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Research paperResearch Paper

Effect of River Shell Particles on The Thermal Conductivity and Flexural Strength of The Polyester Resin

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Abstract

In the present research, the effect of micro river shell percentage on thermal conductivity properties and flexural strength of the polyester compound with different Weight amount (5%, 10%, 15%, 20%, 25%) to the resin. Glacial river shell particle size was introduced in 8 µm, therefore, The thermal conductivity test and flexural strength were performed on samples. The results indicated river shell percentage decrease the thermal conductivity of a polyester composite with an ideal percentage was 10% and the highest flexural strength weight amount 5wt% of River shell.

Keywords: *River shell, flexural strength, unsaturated polyester resin, thermal conductivity*

1. Introduction

These days, polymer composites assume a vital part in polymer industries and engineers dependably continue hunting down the best material which will be financially that will suit certain design and product necessity. One of the key elements which make plastics appealing for engineering applications is the likelihood of property improvement through fiber reinforcement [1].
Natural materials can display amazing mixes of stiffness, toughness, strength, and low weight which are sometimes unmatched by man-made materials [2]. In the past two decades, critical endeavors were therefore undertaken in the materials research community to illustrate the components behind and microstructure these mechanical exhibitions, in order to duplicate them in synthetic materials. This way to deal with configuration, called biomimetic, has now begun to yield materials with wonderful properties[3]. The initial phase in this biomimetic approach is the identification of materials exhibitions in characteristic materials, together with a fundamental understanding of the mechanisms behind these performances (which has been extraordinarily quickened by recent techniques such as examining test microscopy) [4].
In general, composite polymers possess good thermal and mechanical properties, sustainable over an extensive variety of temperatures. The desirable factors such as property requirements, cost factor considerations, and future application prospects would decide the choice of the processing method [5]. Presently, composite materials with a metal or a mixture of the blend are manufactured either by casting or by powder metallurgy strategies [6]. They are considered as a potential material contender for a wide assortment of basic applications in the transportation, vehicle and game products fabricating ventures because of the prevalent scope of mechanical properties they display [7].
In this paper, studies have been performed to test the thermal conductivity and flexural strength of polyester resin with adding different weight amount from 5%Wt to 25%Wt of river shell particles. For this purpose, firstly modifications of polyester resin investigated with thermal conductivity and flexural strength.

2. Materials and Methods

2. 1. Unsaturated polyester resin

Polyester resin is a type of thermoplastic resin and is prepared from the reaction of monomer glycol with a two-base acid. This resin has good thermal properties, with high temperatures of up to 260 ºC, but it automatically disintegrates at a higher temperature even without oxygen. It is also characterized by excellent electrical resistance and chemical resistance to solvents, acids, salts, anti-wear and environmental effects, in addition to being low cost but weak and fragile. The polyester is added to the fiberglass for the manufacture of mold structures and components of aircraft bodies, automobiles and other industries, the thermosetting resin used was unsaturated polyesters type with thermal conductivity 0.288 W/m. ºC and density 1.04 g/cm^3. The Diagram shows the chemical composition in Fig.1.

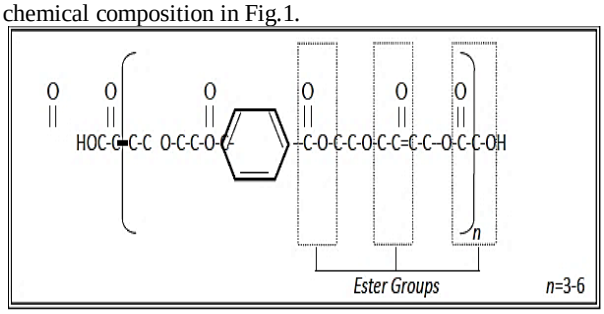

Fig. 1: Chemical composition of unsaturated polyesters

2.2 Collection and conversion of river shells

River shells are collected from the Diyala river shore. The shells were cleaned and dried in the furnace with 55ºC temperature before grinding. The shells are crushed and made into fine particle and sieved with a sieve size of 50 micron. Examine process was performed for chemical compositions of the river shell used as shown in the Fig.2.

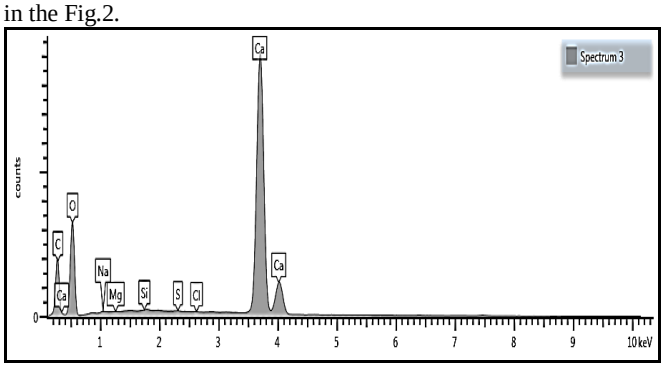

Fig .2: Chemical compositions of the river shell.

2.3 Mixing process

After preparing the weights of materials that used in this search, six specimens were used by mixture with the polyester as appeared in Table 1 .Blending procedure of the materials with the polyester in the concrete laboratory in the materials Engineering Department – Engineering College / Diyala University using a pan mixer with a capacity of 0.5 m^3. The polyester was added and mixed in 15 minute in room temperature to obtain a homogeneous mixture. The high in the temperature of the mixture will come about as a sign to the start of the mixing process [7]. Then the blend has filled the shape and leaves for 24 hours at room temperature as appeared in Fig.3. Heat treatment is performed for all samples in a furnace at (60 ºC) for period of (4) hours [8]. This process is important for the objective of obtaining the cross-linking between polymeric chains, and to removes the stresses and complete the hardening of the samples.

Table 1: Designation and Composition of Composites

Sample No.	River shell %	polyesters %
SP.١	٠	١٠٠
SP.٢	٥	٩٥
SP.٣	١٠	٩٠
SP.٤	١٥	٨٥
SP.٥	٢٠	٨٠
SP.٦	٢٥	٧٥

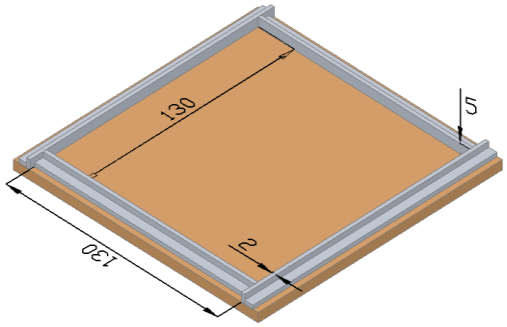

Fig. 3: The Shape of the Prepared Moulid

All specimens are cut by laser machines to the required dimensions for mechanical characterization.

2.4. Testing Methods

2.4.1. Flexural Test

The Flexural strength is the maximum stress created when a bar-shaped specimen is subjected as a single beam to a bending force perpendicular to the bar ,samples flexural test were fabricated according to (ASTM-D790) rectangular shape (10 mm × 135 mm) as shown in Fig.4. Flexural strength was measured by using the universal hydraulic press (Ley bold Harris No.36110) to figure the most extreme load uncovered of the sample as appeared in Fig.5.

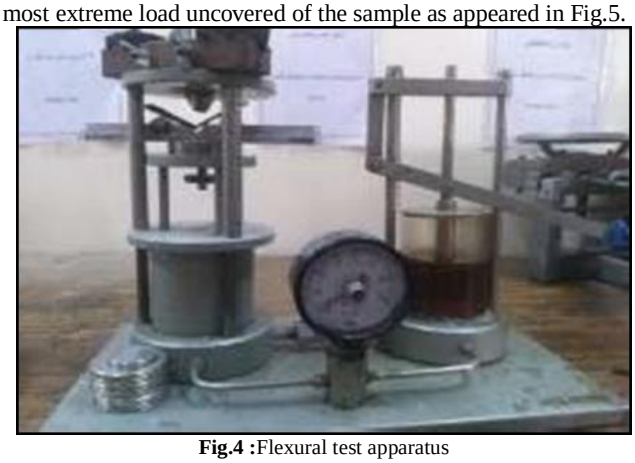

Fig.4 : Flexural test apparatus

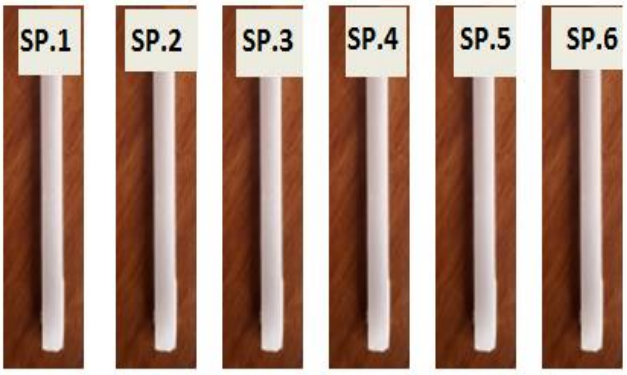

Fig. 5: Specimens of flexural test

2.4.2. Thermal Conductivity Test

Thermal conductivity values are utilized to quantify heat flow through a material as indicated by the device particulars of lee ś disk method type (Griffin and George/England) used in assurance of thermal conductivity of bad conductor, the predefined specimens were found appear as a thin circle, Samples thermal conductivity was as per (ASTM-D790) and that with sample dimension of circle shape (40 ×4) mm. The device is located in materials engineering department/Technical University-Iraq, all specimens shown in the Fig.7.

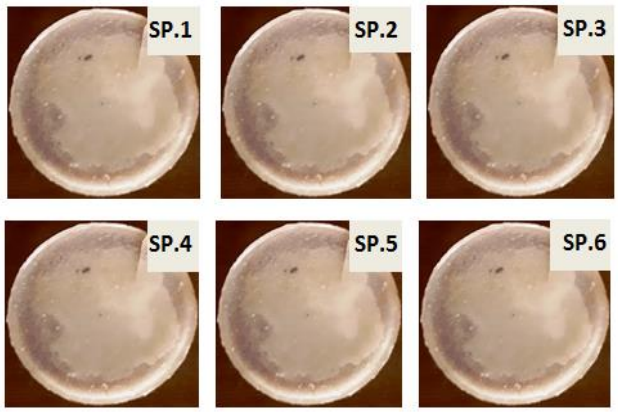

Fig. 7 : Specimens of thermal conductivity test

3. Results and Discussion

3.1. Flexural Strength

The addition of river shell particles to polyester resin serves to decrease costs and improve certain mechanical properties Fig. 8 below shown the highest flexural strength of composite samples over the sus their comparing percentage reinforcement. A definitive strength of a composite depends upon the weakest break way all through the material. Solid particles influence the strength through the weakening effect because the stress concentration they cause, and the reinforcing as it may act as impediments to crack growth [6] in other cases, the reinforcing effect is more critical and afterward, the composites will have strengths higher than the mixture. The river shell particles demonstrated its greatest resist at 5 %Wt. filler concentration. This diagram demonstrates that extra filler focus to the river shell particle

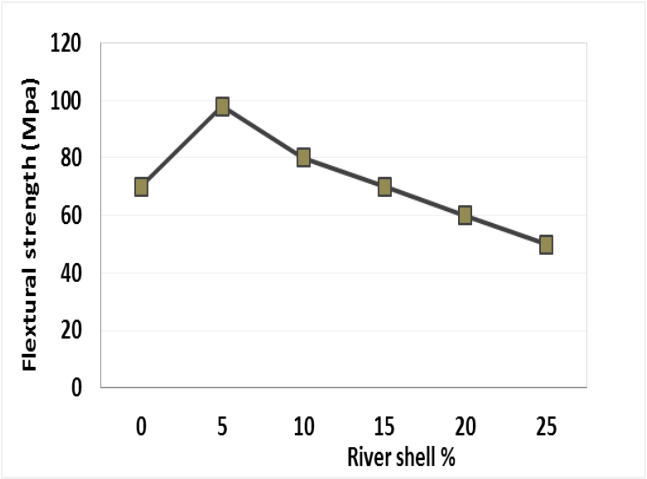

Fig .8 : The Influence of Flexural Strength

3.2 Thermal conductivity

In this work, micro – river shell was used as a filler to improve the thermal insulating properties of polyester resin. Measurement of thermal conductivity revealed that an increase of river shell content in the polyester composite improve the thermal conductivity. Therefore, the thermal insulation rate increased with increasing of the additive percentage of filler particle as illustrated in Fig. 9, which represent the relation between thermal conductivity coefficient, and river shell percentage. The increase in thermal insulated has happened because the increase in temperature leads to an increase in the vibration of river shell particle and then increasing implement of content composite for thermal conductivity.

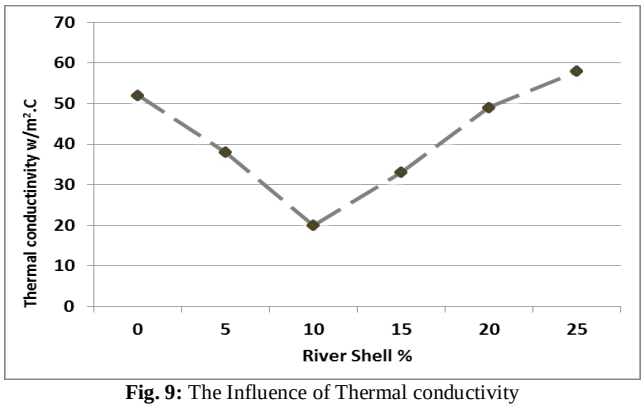

Fig. 9: The Influence of Thermal conductivity

Conclusion

1. Incorporation of river shell particles inside the polyester resin decreases thermal conduction of the composite polymer.

2 . The river shell particles reinforcement of 5 wt% can be used instead of pure epoxy in applications requiring great flexibility and decreases flexural strength with the increase of river shell content.

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