MME 476

POLYMER AND COMPOSITE SESSIONAL

Experiment No: 04

Name of Experiment: Processing of Fiber Reinforced Polymer Matrix Composite

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Date of Submission: 12 September,2023

Objective:

The objective of this experiment is to prepare fibre reinforced polymer composite by hot compression method and by hand layup method. By hot compression method, nylon reinforced polypropylene composite was prepared, and by hand layup method, jute reinforced polystyrene composite was made.

Introduction:

Fibre reinforced composites are widely used throughout the world. They have excellent strength, stiffness, lightweight and good toughness. 2 common methods to form fibre reinforced composites are hot compression method and hand layup method. Jute and nylon are some well known fibre reinforcements. Polypropylene and polystyrene are widely used as polymer matrix.

Used materials:

1. Polyester resin
2. Polypropylene
3. Jute mat
4. Nylon mat
5. Initiator(peroxide)

Equipment:

1. Tray
2. Paint brush
3. Bowel
4. Duster
5. Hand gloves
6. Syringe
7. Roller
8. Hydraulic hot press machine

Methodology for thermoplastic composite:

1. A clean mold was taken and mold release agent(silicon) was applied onto it.

2. A layer of polypropylene was spread on the mold surface.
3. A nylon mat was placed on the layer and another polypropylene layer was spready over it.
4. The mold was closed and it was placed inside a hot compression unit.
5. Heat and pressure were applied inside the hot compression unit which in this case was a hydraulic hot press machine and the mold was held at 180°C for about half an hour.
6. Then the mold was taken out of the machine, allowed to cool down.
7. Lastly, the composite was taken out of the mold.

Methodology for thermoset composite:

1. Hand layup technique was used to fabricate unique sandwich panel.
2. At first, the tray was cleaned and the dimensions were measured carefully.
3. Volume of the specimen was measured taking density of polystyrene resin as 1.1 g/cc.
4. The length, width and thickness of the mat and fabric supplied were measured.
5. The weight of the fabric per square meter was calculated. Densities of jute was taken as 1.3 g/cc.
6. 74g of polystyrene resin was taken. In the experiment, the initiator taken was 5% of the volume of the resin taken.
7. The initiator(peroxide) was thoroughly blended and one layer of resin was applied on the tray and it was spread with a brush.
8. Next a ply of jute was applied and on top of it resin was applied and spread once again with a roller.

Calculation:

Thermoplastic Composite (Nylon Reinforced PP)

Length of Nylon mat = 15.4 cm

Width of Nylon mat = 15.3 cm

Thickness of Nylon mat = 0.095 cm

Volume of Nylon mat = 15.4 X 15.3 X 0.095 cc = 22.38 cc

Weight of Nylon mat = 11 g

Length of composite = 14.7 cm

Width of composite = 14.7 cm

Thickness of composite = 0.35 cm

Volume of composite = 14.7 X 14.7 X 0.35 cc = 75.63 cc

Weight of composite = 65 g

Volume fraction = Volume of mat/ Volume of composite = 22.38/75.63 = 0.30

Weight fraction = Weight of mat/Volume of Composite = 11/65 = 0.17

Thermoset Composite (Jute Resin Composite)

Length of jute mat = 20.6 cm

Width of jute mat = 20.4 cm

Thickness of jute mat = 0.07 cm

Volume of jute mat = 20.6 X 20.4 X 0.07 cc = 29.42 cc

Weight of jute mat = 11 g

Length of composite = 20.6 cm

Width of composite = 20.4 cm

Thickness of composite = 0.14 cm

Volume of Composite = 20.6 X 20.4 X 0.14 cc = 58.83 cc

Weight of the composite = 85 g

Volume fraction = Volume of mat/ Volume of composite = 29.42/58.83 = 0.5

Weight fraction = Weight of mat/Weight of Composite = 11/85 = 0.13

Figure 1 : Nylon reinforced polypropylene composite

Figure 2 : Application of resin over jute matrix for hand layup method

Figure 3 : Jute reinforced Polystyrene resin composite

Discussion:

The composite prepared by hot pressing required less time compared to hand lay up method. Whereas the first method took about 30 minutes, the second method took about 1 day to harden. Both were bubble free. The specific application that would be used determines which method is to be used. Again , the hot pressing method caused greater environmental pollution.