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Improvement of Mechanical Properties of Polyester Composite Reinforced By Bio Filler (Acro Shell)

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Abstract

Recently there has been a great interest in the industrial applications of composites developed from natural fibers, bio or industrial waste. Present work is an attempt to synthesize composites using a bio waste material i.e. peel arko. Composites with 3, 5,7 and 9 wt % arko shell (AS) particulate reinforced polyester composites have been synthesized using Hand layup technique. Mechanical properties have been investigated in detail. Considerable increase in tensile strength and young's modulus and hardness test was noticed with increase in filler content. Composites were found to be more resistant to impact strength. was found to be quite high in comparison to polyester.

Keywords: *Composites, polyester, Hand layup technique, Mechanical properties, Arko shell(As) particles.*

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1. Introduction

Composites consist of one or more discontinuous phases embedded in a continuous phase. The discontinuous phase is usually harder and stronger than the continuous phase and is called the 'reinforcement' or
'reinforcing material', whereas the continuous phase is termed as the 'matrix'. Properties of composites are strongly dependent on the properties of their constituent materials, their distribution and the interaction among them. The geometry of the reinforcement (shape, size and size distribution) influences the properties of the composite to a great extent. Natural fillers and fibers reinforced thermoplastic composite have successfully proven their high qualities in various fields of technical application. As replacements for conventional synthetic fibers like aramid and glass fibers are increasingly used for reinforcement in the thermoplastic due to their low density, good thermal insulation and mechanical properties, reduced tool wear, unlimited availability, low price, and problem free disposal. Arko shell /particles provide a sufficient reinforcement at much lower cost than synthetic and mineral filled thermoplastic. When synthetic and mineral fillers are used, machine wear and damage of processing equipment is much higher than with wood filler. Fiber damage during processing is greatly reduced when arko shell is utilized, which allows for recycling production waste without compromising quality [1]. Luo and Netravali [2], Ahmed [3], Faud [4] and Schneider [5] studied pineapple, filament wound cotton fibre, oil palm wood flour and jute & kenaf fiber based composite respectively.

In general, particles are not very effective in improving fracture resistance but they enhance the stiffness of the composite to a limited extent. Particle fillers are widely used to improve the properties of matrix materials such as to modify the thermal and electrical conductivities. Particles improve performance at elevated temperatures, reduce friction, increase tensile and impact resistance, improve machinability, increase surface hardness and reduce shrinkage. Particles are more commonly used as extenders to lower the polymer use with other simultaneous improvement in properties. Arko shell is one of the most important natural fillers. Many works have been devoted to use of other natural fillers composite in recent past and arko shell filler is a potential candidate for the development of new composites because of their high strength and modulus properties. The arko particles also have remarkable interest in the automotive industry owing to its hard-wearing quality and high hardness (not fragile like glass fiber), good acoustic resistance, moth-proof, not toxic, resistant to microbial and fungi degradation, and not easily combustible. Composite of arko fillers with high compressive strength can be used in broad range of applications of load bearing.

The aim of this study

The aim of this study is to improve the mechanical properties(tensile strength, impact strength and hardness test based arko shell filler particles composite.

2. Materials and Method

2.1 Arko Shell and Particles

Arko shell particles are used as reinforcing material for investigation. Shell particles of size between 300-800μm are prepared in grinding machine. Arko shell filler are potential candidates for the development of new composites because of their high strength and modulus properties. An approximate value of coconut shell density is 1.60 g/cm3.

2.2 Polyester

Unsaturated polyester resin (UP) type () was used as matrix material, supplied by (SIR) Saudi company. Was a viscous liquid, transparent at room temperature. It's one types of peroxide supplied by the company itself) to form a strong permanent band converted to a solid state. The weight ratio between hardener and resin was 2 gm of hardener per 100 gm of the resin.

2.3 Surface Modification

Chemical treatments were employed for surface modification of shell beans was soaked in 5% sodium hydroxide (NaOH) for 48hours and then washed many time in distilled water and dried in a hot air oven at 70°C for 8h and then stored in a vacuum desiccators' before preparation of composite.

2.4Experimental procedure

The composites slabs were prepared by hand layup method or contact mold method. A metallic mold was prepared and the dimension of the mold was 40cm x 15cm and a depth or thickness of 0.3 Polyester resin (NYCIL 6043) belonging to ester family was used as the matrix material, methylethylketone peroxide (MEKP) introduced as the catalyst and combat derivative accelerator (CDA) was used as the hardener Polyester resin and the hardener were mixed in the ratio of 100:2 by volume and the catalyst methylethylkettone peroxide added to effect the chemical reaction. Composites of five different bio filler compositions of Arko shell such as 0wt%3wt%,5wt% and 7wt% and 9wt% also a neat counterpart produced as control. The casting were left for 24 hours for proper curing at room temperature. Specimens of suitable dimension were cut for test. Tensile, hardness and impact test were carried out on each sample specimen. This was done according to ASTMD 638-90 with the aid.

3. Results and Discussion

3.1 Tensile Strength

The tensile strength of the composite materials depend upon the strength and chemical stability of the matrix with the filler.

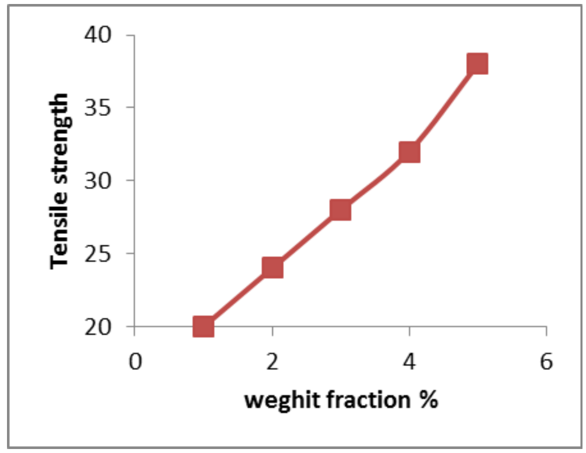

Figure (1) Ultimate Tensile Strength for different composition of composite

From Fig. 1. it is observed that composite high optimum by (9% wt) exhibited maximum ultimate strength (38MPa) when compared with other filled composites but lower than the un-filled composite this may be due to good particle dispersion and strong polymer/filler interface adhesion for effective stress transfer but further increase in filler content (up to 15 % Vol.), the tensile strength is found to be less this is due to more filler material distribution in the material.

3.2 Hardness test

The hardness values shown in Fig. 2 indicated that increase in filler content increases the hardness. The addition of filler content increases the hardness of composite material due to increase in the resistance strength of polymer to plastic deformation. In this case, the polymeric matrix phase and the solid filler phase would be pressed together and touch each other more tightly.

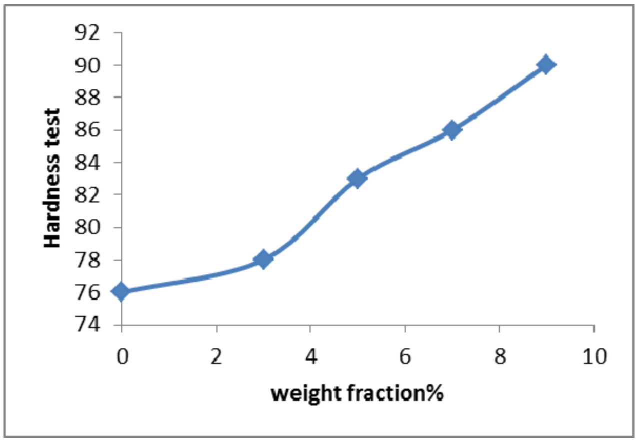

Figure (2) Hardness test

3.3 Impact test

From Fig. 3. it is observed that composite high optimum by (9% wt) exhibited maximum ultimate strength (28MPa) when compared with other filled composites but lower than the un-filled composite this may be due to good particle dispersion and strong polymer/filler interface adhesion for effective stress transfer but further increase in filler content (up to 15 % Vol.), the tensile strength is found to be less this is due to more filler material distribution in the material.

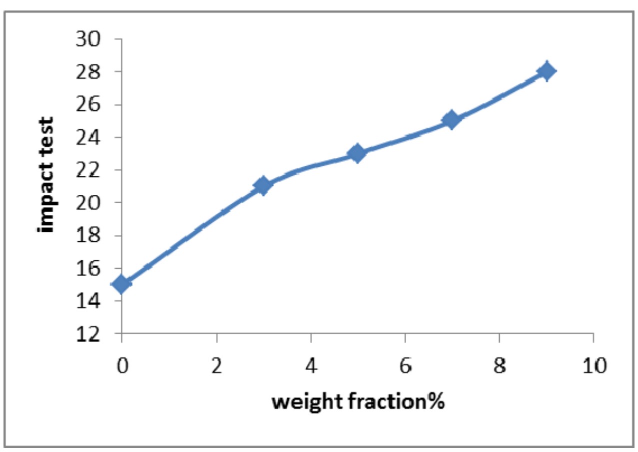

Figure (4) Impact test

4. Conclusions

From the results obtained in the tests, it was established that the tensile properties of the composites produced with filler showed an appreciable improvement. When 9 % filler content was studied, it was noted that up to 38 Mpa on strength when compared with the neat resin. There was also an increased hardness with addition of filler when 9% filler content , it was noted that up to 90 on strength when compared with the neat resin.. There was also an increased impact strength with addition of filler in the composite when 9 % filler content was studied , it was noted that up to 28 on strength when compared with the neat resin . Composite filled by 9% Vol. of matrix arko shell (MAs) exhibited maximum hardness number, tensile strength, and impact test this may be due to uniform dispersion and decrease in inter particle distance with increasing particle loading in the matrix results in increase of resistance to indentation.

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