

# Characterisation of Glass Fibre Reinforced Hybrid Resin (PBI & Vinyl Ester)

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**Abstract :** Use of composite started from World War II in marine application for military .Now today composites are used in all sectors including aerospace, automotive, marine, boating, sporting goods, and infrastructure. In order to study mechanical properties of glass fiber reinforced hybrid resin composite. Hybrid resin consist of two different types of resins in which ploybenzimidazole (GAZOLE 5200P) is used because it has very high chemical and thermal stability and vinyl ester is used in order to increase its strengths, corrosion resistance .In our project we have developed glass fiber reinforced hybrid resin using hand lay-up method

**Index Terms -** Glass fiber, Vinyl ester, Ploy-benzimidazole, Mechanical properties, Hand lay-up method ASTM standards

## Introduction

Polymer matrix composites are widely used in aerospace application because of their high strength with low weight properties and this can be tailored through the addition of selective reinforcement with different matrix material to increase its bonding strength[1] .Glass fiber reinforced resin matrix composite were used in 1940 since from use of composite increasing in Industrial sector[2]. Composites are designed for certain process which gives selective property in desired application .Glass fiber reinforced hybrid resin have recently found special interest because of their thermal stability at high temperature , strength , corrosion resistance, low weight , good mechanical and tribological properties. Vinyl ester based composites are increasing in engineering material [1].

Hybrid resins combine two kind of monomers functionality in order to increase reaction rate and physical properties of polymer material formed. Due to presence of multi-functional monomers, hybrid formation results in formation of new bonding that gives versatile nature in physical properties of polymer. The introduction of use of hybrid resin containing PBI & vinyl ester improves physical and thermal properties of composite which is reinforced in glass fiber.Due to low viscosity, good mechanical properties and corrosion resistance vinyl ester material is first preferable material for research.[5]

Use of Ploybenzimidazole is because of its less prevalent than other polyamides, superior mechanical and thermal properties it does not burn and contribute fuel to produce smoke [8]. It is extremely high temperature resistance used for adhesive in resin form.

In present investigation ploybenzimidazole and vinyl ester hybrid formation is used as matrix material for reinforcing in glass fiber (1200GSM) by considering fully mixed two resin material we will get new composite is of having good strength, corrosion resistance and thermal stability .we are fabricating four different specimen of different resin percentage by volume by taking fiber constant percentage .The effect of hybrid resin on glass fiber is to improve mechanical properties of material, tribological properties of material. To make composite corrosion resistant and thermally stable at high temperature

## Material And Methods

### Materials

E-Glass fiber (1200GSM) with two different resin ploybenzimidazole (GAZOLE5200P) and vinyl ester details of these material given below.

#### 1. Glass Fiber

A combination of good mechanical properties and relatively low cost makes glass fiber attractive choice for the Various structures [7] The glass fiber chosen is E-Glass most commonly used in composite manufacturing [7]. The type of Glass fiber used in

this investigation is Uniwave E-Glass fiber reinforced in hybrid resin matrix contains vinyl ester and PBI .The areal glass fiber weight is 1200 gm./sq. and construction was unidirectional wrap direction glass fiber with three layers that has been shown in fig1.



Fig 1. Unidirectional Glass fiber Hybrid Resin

## 2. Vinyl ester :

Vinyl ester has having higher fatigue strain than polyesters, hence it is mostly used for improving mechanical properties of material .It has good impact strength with fatigue life [2]. Vinyl ester used as one resin in this experiment type of vinyl ester used is Ecmalon 9911 which was procured from Emak Glass Fiber Accessories Ambattur Chennai, with 2% cobalt accelerator, catalyst 50% methylethyl ketone peroxide (MEKP) in 10% DMA solution, ratio of resin/accelerator/catalyst/ promoter: 100/2/2/2). For experiment we have used 200ml vinyl ester with 10ml of all accelerator, catalyst and promoter. All process of mixing is steering which is slowly one by one with less quantity.

## 3. Ploybenzimidizole

It comes under thermoset plastic group. This is very costly resin powder form. It has high thermal stability with high chemical resistance and having compressive strength is 350Mpa. Now in this experiment we are using ploybenzimidizole of grade GAZOLE 5200P having solid density 1.3 g/cc Ultra High performance thermoplastic polymer, unreinforced PBI semi crystalline fine powder (GAZOLE 5200P, GHARDA PLASTICS AND CHEMICAL LTD). In this method resin is cured at room temperature as PBI give better result at room temperature with vinyl ester. The specimens is fabricated by hand lay - up method

## III. COMPOSITE MANUFACTURING

A glass fiber is moulded in required standard dimension and coated with mould releasing agent for easy removal of sample. We consider standard size of fiber for the investigation is 300x300mm square form. The resin and hardener is taken in the ratio of 100:5 parts by weight respectively .Both resins were mixed correctly by stirring process for 1 hr. before applying as curing of resin is at room temperature. Hand lay –up method is used for manufacturing, in this firstly take standard size glass fiber clean the surface of glass fiber before using it.

Properly added hybrid resin is poured on to the fiber material with equal lay-up .left over quantify resin is properly poured over a glass fiber in order to make strong bonding. Remove extent amount of matrix material by making surface uniform

In this experiment we have made three specimen with different configuration of resin contains 0%,10%,20% of PBI with corresponding vinyl ester resin. we are taking glass fiber as constant standard size of material. In this technique glass fiber were wetted by thin layer of hybrid resin .After completion of all process of manufacturing keep composite in open atmosphere to dry fully

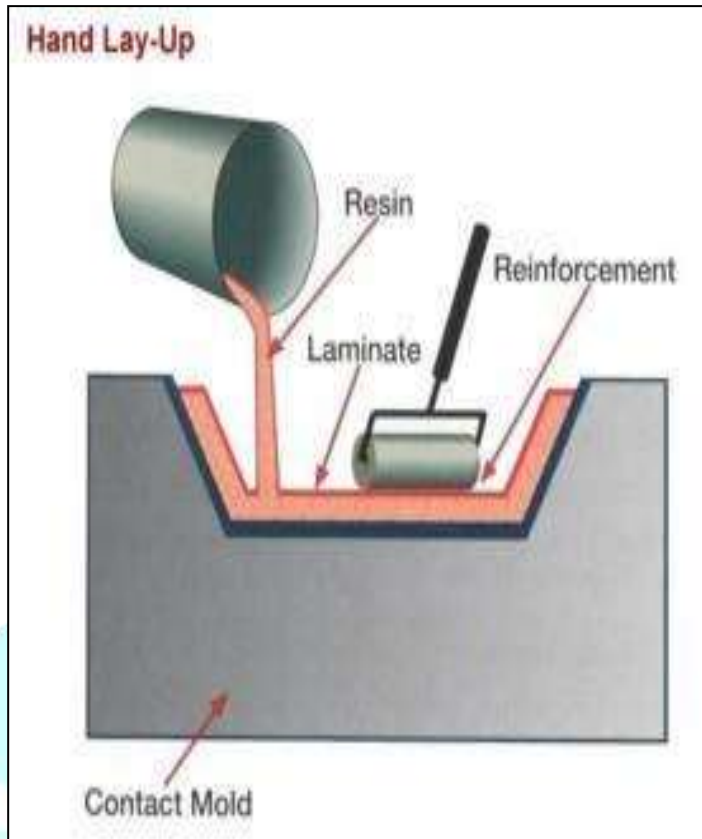


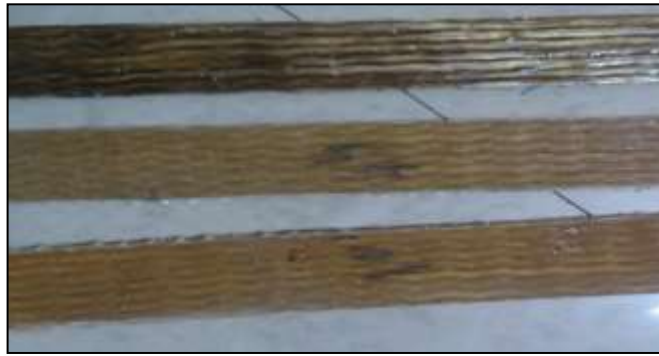
Figure 2. Manufactured composite

#### IV TESTING OF COMPOSITE

The obtained composite is tested for mechanical properties. In order to obtain tensile strength, flexural strength, and impact strength of treated and untreated hybrid resin base composite were carried out on Universal testing machine.

##### Tensile test

The obtained fiber composites are subjected to tensile strength as per ASTM D3039-76 were shown in fig.



In tensile test specimen of different resin are placed in grip of universal testing machine by specified gauge length consideration and pulled until failure. For ASTM 3039 speed of test is specified by the material specification. Generally speed of test is 2mm/min an extensometer and strain gauges are used for measuring the specimen .more than one orientation is necessary for the given composite because of different hybrid material .Expected result will come after testing of specimens.

### Impact Test

Not only had this obtained specimen tested under impact test [4]. Composites are to be tested in impact testing under ASTM D256. In this test specimen is clamped in pendulum impact test fixture with notch side against pendulum .Pendulum released and allowed to strike on the specimen, because of high weight with speed impact material fails .if breakage does not occur heavier hammer is used until material fails expected results would come in to picture.

### Flexural test

In flexural test the specimen is simply supported at two Ends and the load is applied on the top of the specimen. The specimen is subjected to bending. During the test the top layers are subjected to the compressive stress whereas the bottom layers are subjected to tensile stress. [1] Flexural Strength increases with increase in bonding between the Phases of composite i.e. fibers and matrix.

## V. RESULTS AND DISCUSSION

### 1. Mechanical properties

The mechanical properties of the composite manufacture without hybrid resin it contains only vinyl ester gives less strength as compare to addition of new high temperature stability material Ploybenzimidazole. The results of mechanical properties of different percentage of ploybenzimidazole are given in table 1. This hybrid resin use as a matrix form giving increase in its strength and corrosion resistance .All tests are carried according to ASTM standard

The effect on mechanical properties due to PBI give a clear understanding of the effect of addition of the filler

Material	Tensile Strength	Impact strength	Flexural strength
0% PBI	120	9	114
5% PBI	140	11	165
10 % PBI	147	15	182

## VI CONCLUSION

The influence of ploybenzimidazole powder on characteristics of glass fiber –vinyl ester is studied Incorporation of ploybenzimidazole in composite provide getter improvement in its mechanical properties .From the observed results we can understand new matrix material as hybrid resin which will give certain properties which cannot achievable by single matrix material, Tensile strength increases with increase in percentage of ploybenzimidazole. Tensile modulus increase with increase in percentage of new material ploybenzimidazole

## VII. ACKNOWLEDGMENT

The authors are grateful towards GHARDA PLASTICS AND CHEMICAL LTD ,Sakthi fibers, Emak Glass fiber Accessories for providing the raw materials for this research. The authors are sincerely thankful to manufacturing lab in Charge and Dean SMBS, VIT University Chennai Campus.

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