International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072

Effect of Nanoclay on Tensile Properties of Hybrid Polymer matrix Composites

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Abstract - *Composite materials are widely used because of their extreme properties. Researchers working on fabrication of new composite materials worldwide to enhance the applicability of these materials. There are very few works about the effect of nanoclay on Kevlar fabric with S-glass fabric. Therefore this paper intends to analyze the effect of nanoclay on Kevlar/S-glass/Polyester with nanoclay as filler. Composites were manufactured with 0 wt% nanoclay, 1 wt% nanoclay, 2 wt% nanoclay, 3 wt% nanoclay, 4 wt% nanoclay, 5 wt% nanoclay , 40 wt% of fiber and matrix is polyester. Tensile properties studied in this investigation. The optimal clay loading obtained is 2wt%.*

Key Words: **Nanoclay, Kevlar fabric, S-glass fabric, Polyester,filler**

1.INTRODUCTION

Composites materials can be defined as engineered materials which exist as a combination of two or more materials that result in better properties than when the individual components are used alone. They can improve mechanical properties such as stiffness, strength, toughness, etc; the resulting properties are largely dependent on the distribution, relative amounts and geometries of constituents.

Kevlar is an organic fiber and has a unique combination of high strength ,high modulus, toughness and thermal stability. Kevlar is a material formed by combining para-phenylenediamine and terephthaloyl chloride. When woven, Kevlar forms a strong and flexible material, light and has twenty times the strength of steel. It is also superior to specialist metal alloys.

Glass fiber reinforced composites have become attractive structural materials not only in weight sensitive aerospace industry but also in marine, automobile, railways, civil engineering structures, sport goods etc. This is attributed to high specific strength and specific stiffness of the glass fiber reinforced composites.

polyester is one of most commonly used polymer matrix with reinforcing fibers for advanced composites applications due to its low cost, easy handling, rigid, resilient, flexible, corrosion resistant, weather resistant, and flame retardant.

Nanoclay has received much attention as reinforcing materials for polymer because of its potentially high aspect ratio and unique intercalation/exfoliation characteristics. The small amount addition of nanoclay into polymer matrix exhibits unexpected properties including reducing gas permeability, improved solvent resistance, being superior in mechanical properties and thermal stability, and enhanced flame retardant properties.

1.1 Literature

[1]P.N.B. Reis , J.A.M. Ferreira et.all. study the ideal amount of nanoclays to obtain the best impact performance. Laminates manufactured with epoxy , and 1.5 wt% nanoclay, 3 wt% nanoclay , 6 wt% nanoclay. The laminates manufactured with epoxy resin filled by6 wt.% of nanoclays shown the best performance.[2] A. B. Inceoglu and U. Yilmazer studied that the tensile strength, tensile modulus, flexural strength, and flexural modulus of neat UP were improved by the presence of clay up to 5wt%. Above 5wt% of clay, tensile and flexural properties were decreased.

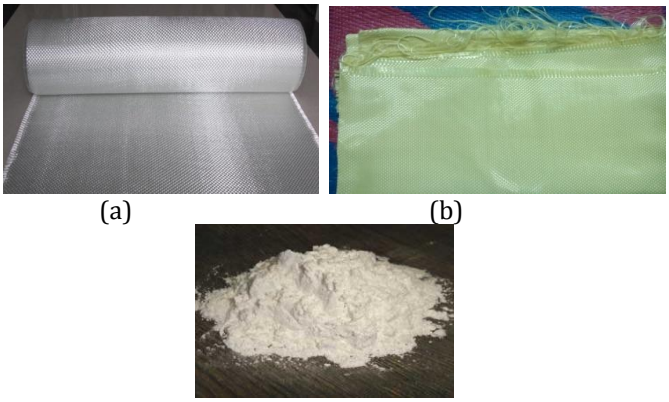
1.2 Problem Definition

Numerous researchers investigated individually polyester/kevlar/glass fiber composites and polyester/clay nanocomposites, no investigation has been carried out on polyester/Kevlar/glass fiber/clay composites. The effect of clay loading on the mechanical properties of Polyester/ Kevlar/glass fiber composites was investigated in this work. The mechanical properties of the polyester/kevlar/glass

fiber/clay composites was determined through the tensile testing .

2. EXPERIMENTAL WORK

Materials used in this experiment are Kevlar woven fabric . S-glass (Al) with aluminum coated Mat . Polyester resin of grade ECMALON 4411, methyl ethyl ketone peroxide and cobalt naphthanate were purchased from Ecmass resin (Pvt) Ltd., Hyderabad, India. Nanoclay, which has its surface modified with 25-30wt% methyldihydroxyethyl hydrogenated tallow ammonium is obtained from Sigma aldrich Banglore.



(a) (b)

(c)

Fig -1: (a) S-glass fabric ,(b) Kevlar woven fabric, (c) Nanoclay

Six types of composites were fabricated(Kevlar/s-glass/polyester/nanoclay) by using Hand lay up method.Firstly, Polyester/Nanoclay composites, with different clay wt% (0, 1, 2, 3, 4 and 5 wt%),were prepared by mixing the desired amount clay with Polyester in a suitable beaker. Then the mixture was placed in a high intensity ultra-sonicator for 30min with pulse mode (15s on/15s off). Two plies of glass fiber and two plies of Kevlar fiber were cut as per the required dimensions. A layer of Polyester/clay mixture which was mixed and kept was applied on a mold. The first Kevlar fabric was laminated until it became entirely wet by the resin. Additional Polyester/clay mixture was added, and the second s-glass fabric was laminated until complete wetting. This procedure was repeated until four plies were superimposed. Then, the sample was pressed with a metal roller to find the thickness of approximately 3 mm. The composites samples were cured at room temperature for 24 hours. The cured composites then were cut in a suitable Geometry per ASTM standards.

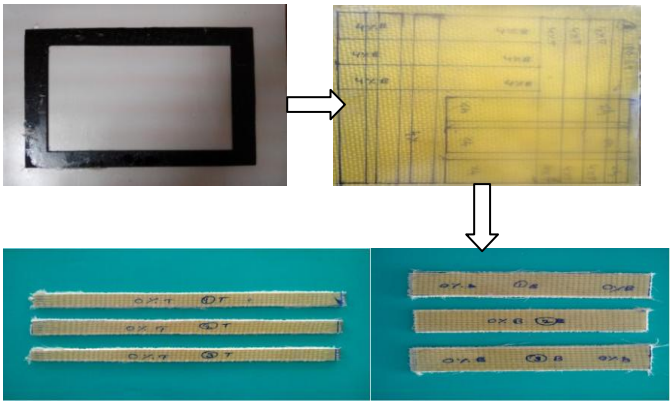


Fig- 1: Specimen preparation

Mechanical testing of Composites is done by using Tensometer. A 2 ton capacity - Electronic tensometer, is used for testing composites. A digital micrometer is used to measure the thickness and width of composites. The tensometer is fitted with a fixed self aligned quick grip chuck and other movable self aligned quick grip chuck. The movable chuck is adjusted to accommodate 25 mm wide and 3mm thick specimen. The specimen was held in fixed grip and the movable grip is manually moved until the specimen is held firmly without slackness. The power supply is switched on. From results obtained from the tensometer we can calculate the tensile strength and tensile modulus values.

Table -1: Tensile Strength

Wt% of Nanoclay	Tensile strength(Mpa)
0 %	61.94
1%	116.66
2%	125.08
3%	104.25
4%	98.61
5%	95

Table -2: Tensile Modulus

Wt% of Nanoclay	Tensile Modulus(Mpa)
0%	1214.50
1%	2405.4
2%	4548.4
3%	2827.1
4%	2528.4
5%	1941.5

Results and Discussion

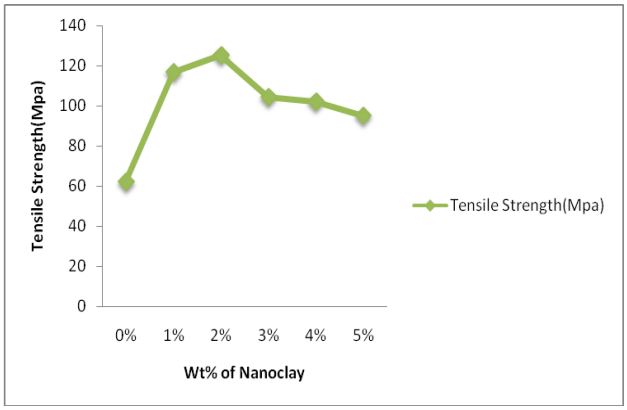


Chart -1: Tensile strength variations for different wt% of nanoclay

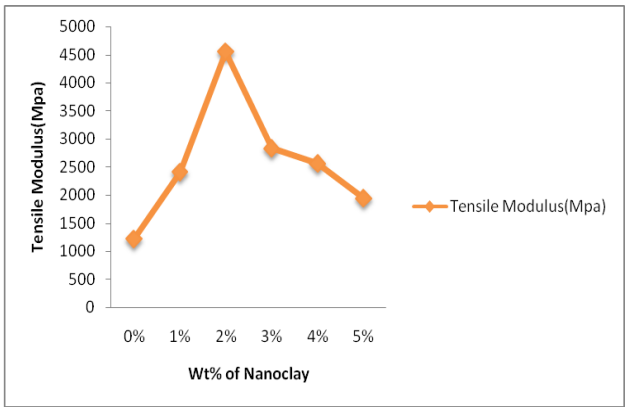


Chart -2: Tensile Modulus variations for different wt% of Nanoclay

From Chart- 1: The maximum value of tensile strength obtained is 125.08 Mpa at 2wt% of Nanoclay.
From chart-2: The maximum value of tensile modulus obtained is 4548.4Mpa at 2wt% of Nanoclay

From the tensile test results, as the weight percentage of nanoclay increased, the tensile strengths of the samples also increased. 2 wt% samples showed the maximum tensile strength,tensile modulus. But it was not the case for3wt%, 4wt% and 5 wt%, instead they tended to break apart before the peak, which meant they were brittle. It was because when the nanoclay weight percentage increased, the mixture itself became too viscous, sluggish and more void formations in the samples of high wt%.The more the nanoclay added the more viscous of the clay–resin mixture. This is the reason for which the higher wt% samples failed.

3. CONCLUSIONS

Kevlar/S-glass / Polyester composite of nanoclay is prepared with six different wt% of nanoclay, i.e: 0wt%, 1wt%, 2wt%,3wt%, 4wt%, 5wt%. From the study, following observations were made. Tensile properties at 2wt% nanoclay composite are more compared to other clay loading. The optimal clay loading obtained is 2wt%.The maximum tensile strength obtained is 125.08Mpa at 2wt% and the maximum tensile Modulus obtained is 4548.4Mpa.

REFERENCES

[1] *P.N.B. Reis , J.A.M. Ferreira , Z.Y. Zhang , T. Benameur , M.O.W. Richardson. "Impact response of Kevlar composites with nanoclay enhanced epoxy matrix".Elsvier*

[2] *B. Inceoglu and U. Yilmazer, "Synthesis and mechanical properties of unsaturated polyester based nanocomposites", Polymer Engineering and Science, vol. 43, no. 3, (2003), pp. 661–669.*

[3] *Dr.P.K.Palani, Nanda kumar-[12]- "Analysis Of Mechanical Properties Of Chopped Strand Mat E-Glass Fiber Epoxy Resin Nanoclay Composites".*

[4] *Kai Kin Herbert Yeung and Kamineni Pitcheswara Rao. "Mechanical Properties of Boron and Kevlar-49 Reinforced Thermosetting Composites and Economic Implications".*

[5] *Kaushic Govindaraj, Suresh Balasubramaniam. "Fabrication And Evaluation Of Mechanical Behaviour In Hybrid Polymer Matrix Composites".*

[6] *Ravikumar and M.S. Sham Prasad- "Fracture Toughness and Mechanical Properties of Aluminium Oxide Filled Chopped Strand Mat E-Glass Fiber Reinforced–Epoxy Composites".*