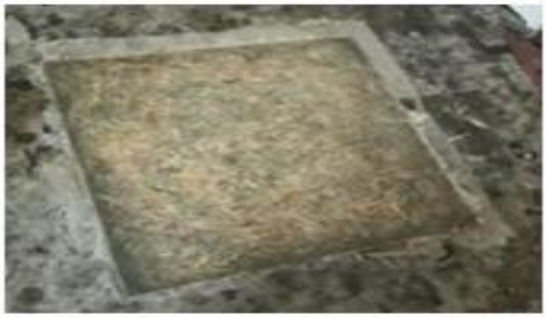
5. METHODOLOGY



6. COMPRESSION MOULDING

Compression moulding is a fairly easy procedure concerning urgent or squeezing a deformable cloth price among halves of a heated mold and its next transformation right into a moulded component after cooling or curing. Here we making use of stress approximately 1500psi and temperature approximately 900^0 to 1000^0 C.

Composition 1



Composition 2

7. TESTING SAMPLES

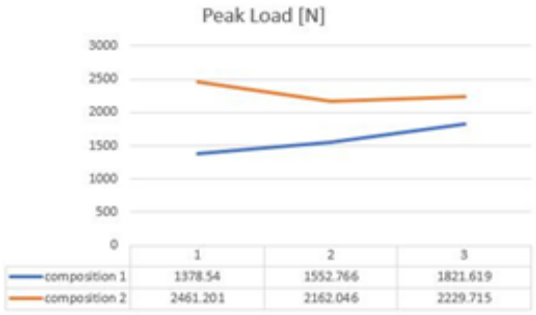
7.1.TENSILE TEST

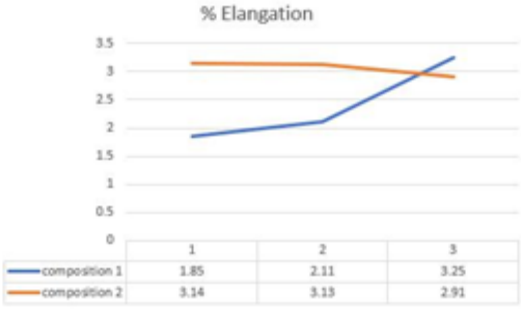
Tensile checking out, additionally called anxiety checking out, is a essential substances technological know-how and engineering take a look at wherein a pattern is subjected to a managed anxiety till failure. Properties which are immediately measured thru a tensile take a look at are remaining tensile strength, breaking strength, most elongation and discount in area. From those measurements the subsequent houses also can be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardening traits. Uniaxial tensile checking out is the maximum normally used for acquiring the mechanical traits of is otropicsubstances. Some substances use biaxial tensile checking out. The essential distinction among those checking out machines being how load is carried out at the substances.

Composition 1

Composition 2

SAMPLE NO.	CS AREA [MM2]	PEAK LOAD[N]	%ELONGATION	UTS[N/MM2]
1	150	1378.540	1.850	9.192
2	150	1552.766	2.110	10.350
3	150	1821.619	3.250	12.145
4	150	2461.201	3.140	16.412
5	150	2162.046	3.130	14.411
6	150	2229.715	2.910	14.862





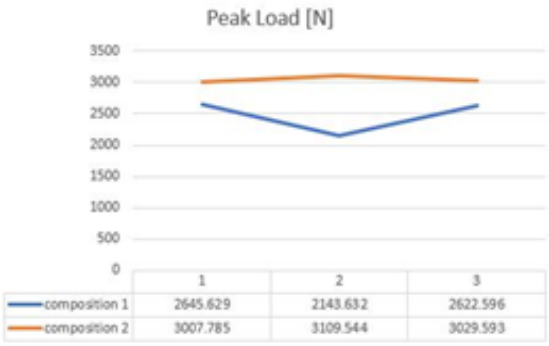
7.2. COMPRESSION TEST

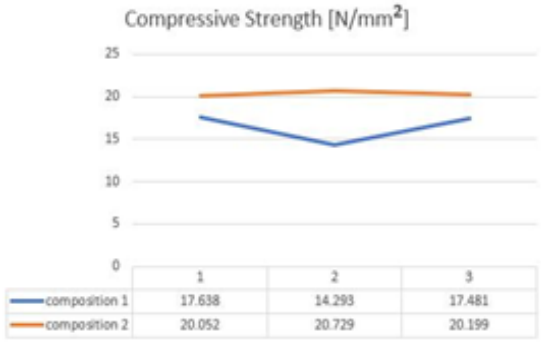
Compression trying out is a totally not unusual place trying out technique this is used to set up the compressive pressure or weigh down resistance of a fabric and the capacity of the fabric to get better after a precise compressive pressure is implemented or even held over a described length of time. Compression exams are used to decide the fabric behaviour below a load. The most pressure a fabric can preserve over a length below a load (steady or progressive) is determined. Compression trying out is frequently accomplished to a destroy (rupture) or to a restriction. When the take a look at is completed to a destroy, destroy detection may be described relying at the sort of fabric being tested. When the take a look at is completed to a restriction, both a load restriction or deflection restriction is used.

Composition 1

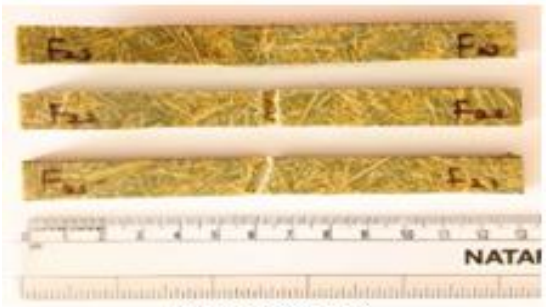
Composition 2

SAMPLE NO.	CS AREA [MM2]	PEAK LOAD[N]	COMPRESSIVE STRENGTH[N/MM2]
1	150	2645.629	17.638
2	150	2143.632	14.293
3	150	2622.596	17.481
4	150	3007.785	20.052
5	150	3109.544	20.729
6	150	3029.593	20.199



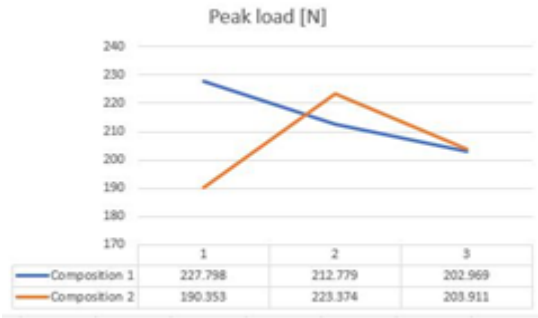


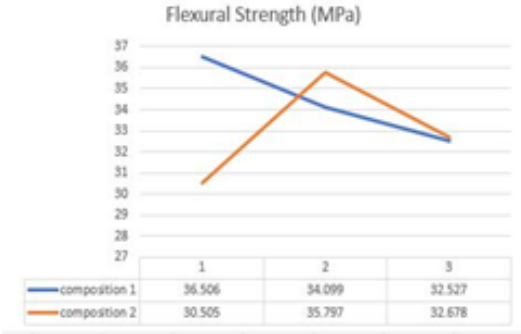
Composition 1



Composition 2

SAMPLE NO.	CS AREA [MM2]	PEAK LOAD [N]	FLEXURAL STRENGTH (MPA)	FLEXURAL MODULUS (GPA)
1	150	227.798	36.506	2605.380
2	150	212.779	34.099	2340.767
3	150	202.969	32.527	2200.955
4	150	190.353	30.505	2550.303
5	150	223.374	35.797	2528.123
6	150	203.911	32.678	2254.084





7.3. FLEXURAL TEST

The check approach for undertaking the check typically includes a targeted check fixture on a established trying out machine. Details of the check preparation, conditioning, and behavior have an effect on the check results. The pattern is positioned on helping pins a fixed distance apart.

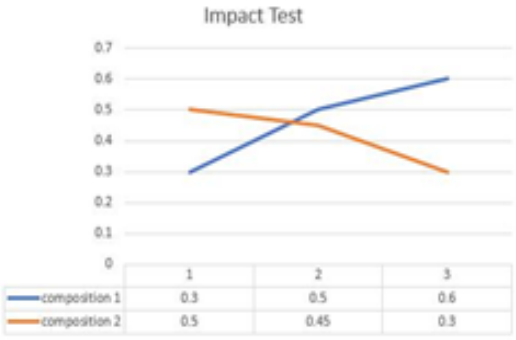
7.4. IMPACT TEST

The Izod effect electricity check is an ASTM trendy technique of figuring out the effect resistance of materials. A pivoting arm is raised to a particular height (consistent capability electricity) after which released. The arm swings down hitting a notched pattern, breaking the specimen. The electricity absorbed with the aid of using the pattern is calculated from the peak the arm swings to after hitting the pattern. A notched pattern is normally used to decide effect electricity and notch sensitivity.

Composition 1

Composition 2

S. NO	IZOD IMPACT VALUE IN J FOR 6MM THICKNESS
1	0.30
2	0.50
3	0.60
4	0.50
5	0.45
6	0.30



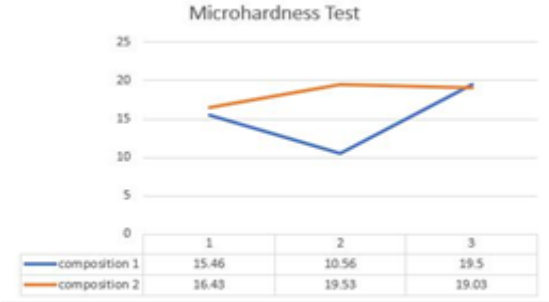
7.5. MICRO-HARDNESS TEST

The Vickers hardness check became evolved in 1921 with the aid of using Robert L. Smith and George E. Sandland at Vickers Ltd as an opportunity to the Brinell technique to degree the hardness of substances. The Vickers check is regularly less difficult to apply than different hardness checks on account that the specified calculations are impartial of the scale of the indenter, and the indenter may be used for all substances regardless of hardness. The primary principle, as with any not unusual place measures of hardness, is to study a material's capacity to withstand plastic deformation from a general source. The Vickers check may be used for all metals and has one of the widest scales among hardness checks. The unit of hardness given with the aid of using the check is called the Vickers Pyramid Number (HV) or Diamond Pyramid Hardness (DPH). The hardness range may be transformed into gadgets of pascals, however ought to now no longer be pressured with pressure, which makes use of the identical gadgets. The hardness range is decided with the aid of using the weight over the floor place of the indentation and now no longer the place regular to the force, and is consequently now no longer pressure.

Composition 1

Composition 2

S. NO	MICRO HARDNESS (VICKERS) HV (H)	AVERAGE HV (H)
1	16.2	15.46
2	15.0	
3	15.2	
4	9.2	10.56
5	11.5	
6	11.0	
7	20.2	19.50
8	19.1	
9	19.2	
10	18.0	16.43
11	15.4	
12	15.9	
13	20.3	19.53
14	18.1	
15	20.3	
16	18.5	19.03
17	17.6	
18	21.0	



8. CONCLUSION

The polymer matrix composite was reinforced with Agave Americana Fiber and single-use waste plastic. We utilised waste plastics in powdered form by employing a plastic pulverising machine, which does not pollute the environment. As a result, it aids in the reuse of plastics while also reducing pollution. With two different proportions of reinforcement materials we ended up in making two laminate composition 1 and composition 2 structures out of which composition 2 resulted in better mechanical properties, which means that as the proportion of single use waste plastic increases the composite laminate process better strength.

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