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Strength Characterization of Plated and Non plated Reinforced Polyamides

Gopinath B[1], kalyan s yadav[2]

Aeronautical Engineering, MVJCE, VTU,
gopinathbgowda@gmail.com

Abstract

Nylons, or poly amides (PA), are high performance semi-crystalline thermoplastics with a wide range of end-use performances in many industrial applications. It is believed that Nylon-6 matrix has a high moisture absorption capacity; the moisture content in the nylon-6 based thermoplastic composite significantly affects its mechanical properties. In this present work the Nylons have been reinforced with 30% Glass Fiber along with 3% $CaSiO_3$. The mechanical properties of this hybrid material have been carried out under Normal& 24 hours water dipped condition. The mechanical tests conducted were Tensile, Compression, Hardness, Three body wear and Water absorption test. Water absorption test was carried out on the specimens to study the effect of water content on the material under study. All the above mentioned tests were carried out according to the ASTM standards. The results thus obtained have been recorded and tabulated.

Keywords
Normal condition, 24 hours water dipped condition, tensile test, Compression test, Hardness test, Three body wear test, Water absorption test.

1. INTRODUCTION

Plastics for replacement of metals and for new products began essentially in the late 1930s, and their development and use of products has proliferated ever since. Plastic materials display properties that are unique when compared to other materials and have contributed greatly to quality of our everyday life. Plastics, properly applied, will perform functions at a cost that other materials cannot match. Plastics are used in our clothing, housing, automobiles, aircraft, packaging, electronics, signs, recreation items, and medical implants to name but a few of their many applications. Plastics are changed into useful shapes by using many different processes. The processes that are used to mold or shape thermoplastics basically soften the plastic material so it can be injected into a mold, flow through a die, formed in or over a mold. The processes usually allow any scrap parts or material to be ground up and reused. Some of the more common processes are injection molding, extrusion, blow molding, rotational molding, calendaring, and casting. Nylon plastics have a large area in industry nowadays because of their reduced weight, enhanced strength and stiffness, flexibility in design, good chemical, corrosion and electrical resistance. Injection molding is very widely used in automotive industry to produce plastic articles. A major advantage of this manufacturing technique is forming fairly complex shapes at a high production rate in view of the cyclic nature of the process. For effective processing of the Nylon composites, adhesion of matrix resin and glass fibers, volume fraction, fiber length distribution, fiber diameter, fiber and molecular orientation must be characterized. Fiber length has a great effect on mechanical properties of composites. Firstly, with extrusion compounding, then injection molding; fiber length decreases to only a small portion of its original value so this length reduction affects the mechanical properties of the composite negatively. The reinforcing effects of fiber reinforcement increase with aspect ratio. Processing conditions of injection molding causes fiber attrition such that molded products have low aspect ratio values so; by determining the optimum conditions, this situation can be controlled. Fibers display flow orientation during injection molding. This orientation also depends on aspect ratio and affects the mechanical properties of molded articles. In this study, 30% glass fiber reinforced Polyamide-6 was used, and by altering the process parameters of injection molding, test specimens were prepared to observe the effects of these parameters on mechanical properties, fiber length and the effect of the latter on the former one.

Experimental Model

Mold or die are the common terms used to describe the tooling used to produce plastic parts in molding. Since molds have been expensive to manufacture, they were usually only used in mass production where thousands of parts were being produced. Typical molds are constructed from hardened steel, pre-hardened steel, aluminum, and/or beryllium-copper alloy.

Fig. 1Injection molding dies

Fig. 2 Image of the injection molding machine used in this study

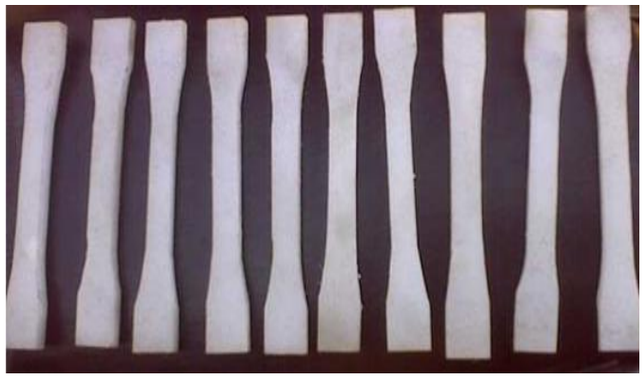

Fig. 3Tensile test Specimen

Results and Discussion

1.0 Tensile test

Tensile testing, also known as tension testing, is a fundamental materials science test in which a sample is subjected to uniaxial tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area From these measurements the following properties can also be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardening characteristics. The Tensile tests for the specimens were conducted according to ASTM D 638. The Table shows the Stress and Strain values for the specimens under consideration. A total of ten specimens were used and the average values have been reported and plotted. A maximum stress of 35.3 Mpa was recorded for the corresponding strain of 1.3%.

TABLE 1

Tensile test on sample(load vs cross head travel)

Load (kn)	Cross head travel (mm)	Load (kn)	Cross head travel (mm)	Load (kn)	Cross head travel (mm)
0.08	0	2.16	3.6	4.56	6.3
0.16	0.2	2.24	3.7	4.64	6.4
0.24	0.27	2.32	3.8	4.72	6.5
0.32	0.4	2.4	3.9	4.8	6.5
0.4	0.5	2.48	4	4.88	6.6
0.48	0.6	2.56	4	4.96	6.7
0.56	0.72	2.64	4.1	5.04	6.8
0.64	1	2.72	4.2	5.12	6.9
0.72	1.1	2.8	4.25	5.2	7
0.8	1.12	2.88	4.3	5.28	7.1

0.88	1.3	2.96	4.32	5.36	7.2
0.96	1.6	3.04	4.4	5.44	7.2
0.88	1.7	3.12	4.46	5.52	7.3
0.8	1.8	3.2	4.9	5.6	7.4
0.88	1.8	3.28	5	5.68	7.4
0.96	1.9	3.36	5.1	5.76	7.5
1.04	2	3.44	5.2	5.84	7.55
1.12	2	3.52	5.3	5.92	7.6
1.2	2.1	3.6	5.35	6	7.65
1.28	2.2	3.68	5.5	6.08	7.7
1.36	2.3	3.76	5.5	6.16	7.8
1.44	2.5	3.84	5.67	6.24	7.9
1.52	2.7	3.92	5.7	6.32	8
1.6	2.8	4	5.8	6.4	8.1
1.68	3.1	4.08	5.8	6.48	8.2
1.76	3.2	4.16	5.6	6.56	8.4
1.84	3.2	4.24	6	6.64	8.5
1.92	3.3	4.32	6	6.72	8.6
2	3.4	4.4	6.1	6.8	8.7
2.08	3.5	4.48	6.2	6.88	9
6.96	9.1	4.72	9.09	2.32	9.024
7.04	9.2	4.64	9.09	2.24	9.02
6.96	9.19	4.56	9.095	2.16	9.019
6.88	9.18	4.48	9.08	2.08	9.017
6.8	9.175	4.4	9.085	2	9.015
6.72	9.17	4.32	9.083	1.92	9.014
6.64	9.165	4.24	9.082	1.84	9.013
6.56	9.16	4.16	9.081	1.76	9.012
6.48	9.155	4.08	9.08	1.68	9.01
6.4	9.15	4	9.079	1.6	9
6.32	9.145	3.92	9.078	1.52	9
6.24	9.14	3.84	9.075	1.44	9
6.16	9.138	3.76	9.074	1.36	9
6.08	9.135	3.68	9.073	1.28	9

TABLE 2

Hardness test

Specimen no	Weight	Trail 1	Trail 2	Trail 3	Trail 4	Trail 5	Avg
01	13.761	95	95.3	97	96.2	97.3	96.16
02	13.456	96.2	97.3	97.2	92.4	96.2	95.86
03	12.194	92.6	96.4	94	96	95.5	94.9
04	13.481	98.2	97.2	96.5	97	96.5	97.08
05	13.369	97.1	97	96	97.2	96.2	96.7

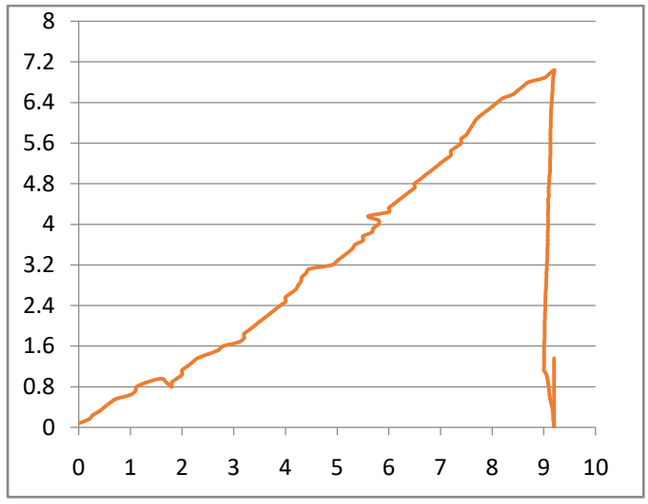

Fig.4 Load vs Cross head travel (tensile sample)

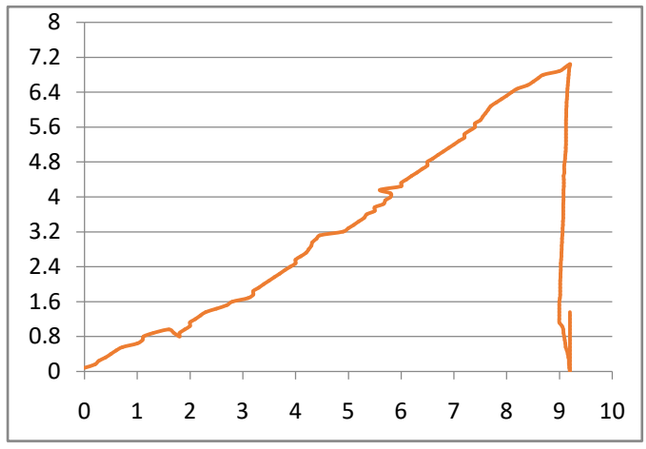

Fig.5 Stress vs strain (compression sample)

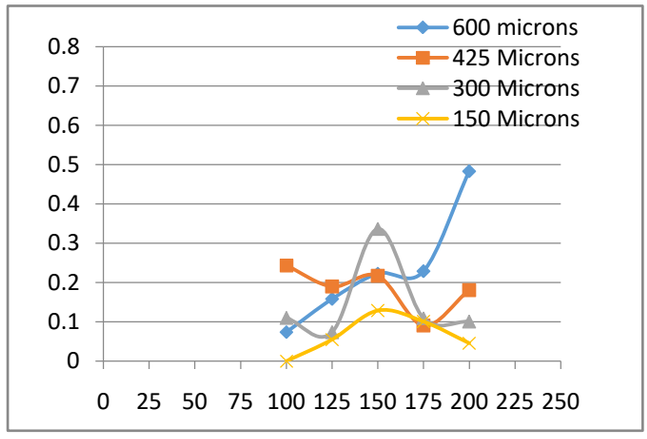

Fig 6.9: Sliding distance vs wear loss (Three body wear)

References

[1] Mueller D.H and Krobjilowski A, "New Discovery in the Properties of Composites", Journal of Industrial Textiles,

[2] Mohanty K, Misra M and Drzal L. T, (2005), Biopolymers and Biocomposites, Boca Raton, FL, CRC Press, Taylor & Francis Group, 2005,

[3] George J, Sreekala M. S and Thomas S, "A review on interface modification and characterization of plastic composites", Polymer Engineering and Science

[4] Majumdar, A.J. (1974), "The role of the interface in polyamide cement", Building Research Establishment, 1974

[5] Wulfhorst B. Production of Hybrid Yarns *6.* to be used in the Field of Plastics. Technical Textiles 1992;