



IMPACT OF CARBON FIBER IN PUR INJECTION

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Abstract : Trim parts with different surfaces are a way to combine functionality and aspect in a vehicle. Most vehicles have trim parts with surfaces such as veneer, aluminium, plastic and also carbon fiber.

The POLY/ISO mixture is predefined and altering it can make the surface more opaque or with presence of a foam like substance. This process requires a controlled environment from humidity and temperature point of view, also raw parts, material and machine should have the same temperature .

The purpose of the paper is to define the impact of the carbon fiber weave and how different parameter manipulation can affect the quality of the surface.

Keywords: : PUR injection; mold; carbon fiber; waviness

1. INTRODUCTION

The PUR lacquer technology means injecting plastic parts with a transparent and translucent cover that acts as protector for the veneer and offers an elegant look to the vehicle[1]

Carbon fiber trim parts are more difficult to produce taking into consideration the fact that the process is based more on a manual labor, referring to cutting and adhesive appliance.

When injecting PUR parts, we must have optimal temperature of the part, mold and material, between 80-90 °C.

Not respecting these rules may lead to incomplete injection, delamination, errors in mold computer(Fig.1)[2][4]

A mold that has not reached the optimal temperature will not start and a part that has not been tempered accordingly will have delamination(the lacquer injected on the surface will not make contact and we will have a “peel-off”effect)

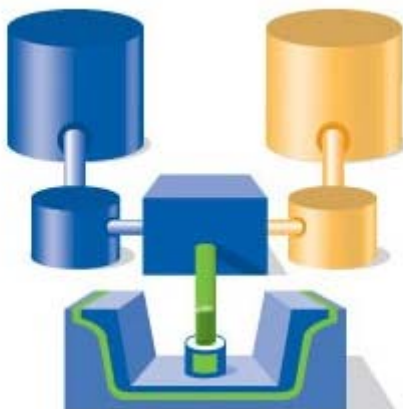


Figure .1 Schematic representation of material forming (POLY+ISO)

2. Material types and application methods

The weaving pattern of the carbon fiber has the most impact in the production process and can produce different types of defects:

•Plain Weave as depicted in Fig.2

◦This type of weave is common for smaller, less complex shapes, similarity to a chessboard

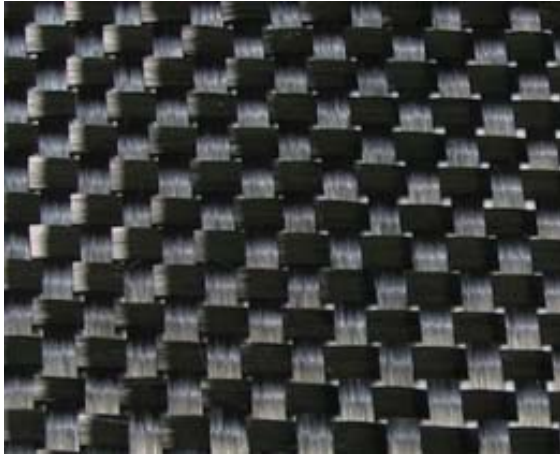


Fig.2 Plain weave

•Twill Weave

◦This is the most common type of weave, and is stronger than the plain weave. Twill weaves are looser than plain weaves, which allows them to drape around 3D shapes and complex curves easier as represented in Fig.3)

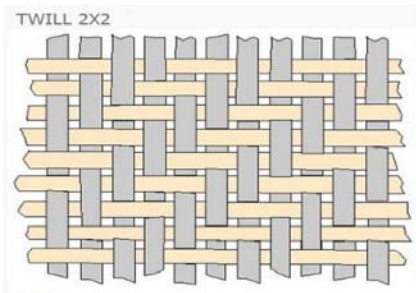
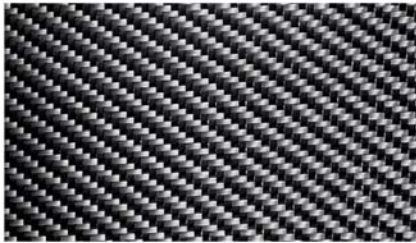


Fig.3 Twill weave representation

The simple carbon fiber weave can be difficult to apply manually, seeing as it has less threads than a twill weave it can easily deform when cutting / shred at the edges.

In PUR injection, the plain weave can have a negative impact on the part. A loose weave means there is air trapped inside the structure and when injecting the lacquer on the surface, the high pressure will release that air in the form of bubbles. When using simple weave in production it is best to use the lining process but apply a small quantity adhesive before to strengthen the fiber .The twill weave is more reliable in the injection process but a tight strain will show on the lacquer surface as waviness .

Waviness in carbon fiber trim parts is a subject treated separately as it can be influenced from parameters depending on shape, type of fiber and prior processes.

There are 2 methods of applying adhesive on carbon fiber :

- Lining – which is applying an adhesive sheet of vliess on the backside of the fiber which will make the material more rigid and after that it will be cut into required shapes with a cutting knife>> next step to plastic injection
- Applying a special adhesive directly on the fiber with a pulverizing gun and after a 15 minute wait, manually applying it on the plastic part ;

Both processes present both advantages and disadvantages. Lining the carbon fiber is a more stable process, with adequate tooling but not suitable for parts with complex geometry. This process is used on small parts which do not have deep exhaust channels on edges seeing as how the rigidity of the fiber sheet will not permit it to mold on the plastic cast ;

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3.Parameter manipulation and effects

The purpose of this experiment was to see how the parameters like the closing mold pressure or the time between closing the two molds (lower and upper) can affect the quality of the surface when using carbon fiber coverage . On carbon fiber trim parts injected through PUR process the most common scrap types are:

- waviness of the material –instead of a clear ,mirror like surface when evaluated at correct angle the image reflected is distorted represented in Fig.4
- bubbles- presence of air cavities inside the lacquer shown in Fig.5- it can be either from injecting valve or because of the fiber weave[5]

Manipulating the parameters can lead to either a qualitative part or scrap as shown in table 1

Table 1. Parameter manipulation effect on PUR parts

Parameters	Waviness	Bubbles
P1	Decreased	Increased
P2	Decreased	Increased
T	increased	decreased
G	increased	decreased

P1- closing pressure of the upper mold (bar)

P2- closing pressure of the two molds (bar)

G-quantity of material injected (grams)

T-time between P1,P2 (seconds)

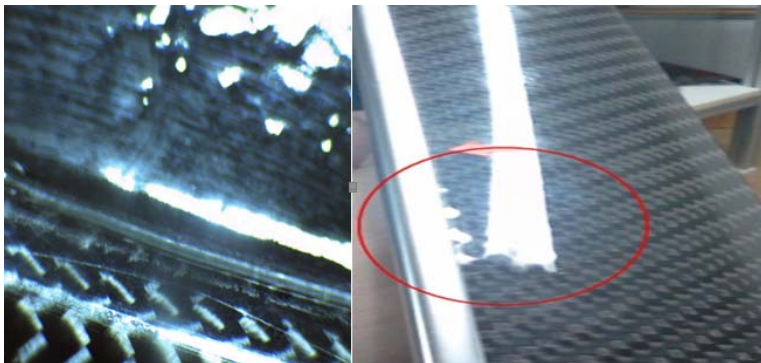


Fig.4 Waviness due to pattern of fiber



Fig.5 Bubbles formed in lacquer

4.Data interpretation

When decreasing the closing pressure of the mold and the pressure of gripping at the same time with increasing the time and the quantity it was observed that the waviness pattern decreased.

When increasing pressures at the same time as lowering the quantity of injected material and time, there was a decrease in scrap regarding bubbles /pinholes

A significant part in parameter research is the analysis of the parts geometry, it is unlikely that a set of parameters could be optimal for two or more different parts. A part which has deep edges or considerable length will automatically need a high quantity of material used and also higher pressures in order for the mold to be able to fully cover the part with material[3]. The final result after injection has to be a transparent layer of lacquer, clean without defects, this can be influenced by the extraction agent.

The compromise on the parameters should be to eliminate bubbles and decrease waviness effect.

5.Conclusion

For producing saleable trim parts with carbon fiber surface covered in PUR injected lacquer, there must be done a thorough research of the geometry of the part, the chosen carbon fiber pattern in order to choose appropriate application methods and correct parameters

References

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