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Izod Impact Behaviour of Polymer Composite Solid Waste Disposal with Epoxy-Matrix

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Abstract
This study presents the Izod impact behaviour of polymer composite reinforced solid waste disposal with epoxy-matrix. Polymer composite have been broadly used in numerous manufacturing application. With new eco-green materials, new alternatives to improve the polymer composite technology such as diapers waste are being developed. This paper aim to study the effect of diapers waste as filler inclusion in epoxy resin and hardener on the Izod Impact response. The preparation of samples involved some stages where the diapers waste were grind into smaller particles sizes. The ground diapers waste were then mixed with epoxy resin and hardener with different ratio of weight for diapers waste which are 0.1wt%, 0.2wt%, 0.3wt%, 0.4wt%, 0.5wt% and 0.6wt%.This evaluation was performed by measuring the Izod absorbed impact energy of standard ASTM notched specimens. The results indicated the increasing of the impact energy absorbed up to ratio of 0.4 diapers waste with 150.90J/m maximum.

1. Introduction

Composite material is a material consists of a combination of two or more difference type of materials with significant different in physical or chemical properties and resulting in superior to the properties of the composite [1,2]. Diapers waste are absorbent that known as incontinence products for personal hygiene deigned to absorb and retain urine and faeces from babies or adult with incontinence problem[3].Diapers wastes are generally considered to be non-biodegradable waste that is problematic because it is made of sodium polyacrylate molecules and able to absorb as many as 200-300 times of its water mass[4].Diapers are made of plastics, cellulose and highly super absorbent polymers (SAP)[5].

Type of plastic contains in diapers composition is polypropylene, polyethylene and polystyrene [6]. Cellulose pulp is produced from wood chips and chemical items that are composite of cellulose pulp, which consists of 35% of diaper compositions, and lignin, the cellulose protein, is broken down together [7]. It has high porosity and excellent hygroscopic

properties to make it great absorbent material for diapers [8]. SAP contains 33% of weight percentage and were used as absorbents, soluble and retain liquid in diapers consists of polymer repeating monomers of sodium polyacrylate ($C_3H_3NaO_2$) [6]. Recycling of the diapers waste includes collecting the plastic and fibre of the waste which have been treated and sanitized. The collected plastic and fibre were used as polymer mixed with epoxy-matrix in this study. The purpose of this study is to determine the impact strength of the polymer composite solid waste disposal which diapers waste mixed with epoxy-matrix

2. Experimental Procedure

2.1 Sample Preparation

The precursor material used in this study was recycled diapers waste, epoxy resin (DER-324) and hardener (JOINTMINE 905-3S). Usage of DER-324 as epoxy resin is because it has lower viscosity and surface tension which gave the better in surface and adhesion. Six samples for the Izod Impact test were prepared with different ratio of diapers waste (DW) as referred Table 1. First of all, ensure that the DW is cleaned from any contaminants. Then, DW is grind using grinder machine (Model No-RT-34) with speed 3450rpm into cotton form approximately 30mesh as shown in Figure 1. Matrix phase was prepared mixing epoxy resin (DER-324) with hardener (JOINTMINE 905-3S) in 3:1 weight ratio as well as different ratio of ground DW (0.1,0.2,0.3,0.4,0.5 and 0.6 wt%). The mixture then laid into prepared mould with 30cmx30cmx0.3cm as shown in Figure 2 and subjected 24hour curing time under room temperature, 26ºC.

Figure 1: Ground Diapers Waste (DW)

Figure 2: Mixture poured onto mould

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Table 1. The ratio of DW in sample preparation for Izod Impact Test

Samples	Ratio of DW	Ratio of Epoxy Resin and Hardener
A	0.1	3:1
B	0.2	3:1
C	0.3	3:1
D	0.4	3:1
E	0.5	3:1
F	0.6	3:1

2.2 Izod Impact Test

In this test, Izod Impact test were performed following ASTM D7136 standard that determines the damage resistance of multidirectional polymer matrix composite laminated plates subjected to a drop-weight impact event with INSTRON CEAST 9050 Pendulum Impact System (Motorized Model) test device as shown in Figure 3. The device has a pneumatically operated hammer release and braking system as per standard. The specimens were prepared with 3mm thickness, 13mm width and 150mm length and notched using an automatic Instron CEAST AN50 notching machine with the appropriate knife (Figure 5B(i)) to make a V notch (45° angle, radii 0.25 and 1 mm) as shown in Figure 4 and Figure 5.

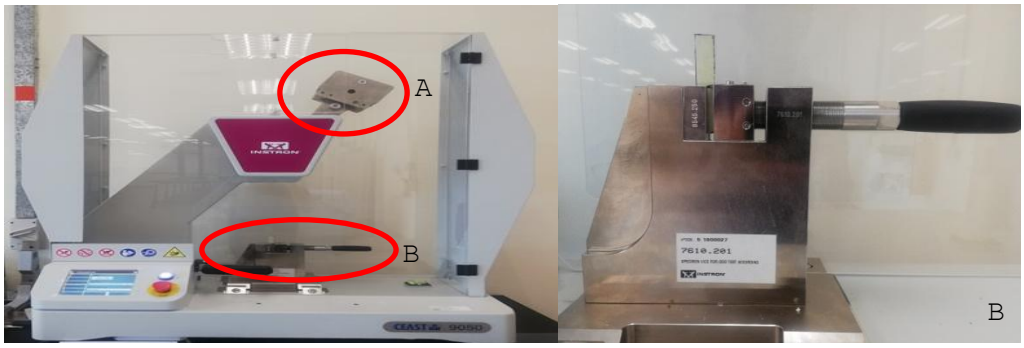

Figure 3:CEAST 9050 Motorized Pendulum Impact Systems; (A) Pneumatized hammer; (B) Sample holder

Figure 4:(A) Instron CEAST AN50 notching machine; (B) Notching process of the sample; (i) knife for notched sample

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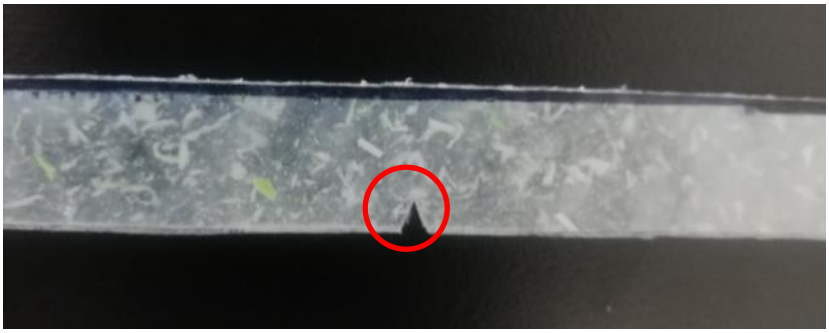

Figure 5: Notched sample

3. Results and Discussion

Impact resistance of polymer composite based diapers waste with epoxy-matrix samples was investigated by using Izod impact test. Figure 6 demonstrate the absorbed energy values of specimens with regards to DW ratio. It observed that following the inclusion of diapers waste to matrix, absorbed impact energy values increase up to 0.4 ratio of DW and slightly decrease at ratio of 0.5. Ratio of 0.4 of DW can be seen as maximum absorbed energy with 150.90 J/m. For impact strength, the variation had the same increasing trend with the absorbed energy variation with respect to DW ratio as shown in Figure 7. Ratio of 0.4 of DW achieves the maximum impact energy strength with 25.65 kJ/m^2.

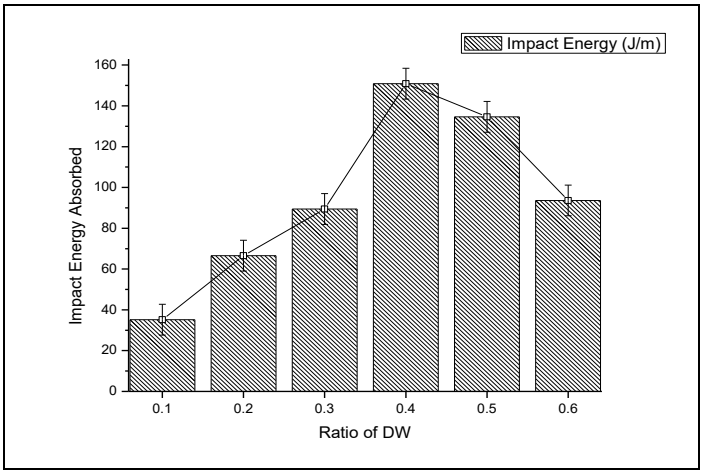

Figure 6: Impact Energy Absorbed

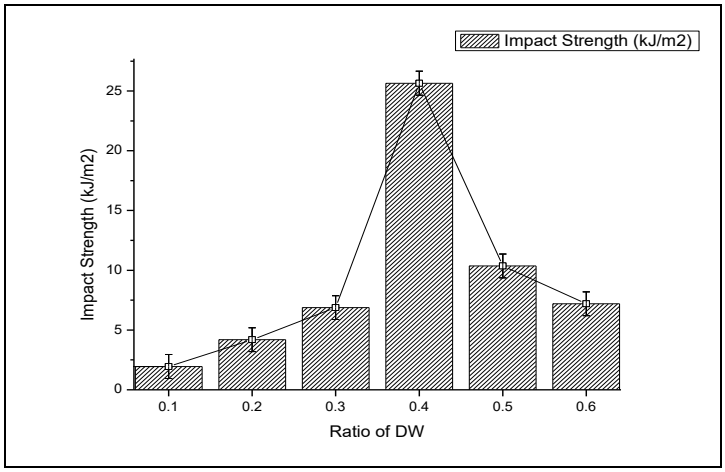

Figure 7: Impact strength of different ratio of diapers waste

Increase in impact strength interpreted that the polymer incorporation into the matrix significantly improves the impact toughness of the composite[9]. The exponential increase can be attributed to decoherence of the fibre / matrix low shear stress interface and tensile rupture of the micro fibrils, resulting in higher absorbed energy as a result of longitudinal spread of cracks and multiple ruptures[10]. The strength of polymer composites can be affected by a number of variables, such as the vital characteristics of the matrix, the composite volume fraction and the strength of the interfacial bond[11]. Therefore, strong interactions between the polymers and the epoxy resin matrix are needed to overcome the inconsistency problem. Figure 8 shows the Izod specimen totally fractured into two parts after contacted with the pneumatically hammer.

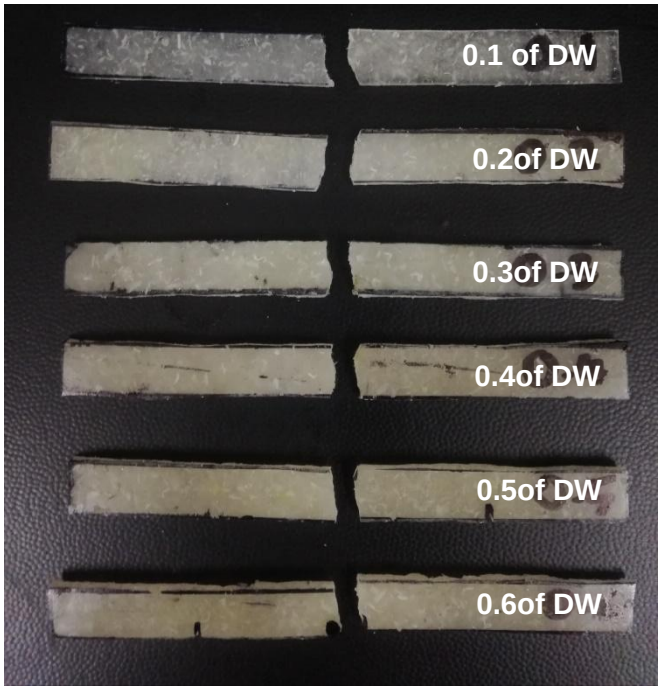

Figure 8: Typical rupture aspect of Izod specimens of polymer composite reinforced with different ratio of diapers waste

4. Conclusions

The inclusion of epoxy matrix and diapers waste as filler to form polymer composite shows the improvement of impact strength of the material. Ratio 0.4 of DW interpret the optimum ratio of the filler in composite material with maximum both Izod impact strength and energy absorbed with 150.90 J/m and 25.65 kJ/m^2.The strength of polymer composites can be affected by a number of variables, such as the vital characteristics of the matrix, the composite volume fraction and the strength of the interfacial bond. Therefore, strong interactions between the polymers and the epoxy resin matrix showed an important role in influencing the Izod impact strength.

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