EXPERIMENTAL RESEARCH REGARDING VACUUM BAG TECHNOLOGY FOR OBTAINING CARBON/EPOXI COMPOSITES

Paul BERE [1],

ABSTRACT: Today the fiber-reinforced polymer composites are of great scientific and technical interest. This fact justifies both the development of complex research in this area, and extension of the production of such materials.
In this paper the author presented the most important technologies to obtain the composite materials. This is vacuum bag technology. Its show the method and materials used. There are carbon fiber/epoxy. The author traded the influence of number of layers and reinforced degree obtained.

KEY WORDS: Composite materials, carbon fibre, vacuum technologies

1 INTRODUCTION

World technological development has created of new modern materials with superior properties like traditional materials. A new class of materials and products have been developed on the basis of plastic materials in special on the basis of fibre reinforced polymer (FRP).
The polymer composite materials have been developed especially over the past four decades.
These special materials coming from the aerospace domain and today find applications in all areas (Lessard LB, et.al 1995),(Lui T. et.al 1980).
Important researches show both advantages and disadvantages of using them. Over the years different authors have treated in their studies these materials, whether it is of their mechanical characteristics, manufacturing technologies, different domain application. The transfer of aerospace in high performance domain can say that was realized by the 80s.

[1] Technical University of Cluj-Napoca, Faculty of Machine Building, Department of Manufacturing Engineering, B-dul Muncii, 103 - 105, 400641, Cluj-Napoca, Romania,

E-mail: bere_paul@yahoo.com

Their occurrence has been proved a real success. Ever since that time top fields like Formula One (F1) great performance were obtained by using these materials. In 1881 McLaren Company he developed his first chassis from FRP. This revolutionary considered as shape and performance, decisively changed the automobile industry. After this success, all participating teams in F1 have successfully used these materials. Due to the physico-mechanical properties that have, these materials are used successfully today, and being very difficult to replace with other materials.
Their use in F1 domain were led to some the special aerodynamic body shapes and physical-mechanical proprieties superior aluminium alloy or steel.
The performances by F1 cars were spectacular. An important problem in this area appeared safety of the drivers.
Because of the high speeds and frequent accidents from this domain the organizers were forced to impose conditions on construction of these cars. Today we can say that the regulations change annually and both at involve changing at body shape as well the other component systems of the car. Approach of these materials by researchers involved and finding new solutions to obtaining them and especially rapid solutions.
Dynamic development in this area is very fast which includes the use of modern manufacture and control methods. A new manufacturing method in this area involves using the latest rapid manufacturing technologies used

worldwide. Different authors proposed some rapid manufacturing technologies to obtain a prototype and FRP pieces (Leordean, V.D, et.al. 2011), (Coman, A, et.al., 2013), (Sabau, E, et.al, 2010), (Panc N., et.al, 2011), (Chhabra, M.a & Singh, R.b.2011), (Kumar, S.a & Kruth, J.-P 2010), (Udroiu, R, et.al. 2011).
Another authors have treated in their papers this top domain of the global technology where is used FRP (Savage, G.,2010), (Cocco, L. and P. Daponte,2008), (Lai, H. and W. Xiao, 2012), (Saddington, A. et. Al. 2007), (Savage, G. and M. Oxley, 2010).
The authors presented in this paper the influence of layers numbers on reinforced degree in obtaining FRP. The manufacturing method used is vacuum bagging. It’s presented manufacturing method to obtain plates from Carbon/epoxy composites.
The vacuum bagging technology is the very important technologies in obtaining the high performance composite materials. This is most frequently used.

2 METHODS AND MATERIALS

2.1 Materials

Were used carbon fibre plain weave fabric 3K, 200 g/m^2 . The hickness of reinforced material layer was 0.3 mm
For the matrix was used an epoxy resin, type Epiphen RE 4020 / DE 4020. The mixing ratio parts by weight were 100:30, according to the manufacturer recommendations.
The epoxy resin Epiphen RE 4020 / DE 4020 characteristics.
- Aspect: transparent;
- Pot life at 20 ºC - 45 min;
-Viscosity Brookfield at 25 ºC – 300 mPa.s;
- Gelling time (thin layer in hours at 20°C), 8 - 9 hours
-Density la 25 ºC - 1150 kg/m^3;
- Curing at 20 ºC, 24 hours

The technology to obtain the plates was vacuum bagging (Figure 1).
Were manufactured plates from these materials by 3-4...7 layers of carbon material. The plates were noted by P1-P5. For P1plate which include 3 layers of carbon material, P2- 4 layers, P3- 5 layers, P4 -6 layers, P5 -7 layers. The same orientation of the fibbers in the all plates was keep. This it was [0^0-90^0].
In the case of the used plain fabric, 50 % of filaments (warp-fabric) are parallel with the longitudinal direction, which is 0°, next 50 % oriented along the transverse direction, which is 90° (woof fibre).

2.2 Manufacturing method

In al the cases was applied vacuum bagging technology.
The layers were applied on the plate mould and impregnated with epoxy resin. The laminating was hand layup procedure. The wet composite were covered with perforated folia and absorbed textile.
All were included in a vacuum plastic bag.
The vacuum bag were closed and applied a vacuum pressure (figure 1)
The vacuum pressure were -0.9 Bar

Figure 1. The vacuum applied to the mould

After vacuum applied all the excess of the resin penetrated the perforated folia and absorbed in textile material. The applied pressure on wet composite material is constant. The air bubble from composite is eliminating and the excess of resin (Figure 2).
This technology allows obtaining very good and compact composite materials. The mechanical characteristic of the composite plates is constant and high.

Figure 2. The vacuum applied to the mould determine the elimination of resin excess

The pressure applied on the composite surface causes the matrix to be removed. The process may be improved by the introduction of the assembly in an oven. Therefore the matrix becomes more fluid and can be removed easily To make a rapid polymerization process will run in an oven at 60 º C. The process takes 3 hours, after the laminate is heated to 20 °C (Figure 3.). For all the plates were subjected to the same polymerization treatment. Throughout the polymerization process of the composite materials the vacuum pressure were applied.

Was proceeding to the release of the composite at the final time. It gradually removes the bag, textile absorbing, perforated folia, and then releases the composite materials on the mould.

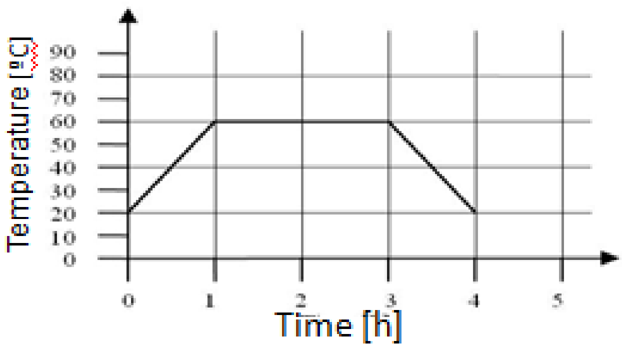

Figure 3. Temperature/time composite polymerization diagram

Precede the composite weighing and measuring dimensions. Obtained are analyzed visually pleasing appearance and possible defects

The plate copied the mould surfaces in one part and in opposite the surface is irregular. This is a characteristic of vacuum bagging technologies for obtain the composite materials.

Vacuum bag forming process is a simple main method. For its realization it is necessary to use additional materials of a vacuum process that increase the cost of the final product. By this procedure, uniform composite structure is obtained, with a higher degree of reinforcement, better compacted

Were obtained carbon/epoxy composite plates.

3 RESULTS AND DISCUSSION

In table 1 is presented weight of the plates and the density o composite materials obtained

To determine the physical characteristics of the plates these were weighed and measured

How is indicate in Table 1 the reinforcement degree is not constant.

In the same time with the increase the number of layers of reinforcement decreases.

Table 1 The characteristic of composite plates

Notation.	Weight of reinforcement (g)	Weight of composite (g)	Reinforcement (%)
P 1	37,5	51	72
P 2	50	74	67,5
P 3	62,5	95	65
P 4	75	116	64,6
P 5	87,5	136	64,3

In Table 2 is presented the density of composite and the final thickness of composite plates.

The density of composite plates is around 1100 Kg/m$^{3.}$ In the same time with the increase of number of the layers the value of density is higher.

Also how is possible to observe, there is a reduction in the thickness of the final plate. The thickness of the layers is not value of the sum.

Table 2 . The characteristic of carbon/epoxy composites plates.

Notation.	Density of composite (kg/m^3)	Thickness of layer (mm)	Nr. of layers	Thickness of composite (mm)
P 1	1087,9	0,3	3	0.7
P 2	1148,8	0,3	4	0,9
P 3	1169,2	0,3	5	1,3
P 4	1173,3	0,3	6	1,5
P 5	1195,2	0,3	7	1,7

The thickness value of composite materials being lower. In the laminating and pressing process the free spaces between filaments is completed with the previous layers of that (fabric is rare). This makes a smaller reduction of the final thickness of composite materials.

As shown in Figure 4. With the increase in the number of layers decreases the degree of reinforcement of the composite material from 72% in the case of the 3-layer laminate for the laminate layer 7.

With the decrease in the degree of reinforcement increases the density of the material from 1087 kg/m^3 to 1195 kg/m^3.

The percentage increase the density is 10%.

With increasing number of layers reinforcement degree decrease. These phenomenon can be attributed to insufficient pressing.

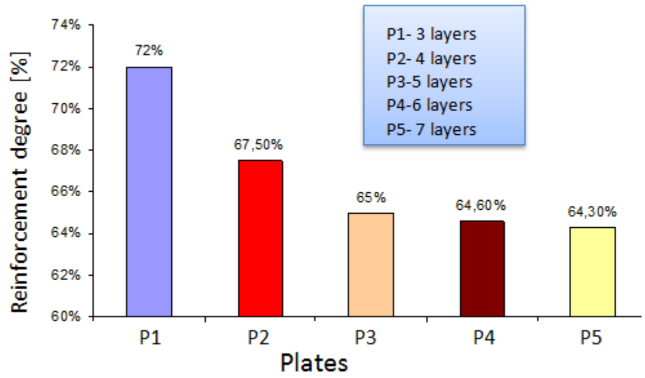

Figure 4 The influence of the number of layers of reinforcement degree

Having multiple layers of fabric, the resin in bottom layer can not be extracted by the vacuum pump. It must moving through the layers of material to the exterior.

So some of resin remains in the lower layers reducing the degree of reinforcement.

The phenomenon of decrease in the degree of reinforcement with the increasing number of layers indicate that is necesary to vacumed a smaller number of reinforced layers.

4 CONCLUSIONS

In vacuum bagging technologies to obtain the composite materials, with the increase the number of layers of reinforcement decreases.

Using this method is necesar to vacuumed a smaller number of layers. This technology allows obtaining very good and compact composite materials. The mechanical characteristic of the composite plates is constant and high.

With the increase in the number of layers decreases the degree of reinforcement of the composite material from 72% in the case of the 3-layer laminate for the laminate layer 7.

The density of composite materials obtained for plates is variable and is influenced by number of the layers.

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