[Gupta* *et al.*, 5(6): June, 2016] ISSN: 2277-9655
IC™ Value: 3.00 Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STUDY OF MODULUS OF ELASTICITY PROPERTIES IN TERMS TENSION AND COMPRESSION MODE BY REINFORCEMENT OF CALCIUM CARBONATE IN DIFFERENT RATIO IN HIGH DENSITY POLYETHYLENE

Pratibha Gupta*, M.D. Choudary
* Technical Manager (Lab) Miltech Industry, MIDC, Nagpur, MS
Professor & Head, Department of applied Science, BDCOE, Sevagram, Wardha, MS

DOI:

ABSTRACT

Modulus of Elasticity - is a measure of stiffness of an elastic material. It is used to describe the elastic properties of objects like wires, rods or columns when they are stretched or compressed.

Rate of change of strain as a function of stress. The slope of the straight line portion of a stress strain diagram. Tangent modulus of elasticity is the slope of the stress-strain diagram at any point.

In present experiment Particular size of calcium carbonate is reinforced in high density polyethylene (HDPE) in different weight ratio .The objective of present experiment to study the tensile properties and Impact properties of reinforced blended material as compare to neat material.

KEYWORDS: Calcium Carbonate, HDPE, Tensile Modulus & flexural Modulus.

INTRODUCTION

Elasticity is a property of an object or material which will restore it to its original shape after distortion. The methods that have been used to measure modulus of elasticity are following: tension (or compression) test, bending test and natural frequency vibration test. The tension and bending test are based on the principle of Hook's law and they are called static methods. Measuring of the natural frequency of vibration gives dynamic modulus of elasticity.

A spring is an example of an elastic object - when stretched; it exerts a restoring force which tends to bring it back to its original length. This restoring force is in general proportional to the stretch described by Hooke's Law.
Hooke's Law
One property of elasticity is that it takes about twice as much force to stretch a spring twice as far. That linear dependence of displacement upon stretching force is called Hooke's law which can be expressed as

$F_s = -k\, dL$ (4)

Where
F_s = force in the spring (N)
k = spring constant (N/m)
dL = elongation of the spring (m)

Tensile strength, %Elongation and tensile modulus measurements are among the most important indication of the strength of material and are most widely specified properties of the plastic material. The forces applied to produce deformation per unit area of the test specimen is called as stress of the material and it is expressed in Newton per millimeter square (N/mm^2). It is tested as per ASTMD 638 standard test method

Tensile modulus calculated as in Mpa
$E_T = F*L_0/ A_0*\Delta L$

Where
E_T= Modulus of Elasticity in tension
F = Force exerted on an object under tension
L_0= Gauge Length
ΔL= Amount by which the length of the object changes;

The flexural modulus is a measure of the stiffness during the first or initial part of the bending process, this value of the flexural modulus is, in many cases, equal to the tensile modulus.

The flexural modulus is represented by the slope of the initial straight line portion of the stress –strain curve and is calculated by dividing the change in stress by the corresponding change in strain. The procedure to calculate flexural modulus is similar to the one described in tensile modulus.

Flexural Modulus calculated as in Mpa
$E_B = L^3m/4bd^3$
Where
E_B = Modulus of elasticity in bending
L= Span Length
B = Width of beam
D= Depth of Beam
M = Slope of tangent to initial straight line portion of the load deflection curve

The tensile testing machine of a constant rate of cross head movement is used . it has a fixed stationary member carrying one grip and a moveable member carrying a another self aligning grip, used for holding the test specimen between the fixed and movable member to prevent alignment problem . A controlled velocity drive mechanism is used to maintain the constant cross head motion between the two grips. A load indicating mechanism is used for indicating total tensile load with an accuracy of the indicated value. An extension indicator, commonly known as the extensometer is used to determine the distance between gauge length of the test specimen, as the specimen stretches during the test.

Test specimen used for tensile strength is molded by injection molding with required injection molding machine parameter that is speed, pressure and temperature of the machine. The test specimen dimensions vary considerably confirming the requirement given in the ASTMD 638 Type 1 . The specimens are conditioned in the standard laboratory atmosphere of 23±3°C and 50±5% relative humidity for 24 Hrs after molding in present experiment. The speed of testing is a relative of grips during the test, in present investigation speed of testing used is 50mm per minute. The test specimen is positioned vertically between the grip of the testing machine , the grips are tightened firmly and evenly to prevent any slippage , speed of machine is set and the machine is started . as the specimen elongated , the resistance of the specimen increases and is directly indicated on the display propositional to load cell

EXPERIMENT

In present experiment, HDPE used for this work is Relene Grade. M60075 of Reliance Industries Ltd. [Density: 0.94 gm/cc; MFI: 8-10 gm/10 minute]. The nano-filler used in this work is calcium carbonate, purchase from local market in Maharashtra. The Calcium carbonate (coated) used is having average particle size 9-11 nm, Grade OMYACARB 2T –SA of Omya Malaysia SDN BHD Malaysia.

For tensile strength test universal tensile testing machine is used having capacity of 3000kgs of M/s Deepak polyplast pvt. Ltd Ahmadabad India

ISSN: 2277-9655
Impact Factor: 4.116

Fig 1: Flexural Modulus Setup

Fig 2: Universal Tensile tester

Table 1 : Flexural Modulus Values

S.No	Composition (HDPE:CaCo$_3$)	Flexural Modulus value in Mpa
1.	HDPE	105.18
2.	HDCC1(95:5)	370.26
3.	HDCC2(90:10)	377.20
4.	HDCC3(85:15)	403.00
5.	HDCC4(80:20)	103.98
6.	HDCC5(75:25)	417.95
7.	HDCC6(70:30)	432.75
8.	HDCC7(65:35)	451.39
9.	HDCC8(60:40)	471.27

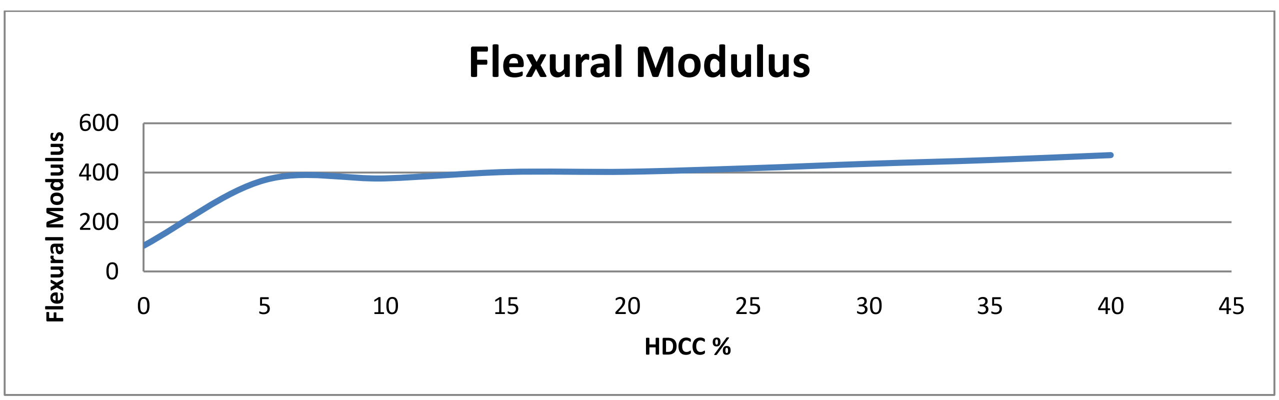

Fig 3: Comparison Graph of Flexural Modulus for HDPE Material and HDCC composites

Table 2 : Tensile Modulus Values

S.No	Composition ($HDPE:CaCo_3$)	Tensile Modulus value in Mpa
1.	HDPE	100.53
2.	HDCC1(95:5)	91.84
3.	HDCC2(90:10)	115.15
4.	HDCC3(85:15)	113.14
5.	HDCC4(80:20)	108.09
6.	HDCC5(75:25)	110.39
7.	HDCC6(70:30)	118.39
8.	HDCC7(65:35)	118.69
9.	HDCC8(60:40)	117.04

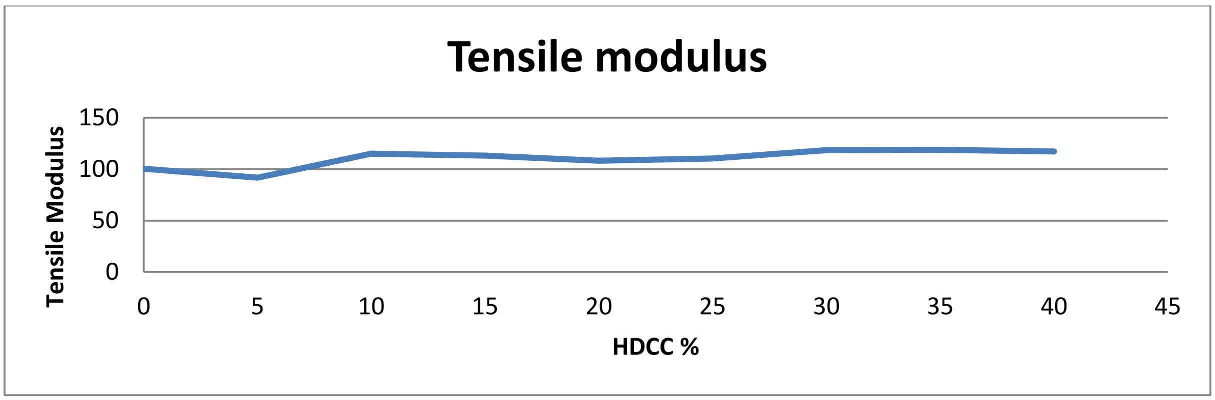

Fig 4: Comparison Graph of Tensile Modulus for HDPE Material and HDCC composites

RESULT AND CONCLUSION

1. From the Table 1 and Fig 3 Flexural modulus values among the nanocomposites is increasing as the percentage of nano calcium carbonate is increases in the HDPE material and flexural modulus values are much higher than the neat HDPE material , this shows that the bending properties is improved by reinforcement of Nano calcium carbonate in HDPE material that increases the application of HDPE material with Nano calcium carbonate .
2. Tensile modulus values among the nanocomposites is slightly increases is the percentage of nano calcium carbonate is increases as compare to the HDPE material. This shows that the tension property of HDPE material and nano composite material remains almost same with slight increase in values, it will better performance with nano calcium carbonate.

REFERENCES

[1] Mechanical properties chapter 2 of handbook of plastic testing technology by vishu shah performance engineered product , Inc. Pononaa, california
[2] Toughening of polypropylene with calcium carbonate particles ARTICLE in POLYMER JANUARY 2003 By W.C.J. Zuiderduin, C. Westzaan, J. Hue ´tink, R.J. Gaymans, Department of Chemical Technology, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands.
[3] The Use of Calcium Carbonate in Polyolefins Offers Significant Improvement in Productivity by M.D. Roussel, A.R. Guy, L.G. Shaw, and J.E. Cara Omya, Inc. 61 Main St. Proctor, VT 05765
[4] EFFECT OF NANOCLAY ON THE MECHANICAL BEHAVIOR OF COMPATIBILIZED ETHYLENE VINYL ACETATE COPOLYMER / HIGH DENSITY POLYETHYLENE BLENDS by Atul Rajan1,

ISSN: 2277-9655
Impact Factor: 4.116

Pradeep Upadhyaya1, Navin Chand2 , Vijai Kumar1 1Central Institute of Plastics Engineering and Technology, Lucknow, India 2Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India

[5] The Influence of Filler Component on Mechanical Properties and Thermal Analysis of PP-LDPE and PP-LDPE/DAP Ternary Composites by Kamil Şirin1, Mehmet Balcan2 and Fatih Doğan3 1Celal Bayar University, Faculty of Science and Arts, Department of Chemistry, Manisa.

[6] Comparison of Precipitated Calcium Carbonate/Polylactic Acid and Halloysite/Polylactic Acid Nanocomposites By XuetaoShi,1,2 GuangchengZhang,1 CristinaSiligardi,3 GuidoOri,3,andAndreaLazzeri2,1DepartmentofAppliedChemistry,SchoolofScience,NorthwesternPolytechnicalUniversity,Xi'an710072,ChinaDepartmentofChemicalEngineering,IndustrialChemistryandMaterialsScience,UniversityofPisa,ViaDiotisalvi2, 56126 Pisa,Italy DepartmentofChemistry,UniversityofModenaandReggioEmilia,41100Modena,Italy