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INVESTIGATION OF TENSILE PROPERTY OF NYLON – GLASS FIBER POLYMER MATRIX COMPOSITE

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ABSTRACT

In this work nylon 6 and E-glass fibre are combined together to get a polymer matrix composite. Nylon 6 gives the composite a high strength which is widely using in gears and in many automotive industries. Due to low cost, high strength and high stiffness, E-glass is used along with nylon 6. Twin screw extrusion process – an injection molding technique was used to fabricate the polymer composite with varying compositions with nylon 6 80% and Glass fibre with 20%. The tensile behavior of the composite was investigated.

Keywords: nylon 6, E-glass fibre, polymer matrix composite, twin screw extrusion process.

1. INTRODUCTION

Composite materials are generally used for buildings, bridges and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bathtubs, storage tanks, imitation granite and cultured marble sinks and counter tops. The most advanced examples perform routinely on spacecraft in demanding environments. Hence, the wear normally controlled. Nylon-6, also known as “polyamide 6”, is a synthetic polymer that has been used extensively in fiber synthesis and, according to recent findings, its incorporation into experimental dental composites has led to material reinforcement [1]. Carbon nanotubes (CNTs) are a hexagonal network of carbon atoms rolled up to form a cylindrical nanostructure. CNTs can be categorized as single-walled (SWNTs) and multi walled (MWNTs) nanotubes, where the former are the fundamental cylindrical structure and the latter are the layer-by-layer junction of two or more coaxial cylinders [2]. Among several unique properties, CNTs are extremely strong and stiff, and they display both excellent thermal and electrical properties [3]. In recent years, polymer nanofibers have been successfully modified by nanotubes with minimal or no agglomeration [4]. Moreover, following the proper chemical surface modification, nanotubes are able to strongly interact with the nanofiber, resulting in a hierarchical engineered nanocomposite [5]. Nowadays melt-mixing and injection molding process are widely used for fabricating polymer composites filled with nanoparticles. These nanoparticles are becoming replacements for conventional micro-composites. [6, 7]. Mechanical properties like tensile, flexural and impact are found on polymer composite made by selective laser sintering, melt compounding and injection molding. It was concluded that composites made by selective laser sintering shown 25% and 35% higher flexural and tensile modulus than other composites [8]. Mechanical properties of jute-flax based GFRP has been investigated and found that the hybrid composites have better tensile and flexural strength than single fiber natural composites [9]. Mechanical behavior of glass fibre based SiC polymer composites has been evaluated. [10, 11].

Nowadays most of manufacturing industries are using composite materials to replace their traditional materials. Recently in automobile industries composite materials have been used for many purposes. The gears used in automobile transmission system are made up of cast iron and it can be replaced by the composite material with the combination of Nylon 6 and E-glass. The noise level will be reduced by using the polymer composite material. The fatigue life can be increased and the wear rate can be reduced.

2. EXPERIMENTAL SETUP

In this work, injection molding machine was used to fabricate the nylon 6 and E-glass fibre polymer matrix composites. The injection molding machines consist of a material hopper, an injection ram or screw-type plunger, and a heating unit. Also, a standard two plates tooling was used as die. Initially the nylon 6 and E-glass fibre are fed into hopper of injection molding machine. The extruded material will be composite. The die consists of two parts one being injection mold (A plate) and other being ejector mold (B plate). Through sprue gate, resin is supplied to fill the mold cavity. The molten plastic flows through the runner and enters one or more specialized gates and into the cavity geometry to form the desired part.

3. TESTING OF COMPOSITE

In this work the fabricated polymer composite was tested for its tensile property. The specimen was prepared as per ASTM D638 as shown in Figure-1 and tested in a universal testing machine. The specimen was pulled till it broke. The break load, area of break, ultimate stress, and yield stress and percentage elongation are noted.

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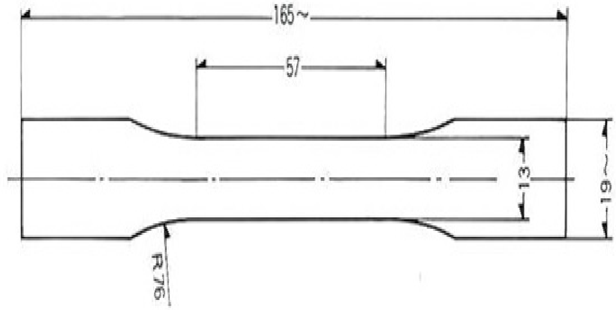

Figure-1. Tensile test specimen -ASTM D638.

4. RESULT AND DISCUSSION

Totally three specimens were prepared and tested to know the average value of tensile properties. The break load, ultimate stress, and yield stress are noted and their average values are furnished in Table-1. From the table it is noted that the composite produced with nylon 6 80% and Glass fibre as 20% has an ultimate stress of 138.27 MPa and yield stress of 136.28 MPa. The Stress Vs Strain graph of tensile test is shown in Figure-2.

Table-1. Tensile test result.

S. No.	Specimen number	Break load	Ultimate stress (MPa)	Yield stress
1	Specimen 1	5.480	138	136
2	Specimen 2	5.472	137.68	135.28
3	Specimen 3	5.488	139.12	137.56
Average value		5.480	138.27	136.28

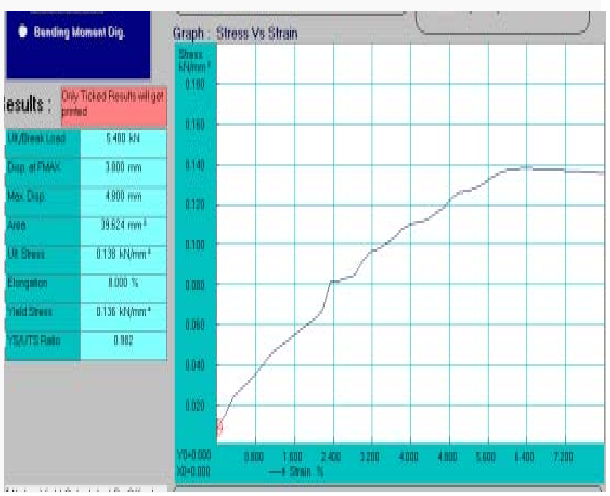

Figure-2. Stress vs. strain graph of tensile test.

5. CONCLUSIONS

In this paper polymer matrix composite was fabricated with Twin screw extrusion process and its tensile property was investigated. It is found that the composite has ultimate stress of 138.27 MPa and yield stress of 136.28 MPa which can used for automobile applications.

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