

Original Article

Effect of the Production Method on the Mechanical Properties of Resin-Fiber S-Glass Composite for the Rocket Nose Cone Application

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Abstract. Composite materials are increasingly developing in industrial advances both for everyday life or technological applications in industry. Composite material is a combination of two or more different components. Composite materials have certain physical and mechanical properties that are better than the properties of each of their constituent components. This research has been analyzed to determine the effect of the method of making fiber composites s-glass matrix resin 100 as material nose cone rocket rx-450 by using the method of hand lay up and vacuum infusion. Making a nose cone is carried out in several stages which are quite complicated, starting with preparation master mole for print beginning until polishing compound molding release on molding as finishing. The results obtained from this study are by using the method vacuum infusion lighter compared with material results method hand lay-up because on method vacuum infusion resin can be removed from the laminate. Whereas on method hand layup infiltration resin in fiber not enough perfect and administration of resin that cannot be controlled so that it can affect the mass from product composite.

Keywords: composite, S-Fiber Glass, Vacuum Infusion, Hand lay-up, Nose cone

1. Introduction

The rapid development of technology currently uses composites based in Indonesia and other countries not yet so popular and in the industrial sector there are also not many who use this technology. The use of composite materials as an alternative to metal materials in the engineering field is increasingly wide spread, not only as panels in the automotive sector but also in rocket technology, namely in the manufacture of nose cone. Nose cone is part which most front rocket that functions as an air breaker so that the nose cone experiences a pressure which strong and could experience crack because of the speed rocket [1].

Making a nose cone is carried out in several stages which are quite complicated, starting with preparation master mole for print beginning until polishing compound molding release on molding as finishing. Process and nose cone making took 28 days from the start making until nose cone the has done made. In making this nose cone, the selection of materials to be used is *S-Fiber glass, hardener* and

resin gurit prime 100. With method which used in process making is method *Hand Lay Up* and *Vacuum Infusion*.

Composites are materials that are the result of a combination of different raw materials, either one or more combinations with the aim of getting certain physical and mechanical properties to be better than the properties of each of its constituent components [2]. Research also conducted by other [3], resulted that vacuum infusion has a level of air absorption so that in the process the air trapped in the metric can be removed so that in this process it does not cause air cavities in the specimen.

2. Materials and Methods

In this research, there were two types of treatment and manufacture of specimens is the manufacture of composite specimens using the vacuum infusion method and the manufacture of composite specimens Specimen Composite Hand Method Lay Up. Making specimens with vacuum infusion, the main tool is a vacuum machine, while in the manufacture of Specimen Composite Hand Method Lay Up is not using a vacuum.

The main material for making the specimens is using s-glass fiber with grit Prime 100 resin. The composite specimen is prepared using the ASTM D3039 tensile test. Then a tensile test was carried out on each composite specimen using the vacuum infusion method with hand lay-up. After testing each of these methods, a comparison of the results is carried out on the comparison of the tensile strength of the specimen, as also presented elsewhere [4].

3. Results and Discussions

The process on making specimen composite method vacuum infusion including smearing fluid Loctite mold cleaner as a lubricant equally on table the place manufacture laminate specimen vacuum infusion for make it easy composite miss from the mold, then laminate the vacuum infusion with the order of 10 layers S-fiber glass, peel ply, flow media and vacuum bag.

After that, make a vacuum tape surround the vacuum infusion composition until there is no air which enter into the infusion, then prepare resin and hardener then due process vacuum and then wait one day until resin dry, Remove the dry vacuum panel from the specimen table and trim the edges of the specimen with a sanding machine so that it is smooth and straight (presented in figure 1). After that, cut specimen use saw with size Specimen 15 mm x 250 mm and Tab 56 mm x 15 mm. After being cut to size then connect the specimen and tab using resin and hardener, until dry so that the specimen to be tested uses standard ASTM D3039 done and ready for in tensile test result (presented in figure 2) below.



Figure 1. Vacuum Infusion Process and Vacuum Specimen Results



Figure 2. Specimens that have been cut

The next process is making specimen composite method vacuum infusions include the application of Loctite mold cleaner fluid as a lubricant equally on table the place manufacture specimen lamination vacuum infusion for make it easy composite miss from table, S-glass resin and fiber coating with a size of 250 mm x 125 mm as much 10 layers use paintbrush and rollers and coating this so that got 4 specimens sized 250mm x 125mm, wait until resin curing. The process can be seen in Figure 3.



Figure 3. Hand Lay Up Specimens and Specimen Cuts

Pieces of dried specimens with a specimen size of 15 mm x 250 mm and Tab measuring 15 mm x 56 mm. Then the specimen will be connected, as shown in Figure 4.



Figure 4. Specimens connected by Tab

As for the results Test Tensile on Specimen The composite that has been done is by getting average variable from results testing as in tables 1 and 2.

Table 1. Average results tensile test composite vacuum infusion

No.	Condition Test	Tensile Modulus (GPa)	Tensile Strength (MPa)	Strain at Break (%)
1.	Room Temperature 31° C	13.74	397.2	5.41
2.	Work Temperature 127° C	5,12	212.94	5.55

Table 2. Average results tensile test composite hand lay up

No.	Condition Test	Tensile Modulus (GPa)	Tensile Strength (MPa)	Strain at Break (%)
1.	Room Temperature 31° C	11.54	388.36	5.01
2.	Work Temperature 127 ° C	5.37	231.82	5.52

The data in tables 1 and 2 are the results of comparison nature mechanic S-Glass fiber composites use two masked methods is vacuum infusion and hand lay-up, which will used for making Noce Cone RX-450 Rocket at the Institute's Rocket Technology Center Fabrication Laboratory Flight and space National. Test this use standardization ASTM D3039 the where dimensions specimen is 250mm x 25mm and fiber which used S-Fiber Glass and matrix resin grit 100.

In the hand lay-up method, the resin impregnation in the fiber is less than perfect and administration of resin that cannot be controlled so that it can affect the mass from product composite. The results from method this very influenced by skills from technician so that no consistent Among product which one product to another. Therefore, vacuum infusion is an improvement from the hand lay-up samples.

Composite with vacuum infusion method has air bubbles which is little compared to the hand lay-up specimens, because it is caused by pump vacuum which suck air which there is in laminate where to put the composite which will be printed. With vacuumed the air in the container then the air that is outside the plastic cover will press in. So that it can produce composite specimens which lighter compared with specimen hand lay-up. It can be seen from picture under which show mass specimen composite results vacuum method infusion and hand lay-up, as in figure 5.



Figure 5. Mass comparison of composite specimens with vacuum infusion method and composite specimens with hand lay-up method

Figure 5 shows the difference in mass in the specimen composite. Composite specimens resulting from the vacuum infusion method have a mass 146.55 grams, and the composite from the hand lay-up method has more mass large is 160.13 grams. From the above results indicate that the specimen The vacuum infusion method composite has a lighter mass because the absence of trapped air bubbles, also the resin can coat the fiber with perfect without existence advantages resin on surface composite. Then table average results testing tensile composite method vacuum infusion and hand lay-up also obtained differences in the value of the tensile modulus (Tensile Modulus), tensile strength (Tensile Strength) and strain at break (Strain at Break).

In the tensile test of the composite specimen the vacuum method infusion scores average modulus tensile it as big as 13.74 GPa, value average tensile strength is 397.2 MPa, and the average value of strain when break up is 5.41%. While in the composite specimen the method hand lay-up, the average value of the tensile modulus is 11.54 GPa and value of the average tensile strength is 388.36 MPa, and the average value of strain moment break up is as big as 5.01 %. From data on could concluded that specimen composite with method vacuum infusion have score strength mechanic which taller compared to specimen composite method hand lay-up, because on specimen composite there is a hand lay-up method excess resin and air bubbles trapped in the specimen. While the vacuum infusion method. ratio fiber with resin which good make density Among matrix and fiber better as well as equally which make specimen vacuum infusion have strength mechanic better, as presented also elsewhere [5,6].

4. Conclusions

Research that has been carried out explains that Material method vacuum infusion better than compared with material results method hand lay-up, Thing the because on method Vacuum Infusion resin can be removed from the laminate. Whereas on method hand lay-up infiltration resin in fiber not enough perfect and administration of resin that cannot be controlled so that it can affect the mass from product composite, besides the results from method this very influenced by the skill of the technician so it is not consistent between products which one with product which other. Specimen composite with method vacuum infusion have score mechanical strength (Tensile Strength, Tensile Modulus, and Stain at Break) which better than compared to specimen composite method hand lay-up, because on specimen composite method hand lay-up there is excess resin and air bubbles trapped in the specimen. While the vacuum infusion method. fiber -to-resin ratio good to make the density between the matrix and fiber better and even which make specimen vacuum infusion have better strength mechanic.

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