

# RESEARCH OF MEDIA-PRESSURE CARBONIZATION ON 2D WINDING C/C COMPOSITES

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## Introduction

Carbonization is a vital working procedure in making C/C composites. If not selecting the process parameter of carbonization properly, the delamination will occur. At first, some company came up against the delamination during their research working. Finally they explored a suitable normal-pressure carbonization(NPC). But subsequently they adopted pressure carbonization(PC). The work efficiency of NPC is very low, it may last for 15 days or more, so many researchers are researching the method of PC process of 2D C/C.

## Experimental

### Winding process

#### Raw material:

carbon fiber: PAN 6K  
strength: 2800 ~ 3200MPa  
modulus: 200 ~ 220GPa  
crack elongate coefficient: 1.2 ~ 1.4%

barium phenolic resin

#### Winding parameter:

winding angle: 34° ~ 40°  
winding direction:

screw winding intercross between  
length and encircle

The sample is a cone whose dimension is  $\phi 360 \times \phi 200 \times 400$ mm. It is preformed by dry-method winding.

### Cure process

The preformer is placed in a rubber bag, then cured in the hot-pressure stove. The cure parameters is as follows:

cure pressure: 2 ~ 3MPa

After cured, the preformer's inner facies is glabrous.

### Media-pressure carbonization(MPC)

The MPC is made in pressure-carbonization stove. The calefactive rate is 5°C/h between 300 ~ 500°C, so that the smaller molecule can volatilize slowly. The pressure is added at 2.5MPa at 160°C, then added to 9.8MPa slowly.

The total time of MPC last 35 hours. At last, the product is made.

## Results and Discussion

The cone does not occur delamination. So that the MPC process is feasibility.

The shear strength of the materia is tested. The results is listed in Tab.1. For compare, the shear strength of the material made by NPC also listed.

Tab.1 Compare of shear strength of MPC and NPC

Process	Density g/cm <sup>3</sup>	Shear strength MPa	S	Cv %
NPC	1.250	5.82	0.8	14.4
MPC	1.405	19.3	1.7	8.92

The barium phenolic resin's saturated steam pressure(SSP) is lower than 2.5MPa at 350°C. So it is effective to prevent smaller molecule volatilization that the sample is added 2.5MPa at 160°C. The main reason of 2D C/C's delamination is the volatilization of the smaller molecule and the shrinkage of the matrix. So when the rate of volatilization of smaller molecule is decreased, the odds of delamination is descended greatly.

Along with the elevation of temperature, the resin's SSP also increase which get to 5 ~ 9MPa at 550°C. So at that time, the pressure of the stove must increase accordingly.

## Conclusion

1. MPC is feasible to make 2D C/C. It can decreased the delamination greatly.
2. MPC expend litter time than NPC. For example, in this process, the product spend only 35h to finish carbonization by MPC, whereas it may spend 360h to do by use NPC.
3. Due the decrease of delamination, the material's shear strength is increased greatly.