Fire Retardant Laminates Test of Epoxy Resin and Polyester Resin Applied on Bus Bodies

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Abstract— Composites are the most important materials in transportation and automotive sector. In the present work the composites were prepared by bus body building method known as hand layup technique. Using this technique the polymers namely epoxy resin and polyester resin were applied separately on chopped strand matt powdered type glass fibers and compared. Sandwich laminate panels were prepared and investigated the fire retardant laminates test. The burning time and burning distance were found to be higher in fire retardant laminates test for polyester resin compared to epoxy resin. The elimination of resin accessories such as gel coat, pva, wax, accelerator in epoxy resin, improved in proportion and percentage of epoxy resin with hardener as (90:10) and 70%,glass fiber consumption of 30%,and at last the standard fixed ratio of 1:1.50:2 for 450:300:225 category of three different combined stack grades of chopped strand matt powdered type glass fiber were the only reasons for decreased rate of burning time and burning distance of epoxy resin in these observations.

Key words: Chopped strand matt powdered type glass fiber, Epoxy resin, Polyester resin, Hand layup technique, Sandwich laminate panels, Fire retardant laminates test

I. INTRODUCTION

Composites are cohesive structures made by physically combining two or more compatible materials, different in composition and characteristics and sometimes in form. The processing of polymer matrix composites need not involve high pressure and doesn't require high temperature. Also equipments required for manufacturing polymer matrix composites are simpler. For this reason polymer matrix composites developed rapidly and soon became popular for structural applications. A composite material consists of two phases. It consists of one or more discontinuous phases embedded in a continuous phase. The discontinuous phase is usually harder and stronger than the continuous phase and is called the reinforcement or reinforcing material, whereas the continuous phase is termed as the matrix[1].Composite materials offer great physical, thermal, chemical and mechanical properties, while maintaining low density, high specific stiffness and strength, good fatigue endurance, corrosion resistance, good thermal insulation and low thermal expansion.Fibre reinforced composite structures have become very competitive engineering materials in recent years and have successfully replaced conventional metallic and other polymeric materials in many important sectors of industry. Epoxy resin matrix based composites because of their favorable mechanical, physico-chemical properties and high strength to light weight ratios. In order to increase the market penetration and because of current stringent aviation and other legislation to increase safety, improvements in flame retardancy have been given significant priority. The organic matrix components are susceptible to combustion and fire damage because of their chemical structures[2].The large variety of organic polymer matrices, both thermo set and thermoplastic, enables composite materials to be used for a wide range of applications in transportation. Composite materials have been increasingly used for various other technical tasks, where it is beneficial to apply lightweight construction materials. Fabrication of fiber reinforced polymer composites shows relatively low cost. Polymer matrix reinforced by fiber is probably the most commonly used form of composites in structural application, automobiles[3].FRP in structural application shows the higher fire resistance of the material.

II. METHODOLOGY

A reinforcement that embellishes the matrix strength must be stronger and stiffer than the matrix and capable of changing failure mechanism to the advantage of the composite. The performance of a fiber composite is judged by its length, shape, and orientation, composition of the fibers and the mechanical properties. The orientation of the fiber in the matrix is an indication of the strength of the composite and the strength is greatest along the longitudinal directional of fiber[4].The poly addition of the hardener with the epoxy resin will then generate hydroxyl groups that can contribute to increasing the cross-linking density of the cured resin[5].

A. Preparation of Composite by Hand layup method

The composites are prepared by hand layup method. The wax,gelcoat applied on a uniform surface. Chopped matt glass fibers (30%)are prepared in proper size and placed above the wax and gel coat applied surface. The Polymer (Resin) are applied on the fiber through brush and the surface evenly rolled by roller. The proportion given as follows, General purpose Resin Proportions: 97% of gp resin,2% ofcobaltoctoate hardener,1%accelerator with wax, gel coat, pva.Epoxy proportions:90% of ly556 epoxy resin,10%hy 951 hardener After the curing of composites, test specimen is prepared as per the specifications.

B. Photos of Specimens

Fig. 1: Polyester specimens for fire retardant laminates test

Fig. 2: Epoxy specimens for fire retardant laminates test

Fig. 3: Gas burner clamped with cylinder tube

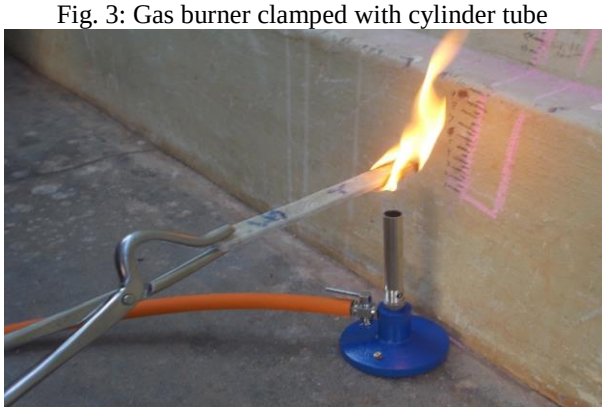

Fig. 5: Polyester specimen exposed to fire retardant laminates test

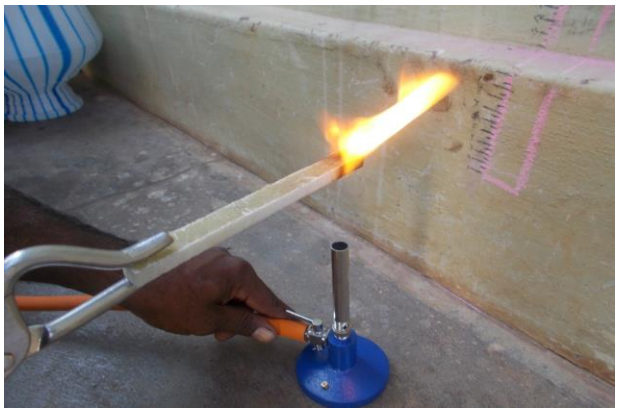

Fig. 6: Epoxy specimen exposed to fire retardant laminates test

III. Results and Discussions

A. Simple Horizontal Burning Test

A strip of material (150mm x 12.5mm) is clamped horizontally and a test flame is applied to one end. The material under test may be a laminate and the test flame can be from a gas burner and the results can be expressed as a burning time, a burning rate or the distance burnt. Tests of this type include BS 2782:1974 Method 508A.

S.no	Composites	Burning Time(min)	Burning Distance(cm)
1	Polyester resin	10	15
2	Epoxy resin	4	10

Table 1: Fire retardant laminates test for polyester and epoxy resin composites.

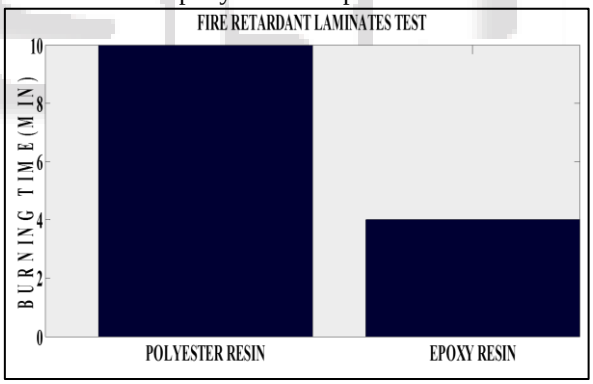

Fig. 8: Burning time(min) vs. Polyester resin and Epoxy resin

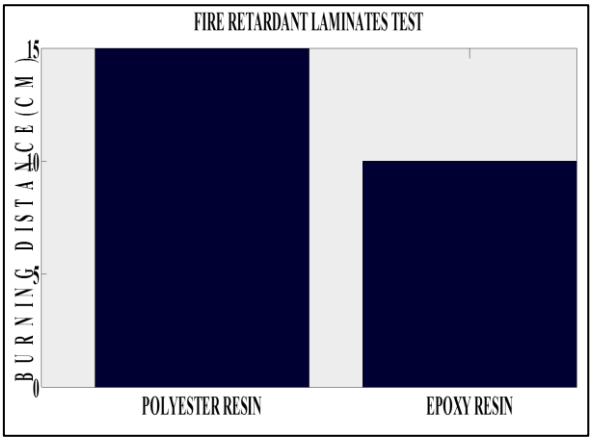

Fig. 9: Burning distance (cm) vs. Polyester resin and Epoxy resin

From the table of fire retardant laminates test the burning time for polyester resin is 10 minutes and the burning time for epoxy resin is 4 minutes. Whereas the burning distance for polyester resin is 15 cm and the burning distance for epoxy resin is 10 cm. Heat release rate of a material measured in small scale tests under simulated radiant exposure conditions is the single most important parameter in characterizing the hazard of a material in a fire. The burner was adjusted to produce a blue flame with a height of 20mm. The flame was applied to the free end of the sample to a depth of 6mm for 30 seconds[6].The fire properties of composite materials depend on several factors such as the type of material, the fire conditions and the test method used to measure the property. Time to ignition is the period of time that a combustible material can with stand exposure to a constant heat flux before igniting and undergoing sustained flaming combustion with the time taken for a material to start burning. The ignition time can be used as a rough measure of the flammability resistance of material. Desirable material with long ignition times in high fire risk applications. Extending the time- to- ignition value reduces the fire hazard of composite material[7].Graph shows the maximum range of values for polyester resin in burning time(min) and burning distance(cm) than the depreciated range of values for epoxy resin in burning time(min) and burning distance(cm).Composite materials are layered and hence, each glass layer acting as an insulator, affects the burning of underlying resin[8].Polyester laminate increases the time to ignition and also duration of burning[9].Epoxy possesses better properties in terms of fire performance in comparison with polyester.

IV. CONCLUSION

Fire retardant laminates test reveals that the burning time for polyester resin is 10 minutes and the burning time for epoxy resin is 4 minutes. The burning distance for polyester resin is 15 cm and the burning distance for epoxy resin is 10 cm.From this it can be concluded that the chopped strand matt powdered type glass fiber with epoxy resin shows better fire retardancy than the chopped strand matt powdered type glass fiber with polyester resin.

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