EFFECT OF INJECTION PRESSURE ON TENSILE PROPERTIES OF POLYPROPYLENE-MATRIX COMPOSITES REINFORCED BY MICA

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ABSTRACT

Polypropylene matrix composite reinforced with particulate materials are gaining researchers' attraction because of their wide industrial applications and low cost. Variation in the mechanical properties of the PPM composite (polyropylene10wt%Mica) with injection pressure is investigated in this paper. Standard specimens of the composites are prepared by twin screw extrusion at various injection pressures.

Keywords: Injection pressure, Polymer-matrix composites (PMCs), Mechanical properties.

I. INTRODUCTION

The mechanical properties of a material are directly related to the response of the material when it is subjected to mechanical stresses. Since characteristic phenomena or behavior occur at discrete engineering stress and strain levels, the basic mechanical properties of a material are found by determining the stresses and corresponding strains for various critical occurrences.

A lot of information about a material's mechanical behavior can be determined by conducting a simple tensile test in which a standard specimen of uniform cross-section is pulled until it ruptures or fractures into separate pieces. The original cross sectional area and gage length are measured prior to conducting the test and the applied load and gage displacement are continuously measured throughout the test using computer-based data acquisition. Based on the initial geometry of the sample, the engineering stress-strain behavior (stress-strain curve) can be easily generated from which numerous mechanical properties, such as yield strength and elastic modulus, can be determined.

Universal testing machines, which can be hydraulic or screw based, are generally utilized to apply the test displacement/load in a continuously increasing (ramp) manner according to ASTM specifications.

The basic idea of a tensile test is to place a sample of a material between two fixtures called “grips” which clamp the material. The material has known dimensions, like length and cross-sectional area. We then begin to apply weight to the material gripped at one end while the other end is fixed. We keep increasing the weight (often called the load or force) while at the same time measuring the change in length of the sample.

Sreenath et al [1] worked on the effect of concentration of mica on the properties of polyester while Akinci et al [2] studied the effect of concentration of graphite flakes on the properties of PPM composites. Mubasher Ali Khan [3] studied the effect of different aditives on some mechanical properties of polypropylene.

II. EXPERIMENTATION AND OBSERVATIONS

Standard specimens (Fig.1) of PPM composites are used to do tensile test on UTM to get displacement verses load data. Displacement and load values are divided by cross-sectional area and length of specimen respectively to obtain the corresponding strain and stress values.

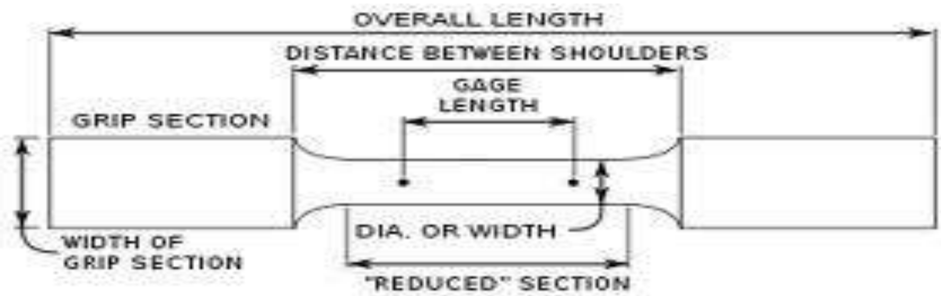

Figure 1: PPM specimen

Table1. Observation And Result Table For Ppm4:

DISPLACEMENT (mm)	LOAD (KN)	STRAIN	STRESS(N/mm^2)
0	0	0	0
0	0	0	0
0.16	0.1	0.002992	0.002449
0.33	0.21	0.006172	0.005142
0.49	0.3	0.009164	0.007346
0.49	0.38	0.009164	0.009305
0.83	0.44	0.015523	0.010774
0.99	0.56	0.018515	0.013712
1.16	0.6	0.021694	0.014691
1.32	0.64	0.024687	0.015671
1.32	0.67	0.024687	0.016405
1.49	0.69	0.027866	0.016895
1.82	0.72	0.034038	0.01763
1.82	0.74	0.034038	0.018119
1.99	0.76	0.037217	0.018609
2.15	0.78	0.040209	0.019099
2.32	0.8	0.043389	0.019589
2.49	0.81	0.046568	0.019833
2.49	0.82	0.046568	0.020078
2.82	0.83	0.05274	0.020323
2.82	0.46	0.05274	0.011263
2.82	0.46	0.05274	0.011263
2.83	0	0.052927	0

Table2: Observation and Result Table for Ppm5:

DISPLACEMENT (mm)	LOAD (KN)	STRAIN(mm)	STRESS(N/mm²)
0	0	0	0
0	0	0	0
0.16	0.07	0.002929	0.001597
0.33	0.14	0.006041	0.003194
0.49	0.22	0.008969	0.005019
0.49	0.28	0.008969	0.006388
0.66	0.33	0.012081	0.007529
0.83	0.38	0.015193	0.00867
0.99	0.43	0.018122	0.009811
1.16	0.48	0.021234	0.010951
1.32	0.52	0.024163	0.011864
1.49	0.56	0.027274	0.012777
1.66	0.59	0.030386	0.013461
1.66	0.63	0.030386	0.014374
1.82	0.66	0.033315	0.015058
1.99	0.69	0.036427	0.015743
2.15	0.71	0.039356	0.016199
2.32	0.74	0.042468	0.016883
2.32	0.77	0.042468	0.017568
2.49	0.79	0.045579	0.018024
2.65	0.81	0.048508	0.01848
2.82	0.83	0.05162	0.018937
2.98	0.85	0.054549	0.019393
2.98	0.86	0.054549	0.019621
3.32	0.88	0.060772	0.020078
3.48	0.94	0.063701	0.021446
3.65	0.95	0.066813	0.021675
3.65	0.26	0.066813	0.005932
3.65	0.26	0.066813	0.005932
3.66	0	0.066996	0

Table3: Observation and Result Table for Ppm6:

DISPLACEMENT (mm)	LOAD (KN)	STRAIN	STRESS(N/mm²)
0	0	0	0
0	0	0	0
0.16	0.07	0.000727	0.001739
0.33	0.15	0.0015	0.003726
0.49	0.22	0.002227	0.005464
0.66	0.3	0.003	0.007452
0.83	0.36	0.003773	0.008942
0.83	0.43	0.003773	0.010681
0.99	0.48	0.0045	0.011923
1.16	0.53	0.005273	0.013164
1.32	0.58	0.006	0.014406
1.49	0.62	0.006773	0.0154
1.66	0.66	0.007545	0.016393
1.82	0.7	0.008273	0.017387
1.99	0.74	0.009045	0.018381
1.99	0.78	0.009045	0.019374
2.15	0.81	0.009773	0.020119
2.32	0.84	0.010545	0.020864
2.49	0.87	0.011318	0.02161
2.65	0.9	0.012045	0.022355
2.65	0.92	0.012045	0.022851
2.82	0.95	0.012818	0.023597
2.98	0.97	0.013545	0.024093
3.15	0.99	0.014318	0.02459
3.32	1.01	0.015091	0.025087
3.48	1.03	0.015818	0.025584
3.65	1.04	0.016591	0.025832
3.81	1.06	0.017318	0.026329
3.81	1.07	0.017318	0.026577
3.98	1.09	0.018091	0.027074
4.15	1.1	0.018864	0.027322
4.31	1.11	0.019591	0.027571
4.48	1.12	0.020364	0.027819
4.48	1.12	0.020364	0.027819
4.64	0.42	0.021091	0.010432
4.64	0.42	0.021091	0.010432
4.65	0	0.021136	0

III. RESULT AND DISCUSSION

Stress strain curves are drawn for differernt composites using the above data on Microsoft office excel.

3.1 Stress – Strain Curves For Different Composites

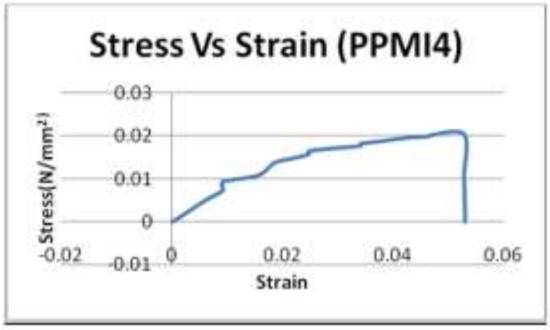

Figure 2: Stress-Strain Curvefor PPM4

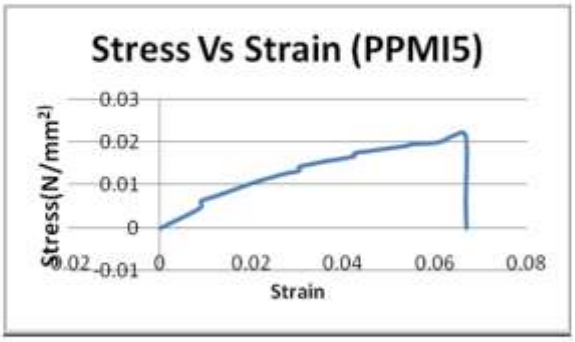

Figure 3: Stress-Strain Curve For PPM5

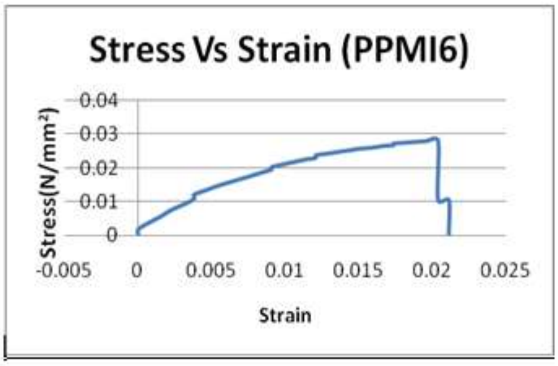

Figure 4: : Stress-strain curve for PPM6

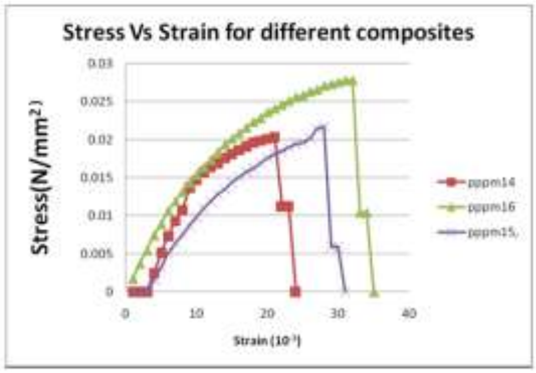

Figure 5: Stress-strain curve for PPM at different pressures

Table4: Result Table

Specimen	PPM4	PPM5	PPM6
Load at Peak (KN)	0.83	0.95	1.12
Load at Break (KN)	0.46	0.26	0.42
Elongation at Peak	2.82	3.65	4.48
Elongation at Break	2.82	3.65	4.64
Tensile Strength at Peak (KN/mm^2)	0.02	0.02	0.03
Tensile Strength at Break (KN/mm^2)	0.01	0.01	0.01
% Elongation at Peak	5.27	6.68	8.83
% Elongation at Break	5.27	6.68	9.15

IV. CONCLUSION

Toughness is the property of a material which enables it to absorb energy without fracture. It is desirable in materials which are subjected to cyclic or shock loading. It is represented by the area under stress strain curve up to fracture.

It is obvious from the figure 4 that the area under the curve increases with increase in injection pressure. It means that the toughness of PPM composite increases with increase in injection pressure.

The data in the result table4 reveals the fact that by increasing injection pressure, tensile strength of the composite at peak initially remains constant but after a high pressure value (like 60 MPa here), it increases. The tensile strength at break remains constant i.e. there is no significant effect of injection pressure on ultimate tensile strength is observed.

But the strain at peak as well as at break continuously increases with increase in injection pressure which implies that the ductility of the composite increases with increase in injection pressure.

In a nut shell it can be concluded that mechanical properties as well as wear resistance of polypropylene-mica composite can be improved by increasing injection pressure.

V. ACKNOWLEDGMENTS

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VI. NOMENCLATURE

PPM: Polypropylene-Mica composite
PPM4: Polypropylene-Mica composite at 40 MPa injection pressure.
PPM5: Polypropylene-Mica composite at 50 MPa injection pressure.
PPM6: Polypropylene-Mica composite at 60 MPa injection pressure.

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