Global Journal of Engineering Science and Research Management

INVESTIGATION ON MECHANICAL PROPERTIES OF E- GLASS, EPOXY RESIN WITH ASBESTOS FILLED /HYBRID COMPOSITES

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Keywords: Mechanical properties, chemical properties, asbestos, glass/epoxy composites.

Abstract
The unique and diverse characteristics of composite materials have increased their utilization worldwide, from featherweight fly fishing rods to high performance airplane parts, the use of fiber reinforced composite materials is becoming more popular due to their high strength to weight ratio combined with easy manufacturing methods. Fiber reinforced polymer matrix consists of reinforcing fibers and polymer resin. The fibers are considered as the main load carrying constituent of the composite, while the role polymer matrix is to transfer and distribute the load between fibers as well as provide corrosion resistance, damage tolerance and thermal environmental stability. Here, the primary objective is to determine mechanical and chemical properties of glass/epoxy composite with asbestos as filler material in different percentage. The composite is manufactured by hand-layup process. Specimens were cut and tested according to ASTM standards. The mechanical properties were studied viz, tensile strength, bending strength, impact strength and hardness of the material. The results were compared for different percentage of filler material.

Introduction
Fillers are used along with various commodities as well as engineering polymers to improve the properties and reduce the cost. Incorporating inorganic mineral fillers into plastic resin improves various physical properties of the materials such as mechanical strength, modulus etc. In general the mechanical properties of particulate filled polymer composites depend strongly on size, shape and distribution of filler particles in the polymer matrix and extend of interfacial adhesion between filler and matrix.
At present, epoxy resins are widely used in various engineering and structural applications such as electrical industries, commercial industries and military aircrafts industries. In order to improve their processing and product performances - reduce cost - various fillers are introduced into the resins during process.
However, polymer composites are susceptible to mechanical damage when subjected to tension, compression and flexural loads resulting in interlayer de-lamination. Over the decade's lot of efforts have been made to study the mechanical characteristics of composites. Reports generally have variation in mainly enhancing the properties by varying the fiber volume fraction, orientation and so on.
Manojmingla and vikas chawla reported that reported that increase in content of fly ash increases the compressive strength and decreases the impact strength. Dr Hani Aziz Ameen studied the mechanical properties of composite material with natural fibers and epoxy resin where he found that compression strength increased for un-vulcanized rubber and decreased for vulcanized rubber whereas Hardness rate increases for both vulcanized and un-vulcanized rubber composites. Dai Gil Lee and Seong Su Kim studied the failure analysis of asbestos-phenol composite journal bearing and found that major cause of failure was interference fitting between the bearing and housing. S.A.S Akers and G.G Garrett studied the influence of processing parameters on the strength and toughness of asbestos cement composite and concluded that progressive increase in impact resistance can be directly related to fiber content irrespective of porosity and progressive increase in pressure applied asbestos cement sheet immediately after manufacturing increases the strength.
Vijay Kumar Thakur and Amar Singh Singha studied the physio-chemical and mechanical characterization of Natural fiber reinforced natural composites and concluded that mechanical property of composite is enhanced by incorporating the fibers into it and even found that polymer composites are sensitive to the swelling moisture and chemicals.

Materials used
In this work matrix materials chosen is epoxy resin(LY-556) and hardener HY951 because it has got good tensile, bending and hardness properties than other resins. The reinforcing material chosen was 600micro meter diameter glass fiber. The asbestos filler is mixed with resin depending upon percentage of asbestos. The details about material combination and percentage of filler used are given in table (1) below.

Global Journal of Engineering Science and Research Management

Table 1 Details of specimens prepared for varied percentage of asbestos filler

Matrix	Volume (%)	Reinforcement	Volume (%)	Filler	Volume (%)
Epoxy	50	Glass fiber	50	Asbestos	0
Epoxy	48	Glass fiber	50	Asbestos	2
Epoxy	46	Glass fiber	50	Asbestos	4
Epoxy	44	Glass fiber	50	Asbestos	6

Epoxy resin is chosen because it has good adhesive properties and good resistance to alkalis. Glass fibers' is chosen as reinforcing materials because it has good strength to weight and it is less dense.

Method of preparation of specimen

The hand lay-up process is employed to manufacture the composite laminates. The glass fibers are cut into definite shape i.e. 300mmx300mm depending upon mass of each glass fiber the number of fibers required to get 3mm thickness laminates is fixed. The filler material asbestos is mixed with the epoxy as shown in table (1) above and then is laid up. The laid laminate is cured for 3days in ambient condition.

The fabricated laminates are cut according to ASTM standards, Tensile test is conducted according to ASTM D 3039 as shown in Fig (1), Bending test is conducted to ASTM D 790 as shown in Fig (2), Impact test is conducted ASTM E23as shown in Fig (3) and Hardness has been measured in terms of RHN.

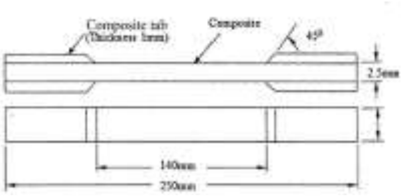

Fig (1)

Fig (2)

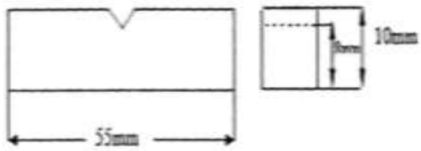

Fig (3)

Tensile strength test

Tensile test is carried out for unfilled glass/epoxy composite and for different proportions of asbestos filler i.e. 2%, 4%, and 6%.From the Fig (3.1.a), it is clear that fracture is purely due to the fiber breakage, fiber breakage at the surfaces and de-lamination of the fibers. De-lamination of the fiber is due to weak bonding between the fibers. The fracture is due to de-lamination of the fiber increased as the percentage of asbestos is increased because asbestos is laid up along with epoxy as the percentage of asbestos increases epoxy percentage decreases this is done to maintain constant volume of 300mmx300mmx3mm.From the Fig (3.1.b) it is seen that as the percentage of asbestos filler increases the yield point and ultimate point.

0% filled tensile specimen

2% filled tensile specimen

4% filled tensile specimen

6% filled tensile specimen

Fig (3.1a) De-lamination of fibers due to tensile load

 ISSN: 2349-4506

Global Journal of Engineering Science and Research Management

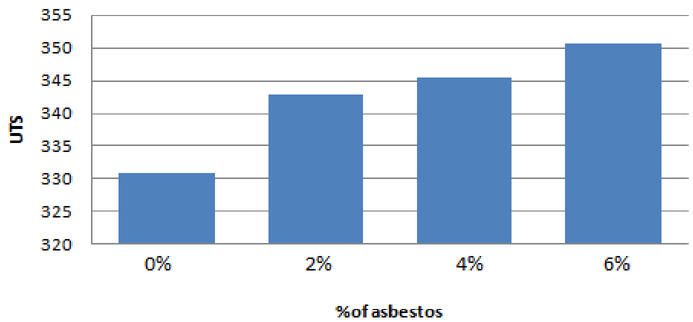

Fig (3.1b) Comparison of Tensile Strength for different % of Asbestos

Bending strength test

The bending test measures the force required to bend a beam under 3 point loading conditions. The data is often used to select materials for parts that will support loads without flexing. In bending the materials experiences both tensile and compression loading. The bending test is carried out for unfilled and filled composites. From fig (3.2.b) the result it is known that as the percentage of asbestos filler increases even the bending strength increases this is may be due to as the percentage of filler increases ductility of the material increases. The Fig (3.2.a) shows the delamination of the fibers due to bending load.

0% filled bending specimen 2% filled bending specimen 4% filled bending specimen 6% filled bending specimen

Fig (3.2.a) De-lamination of fibers due to bending load

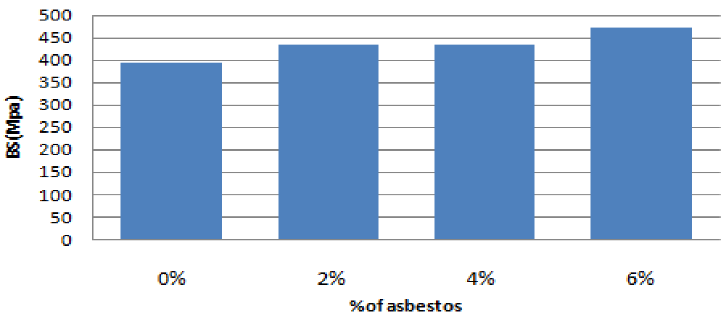

Fig (3.2.b) Comparison of Bending Strength for different % of Asbestos

Impact strength

A metal may be very hard which it is subjected to sudden loads in service. Materials behave quite differently when they are loaded suddenly than when they are loaded slowly as in tensile testing. Because of this impact test considered to be one of the basic mechanical test. Impact test is where in which rapid propagation of cracks without any excessive plastic deformation at a stress level below the yield stress of the material. Metals that show ductile behavior usually can, under certain circumstances, behave in a brittle fashion. From the fig (3.3.b) it is known that as the percentage of filler asbestos increases the energy requires to develop the crack is required more. The Fig (3.3.a) shows the delamination of the fibers due to impact load.

Global Journal of Engineering Science and Research Management

0% filled impact specimen 2% filled impact specimen 4% filled impact specimen 6%filled impact specimen
Fig (3.3.a) De-lamination of fibers due to impact load

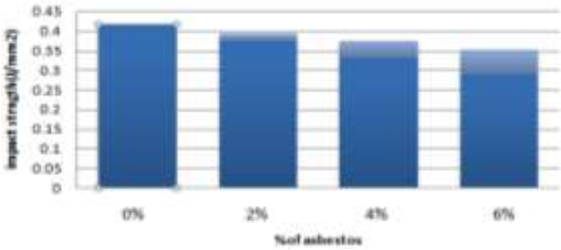

Fig (3.3.b) Comparison of Impact Strength for different % of Asbestos

Hardness

The hardness is measured, as of how deep the indentation has pierced under minor load. The Rockwell number is defined as the difference in the depth pierced by the indenter and the position of the indenter at surface (zero reference).Rockwell hardness number is represented in a different scale depending upon the scale used. During the course, it is observed that the value of hardness decreases gradually with respect to the percentage of asbestos. This might be because as the filler percentage increases the ductility also increases alongside the resistance to the indentation also decreases. The graph for the same is shown below.

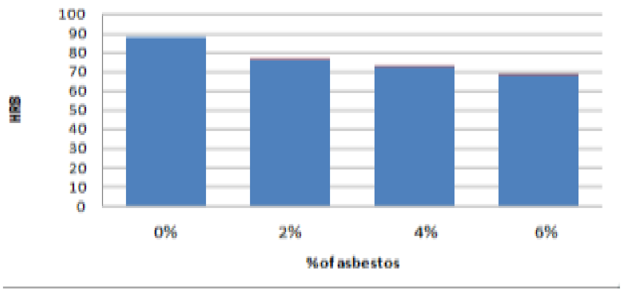

Fig 3.4Comparison of Hardness for different % of Asbestos

Conclusion

1. All composite with filler material exhibited better mechanical properties than unfilled composites.
2. Composites showed failure due to de-lamination, as the filler percentage increases this may be weak due to bonding between the fibers.
3. As the filler percentage is increased, tensile strength and bending strength is also increased because the asbestos influences the composite to enhance the ductility property.
4. Increase in the percentage of filler material causes decrease in the hardness and impact strength. This is because the filler material added does not support the enhancement of brittleness of the composite.

References

1. *ManojSingla and Vikas Chawla, "Mechanical Properties of Epoxy Resin – Fly Ash Composite", Journal of Minerals & Materials Characterization & Engineering, Vol. 9, No. 3, 2010, 199-210.*
2. *Jane Maria Faulstich De Paiva, Sergio Mayer, Mirabel CerqueiraRezende, Evaluation of mechanical properties of four different carbon/epoxy composites used in aeronautical field", Materials Research, Vol. 8, No. 1, 2005, 91 – 97.*
3. *E.J. Barberoi and Liliana de Vivo, "A constitutive model for elastic damage in fiber-reinforced PMC laminate", International Journal of Damage Mechanics, Vol. 10, No. 1, 2001, 73 -93*
4. *Dai Gill Lee and Seong Su Kim, "Failure analysis of asbestos–phenolic composite journal bearing" Composite Structures, vol 10, 2003.*
5. *S.A.S Akers and G.G. Garrett, "Influence of processing parameters on the strength and toughness of asbestos cement composites", Internatinal journal of cement composites and light weight concretes, vol 8, no 2, 1986*

Global Journal of Engineering Science and Research Management

6. *Dr. Hani Aziz Ameen, "Mechanical Properties of Composite Material Using Natural Rubber with Epoxy Resin" Engineering and Technology, vol26, no2, 2008.*
7. *Vijay Kumar Thakur and Amar Singh Singha, "physio-chemical and mechanical characterization of natural fiber reinforced polymer composites" Iranian polymer journal,19(1), 2010, 3-16.*