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Study of Vacuum Bagging Process

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ABSTRACT: Fiber-reinforced polymers composites like Carbon Fibers have multidimensional uses in many industries, but the fiber sheets or yarn in its initial stages are not rigid enough to be directly used in making various components. One of the procedures used in the making of composite materials is Vacuum Bagging which is the most time-saving and economical way of doing it. The Authors, through this paper, would elaborate on the Vacuum Bagging procedure and its advantages and disadvantages.
Keywords: **Fiber, Composites, Vacuum Bagging**

I. INTRODUCTION-

Vacuum bagging is the technique of creating mechanical pressure on a laminate when it is in its cure cycle. Pressurization of a composite has various functions.

- It is used to remove air that is trapped between layers.
- It is helpful in reducing humidity.
- It is helpful in compacting the fiber layers, which prevents the shifting of fiber orientation during its cure and provides efficient force transmission among the various fiber bundles.
- It optimizes the fiber to resin ratio in the composite part.
- These certain advantages have allowed racing and aerospace industries to utilize the composites to their maximum potential.

Figure 1: Vacuum Bagging Process

II. MANUFACTURING PROCESS-

Preparing a frame protector using composite mould Before we start, we make sure that we are using a mold that has epoxy or vinyl ester Gelcoat which ensures a reliable and easy reliable release from the mold. To prevent the laminated part from sticking in the the mold we use release wax .5 applications of wax are added by swirling the wax on, then after that we wait for 10-15 minutes and buff the wax to a shine before the next application

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Figure 2: Application of mold release wax to the mold

The pieces of equipment needed are high-quality epoxy laminating resin, along with mixing cups, gloves, and laminating brushes. We also require digital weighing scales for measuring the correct resin ratio for measuring the mix ratio of fast hardener and epoxy laminating resin. To vacuum bag the part using conventional industrial materials and equipment, we used our EC4 dual-stage composites vacuum pump, VB160 vacuum bagging film, PP180 peel ply, BR180 breather cloth, ST150 sealant tape, and a through-bag connector.

Figure 3: Materials and types of equipment.

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Figure 4: Cutting reinforcement of carbon fiber cloth

The carbon fiber cloth can be cut with the help of household scissors. To make sure that we cut the carbon fiber cloth is cut straight, we make a snip, and a single carbon fiber tow is pulled out, allowing us to cut the line quickly.

Figure 5: Preparation of the vacuum bag.

The vacuum bagging film is firstly cut into a folded sheet (it should be larger than the component which we are going to place inside it).sealant tape is applied around the edge of the bag, making it ready to form the seal. Then a tiny hole is made, and a TBC 2 through bag connector is passed through the hole and closed .a breather cloth patch is then positioned below the connector, which makes sure that an air path between the connector and where the part will be positioned.

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Figure 6: Measuring and mixing of the resin

Epoxy laminating resin should be accurately measured and thoroughly mixed according to the instructions. Once mixed, the resin's pot-life is around 10 mins, so after that, we should start laminating immediately.

Figure 7: Lamination of the Part.

The better way to do the hand lamination of the carbon fiber part properly is to treat the gently
reinforcement and not dragging it too much with the roller and brush and also resins should also be avoided as much as possible since it adds much more weight to the part than it should. There are specific steps with which we can laminate the part properly:

1. First, we need to apply a liberal coat on the mold directly; the resins seem to be a completely normal pull, especially in the mold, which is highly waxed.
2. Then, the layer of the first cut carbon fiber cloth is directly onto the mold's wet resin. When we pushed the carbon fiber more deeply into the mold's surface, the resin helps the carbon cloth be at the place firmly.
3. When the layer looks much wet, another layer of resins is applied to the same layer very rich in resins; after this, another layer of the dry carbon cloth is added to the wet resin layer. Again, the same process is followed as in the first step; the layer is pushed deep on the mold's surface such that the resins started to drive into the new dry layer from below.This entire process is repeated until all the layer of the carbon cloth laminated into the mold.

Figure 8: Vacuum bagging of the part.

There are many possible combinations are available of vacuum bagging consumables, and vacuum pressure is used to do the vacuum bag lamination. The final choice of using the correct combination depends on what kind of qualities are required for the finished part.

For example- If we need to have a perfect surface finish, we need to keep the vacuum low at around 15-20 percentage. These combinations can be used for a peel ply and a breather cloth. We can still achieve a smooth finish with a high vacuum pump, but in that case, we need to use a vacuum regulator to reduce the vacuum to a minimal level. There are also various positions of the vacuum in which it is should be kept; it should be carefully positioned so that any bridging of the film is avoided from the inside of all the corners, and we also need to make sure to push it to all the parts of the mold ultimately.

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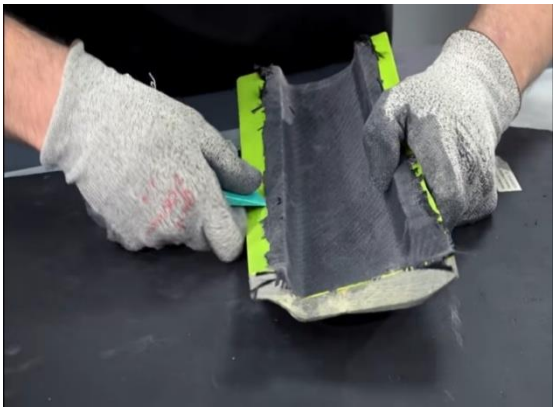

Figure 9: Demoulding of the cured part.

The part is removed from the mold when it is fully cured. One needs to be careful of any sharp
splinters possible. There is also an indication of a fully cured part, which is the sound of the 'ringing' ithe sound is not ringing; instead, it is dull.

III. ADVANTAGES

1) It can be used to manufacture large parts like wind turbine blades, and for other industrial applications.
2) It has a relatively low cost.
3) Due to uniform application in all directions, it produces an even consolidation.
4) The upper surface has a relatively better finishing.
5) Due to the vacuum, degassing becomes more straightforward, and the number of bubbles and voids are also reduced.

IV. DISADVANTAGES

1) The process is highly complex.
2) The part size gets limited due to the size of the mold.
3) It is required to change and tailor the bag according to part and mold shape.
4) It requires additional capital for the vacuum device.
5) This process generates a lot of waste –the vacuum bag, breather fabric, and peel ply are thrown away after their use.
6) Good surface finish is provided only on the tool side of the part. The bag side has a relatively less good surface finish.

V. ACKNOWLEDGEMENT

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VI. CONCLUSION

Vacuum Bagging is the most sought-after technology to obtain composite material. It has both advantages and disadvantages like the process are labor-intensive and time-consuming but has advantages like can be used for manufacturing large products like wind turbine blades. Following of correct procedure at each stage is required at each step for getting the exact product.

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