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Mechanical properties of recycled natural composite material with polyester

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ABSTRACT

One of the most critical environmental problems currently available is waste and the method of disposal,therefore, it has become necessary to find appropriate ways to get rid of them. The purpose of this research is using waste natural composite materials as base materiales to manufacturing new composite materiales and study a mechanical properites of it. The waste natural composite (saws dust, walnut peels with polyester) are ground into small particles (9.5 mm, 4.75 mm and 2.36mm). After that,the particles was mixed with polyester (10, 15, and 20% mass fraction). Compression static test used to investigate the mechanical properties. From experiment result that the elastic modulus of polyester was increases (improve) when adding 10% particales from the waste natural composite , the elastic modulus increase by 30% ,35.5% and 40% when adding 10% particles from Peels walnuts with 2.36mm,4.75mm and 9.5mm respectively and increases by 40% ,30% and 3% when adding 10% particles with 2.36mm,4.75mm ,9.5mm respectively from saws dust

KEYWORDS

recycling waste , natural fibers, composites

INTRODUCTION

Thousands of tons of composites, including natural composites, are manufactured every year, and are used in so many applications as automotive and renewable energy manufacture. Fiber of Natural composites has become widespread in recent years, although there are many successful applications of it, Recycling of composite materials is an important primary issue at the end of life of composite materials these material because it difficult to know behavior of these material after recycled. So many researchers studied to solve this problem. Agunsoye J. O. et. al.[1] studied mechanical properties and tribological behaviour of recycled polyethylene/cow bone particulate composite. Specimens prepared by changing (the cow bone) by changing particles ratio from 5wt% to 25 wt% with 5 wt% interval using the way compression method..The mechanical properties and scanning electron Microscopy (SEM) was investigated. the Wear were happened on the composite material by using pin with diffetent speed on disc machine , time and load. The results shows the tensile strength and the values of hardness of the composite increases with increased in wt% cow bone particles while the impact strength and rigidity decreased.

E Jime´nez-C. A. et. al.[2] Recycled(polypropylene compounds) were prepared from chicken feathers prepared by extrusion process .the density, thermal, morphological and thermo-mechanical properties of the preparation specimens were evaluatedThe composite material has a lower density. The transition temperature of composite material remained unaltered when compared with polypropylene compounds. Zaineb M. et. al. [3] investigated mechanical properties of recycled plastic waste with the polyester. Waste of PET and HDPE were used after its' cutting in as (fibers and particles) and then mixed with polyester. The specimens were tested (tensile and compression) test. It is show the To reduce the material it can bear, on the other hand the strain in most tests increased, but is considered it an important way for waste disposal a safety way and harmless to the environment and useful at the same time. Polypropylene composites reinforced with differently treated bagasse and straw fibers (10 and 20 wt%/PP) [4] were obtained through melt mixing using a high-intensity thermo kinetic mixer and were subsequently injected. The analysis of variance used to evaluating mechanical properties of these materials. The recycled materials show decreased tensile strength relative to the original composite materials.

Due to the natural composite waste recycling, the price of the products can be reduced and it saves the environment and reduces solid waste, the aim of paper stuided the behavior (mechainical properties) of composite materials (after Recycling) and most importantly , Recycling will ultimately lead to resource and reserve energy. Yong Lei et. al.[5] studied Composites setup recycled (HDPE) and natural fibers (wood and bagasse) were made through melt blending and compression molding. The effects of the fibers and coupling agent (type and concentration) on the composite properties were studied. The modulus and impact strength of the composites had maxima with MAPE content increase. The composites had lower crystallization peak temperatures and wider crystalline temperature range than neat RHDPE, and their thermal stability was lower than RHDPE. This work included added partical of waste natural composite materials (saws dust, walnut peels) to polyester resin with difereny partical size and different weight fraction to finding the mechanical properites

EXPERIMENTAL METHOD

The main purpose of this experiment is to dispose of waste safely and in a healthy way, as well as recycle and use this waste. Therefore, samples were taken from Natural waste composite (which made from two type of fiber saws dust and walnut peels with polyester resian) are crushed then grinded to get small particles which classified into three sizes [6,7,8] (9.5 mm, 4.75 mm and 2.36mm). where are used three sieves to classify the particles as in figures (1).

Figure 1. Sieves to isolate the particles

The partical are mixed with polyester with(20,15, 10%) weight fraction ratio [9,10]. After mixing polyester with various particles, it is poured into special mold[11,12] to obtain samples for static compression tests according to the specifications for compression ASTM- (D695M-89). In this work ,the dimensions used for compression test (cylindrical specimens) Lo/do are 1.5 to 3. where used length and diameter respectively (36 and 18 mm) .as shown in figure 3 in figure (2) [13,14]

Figure 2. The test specimens of polyester mixing with particles

The compresion tests are held in the laboratories University of Mustansiriyah - College of engineering and The test machine which used of (LARRY) The speed was set to 2 mm/min [15] brand as shown in the figure (3).

Figure 3. Compression machine (LARRY brand) to test sample

RESULTS

As shown in Figures (4 to 12), the practical results presented in the stress and strain curves. The results were represented in the compression test for particles (2.36 mm in size) mixed with polyester with two particles (saw dust and walnut peels) by ratio 10% compared to pure polyester, it can see that when adding 10% of the particles with size (2.36mm) improve the elastic modulus from 4.28 Gpa to 5.6 GPa when adding walnut peels and to 6 GPa by adding saws dust, meaning that it increased by 30% and 40% respectively, as well as the stress failure of pure polyester 103 Mpa decreased in very simple proportions (7,3) % when adding 10% of (saw dust and walnut shells) respectively. The elastic modulus of samples was reduced by a mixing ratio of 15% from particles (4.75 mm and 9.5 in size) to 3.6 GPa when adding saws dust [16,17]. The minimum failure stress is happened when adding 20% of the particles (9.5 mm size) from saws dust ,where the stress is 58 Mpa and the elastic modulus is 3.7 GPa All results for all samples are shown in table (1) and (2)

Table 1. Results for stress – strain curves for pure polyester

Sample	Failure stress MPa	Maximum strain	Elastic Modulus (E) GPa
Pure polyester	103	0.065	4.28

Table 2. Results for stress – strain curves for pure polyester with particles different samples

Sample		Saw dust			Peels walnuts		
Particles ratio %		Failure stress MPa	Maximum strain	Elastic Modulus (E) GPa	Failure stress MPa	Maximum strain	Elastic Modulus (E) GPa
2.36 mm	10%	96	0.035	6	100	0.04	5.6
	15%	89	0.013	4.5	90.6	0.017	4
	20%	71	0.015	4.5	79.3	0.012	4.6
4.75 mm	10%	93.5	0.0117	5.6	95.7	0.0165	5.8
	15%	77.8	0.014	4.2	72	0.0115	3.6
	20%	66.5	0.0113	4.4	70	0.0125	3.2
9.5 mm	10%	82	0.0145	4.4	89	0.0115	6
	15%	62	0.011	4	66	0.0118	3.6
	20%	58	0.01	3.7	61	0.0115	3.6

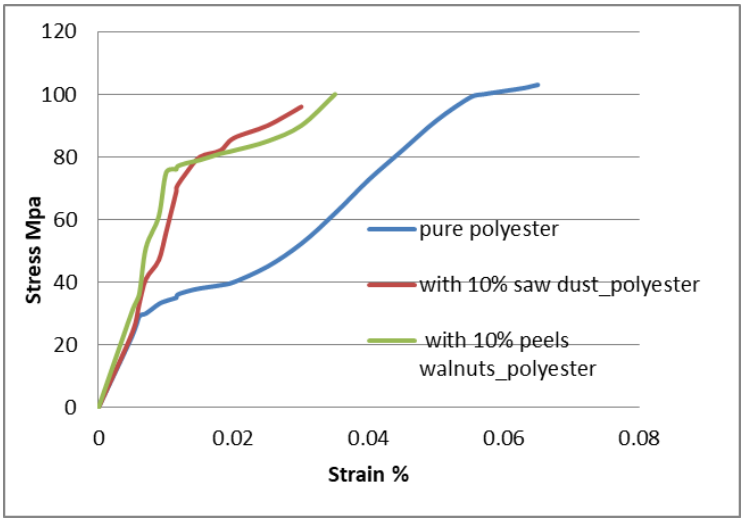

Figure 4. Stress – strain curve for compression test for 10 % from 2.36mm particles mixed in polyester

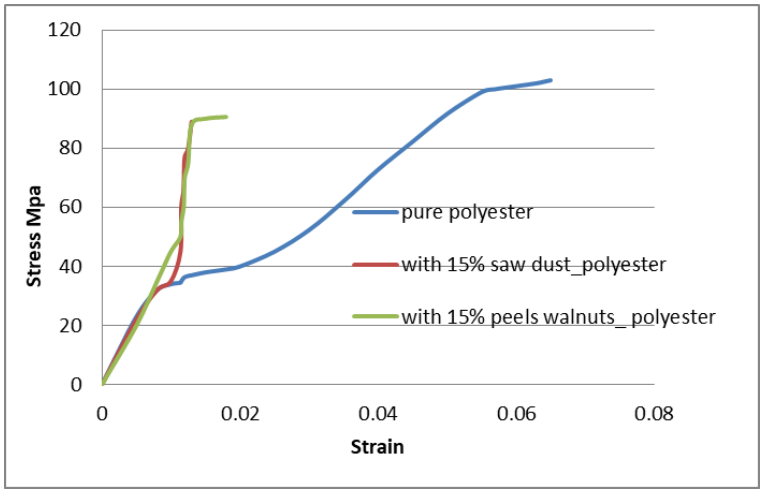

Figure 5. Stress – strain curve for compression test for 15 % from 2.36mm particles mixed in polyester

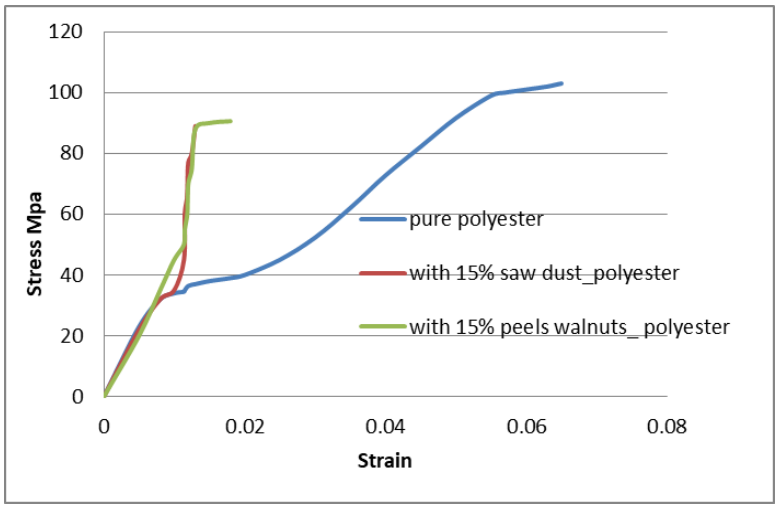

Figure 6. Stress – strain curve for compression test for 20 % from 2.36mm particles mixed in polyester

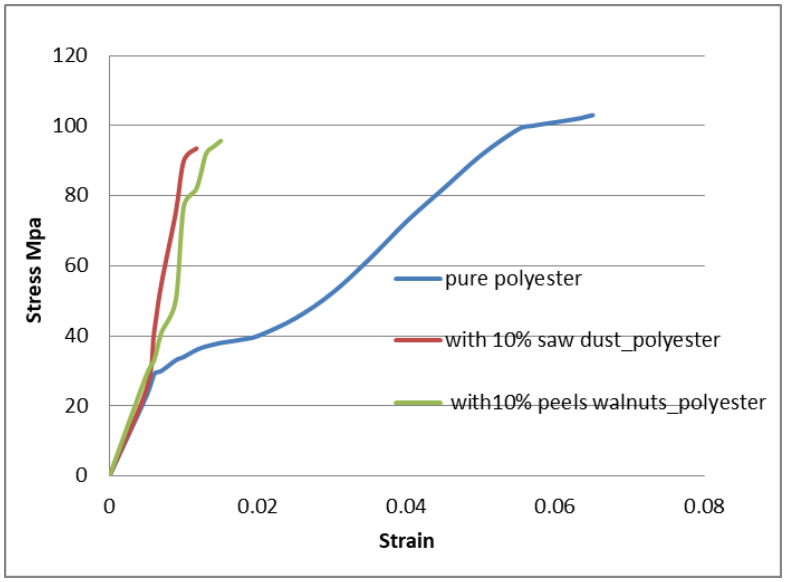

Figure 7. Stress – strain curve for compression test for 10 % from 4.75 mm particles mixed in polyester

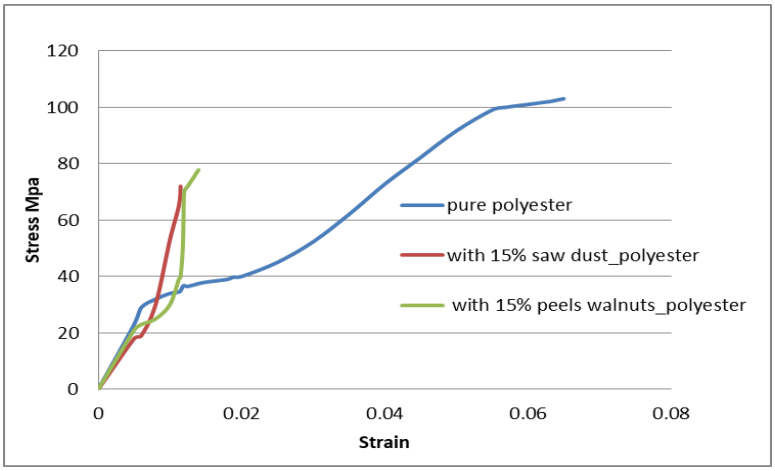

Figure 8. Stress – strain curve for compression test for 15 % from 4.75 mm particles mixed in polyester

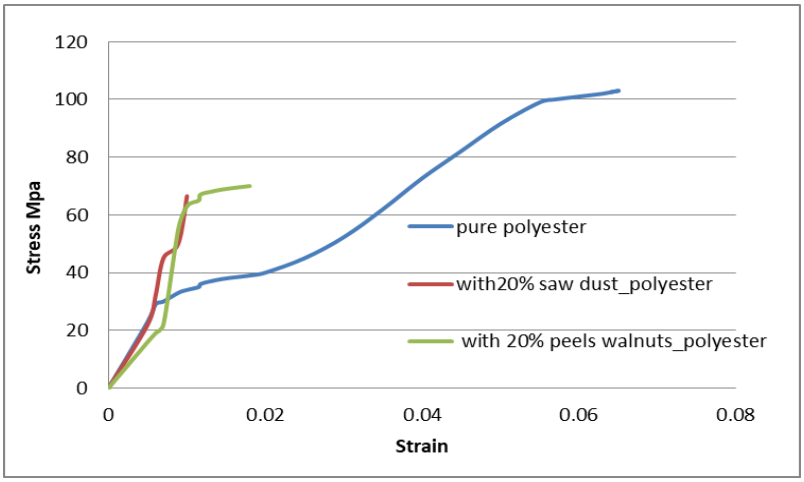

Figure 9. Stress – strain curve for compression test for 20% from 4.75 mm particles mixed in polyester

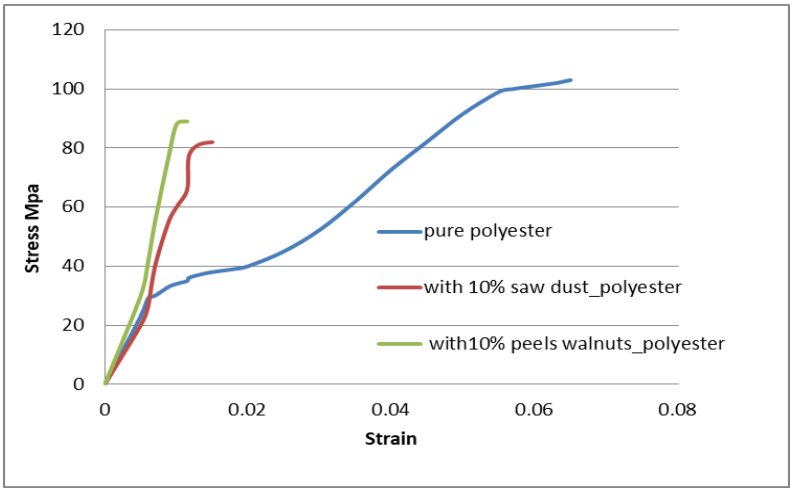

Figure 10. Stress – strain curve for compression test for10% from 9.5 mm particles mixed in polyester

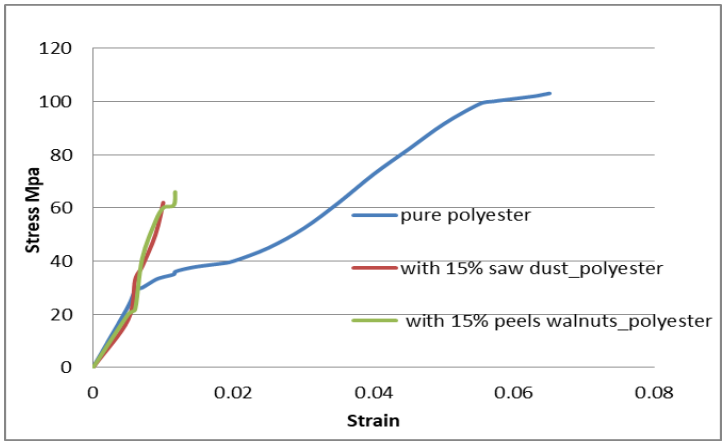

Figure 11. Stress – strain curve for compression test for 15% from 9.5 mm particles mixed in polyester

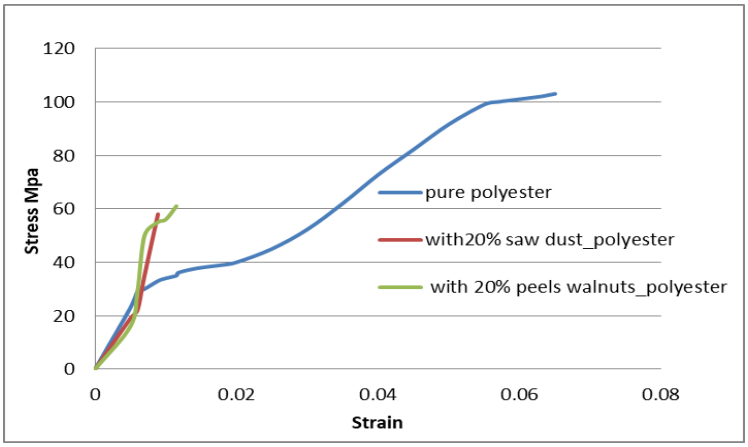

Figure 12. Stress – strain curve for compression test for 20% from 9.5 mm particles mixed in polyester

CONCLUSION

1. It was found that it is possible to reuse materials that made from natural composite materials (thermoset), which are difficult to dispose of by traditional methods and take them from waste and broken down mechanically into small particles of different sizes (9.5mm, 4.75mm and 2.36 mm) and mixed with the resin material .

2. It was found that when adding these particles (Natural waste composite) to polyester directly affects on the elastic modulus of polyester and that this change is non-linear, This effect changes with the change of the size of the particles and the mixing ratio.
3. The elastic modulus of polyester increases when adding 10% of particles (natural waste composite) with size (2.36mm,4.75mm,9.5mm).
4. The stress decreasing when adding the particles (Natural waste composite) to polyester ,and this decreasing was very small when adding 10% of particles.
5. The elastic modulus of polyester increase by 40% ,30% and 3% when adding 10% particles from saws dust with 2.36mm,4.75mm ,9.5mm respectively .
6. The elastic modulus of pure polyester increase by 30% , 35.5% and 40% when adding 10% particles of Peels walnuts with 2.36mm ,4.75mm and 9.5mm respectively .
7. The method of utilizing the waste was obtained by re-using it in various industries. Therefore, in this paper recommend and emphasize through this research the importance of recycling composites in general and using them in new applications.

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