

Additional Questionnaire : Manual Methods

Question 1 : Classify the following techniques according to the Technique.

- Manual
- Automatic or Semi-Automatic
 - Centrifugation
 - Low-pressure compression molding
 - Pressure bag molding
 - Stamping Thermoplastics (RTF)
 - Resin injection molding (RTM and RTM light)
 - Simultaneous projection molding
 - Compression of BMC and SMC
 - Pultrusion
 - Filament winding
 - Vacuum molding and autoclave.
 - Contact molding
 - Reaction molding (RIM)

Question 2 : Vacuum Molding

There are two main techniques of vacuum molding :

- Vacuum bag molding
- Infusion molding

Here are the consumables used for these two techniques :

- Breather
- Vacuum line
- Vacuum pump breather
- Peel ply
- Vacuum bagging film
- Net bleeders
- Sealant tape
- Vacuum pipe
- Perforated film

Find for each technique :

Which consumables to use.

The different steps of implementation (in the right order).

Which consumables are common to both techniques.

Question 3 : What is of interest in infusion compared to vacuum molding ?

- | | | | |
|---|------------------------------|------|-------|
| ➤ | Saves time | True | False |
| ➤ | Saves resin | True | False |
| ➤ | Limits VOC | True | False |
| ➤ | Better mechanical properties | True | False |
| ➤ | Savings on consumables | True | False |
| ➤ | Two smooth surfaces | True | False |

Question 4 : Degassing

Degassing consists in removing air pockets with a spiked roller.
It is necessary for the following techniques :

- | | | | |
|---|---------------------------------|-----|----|
| ➤ | Vacuum bag molding | Yes | No |
| ➤ | Stamping thermoplastics (RTF) | Yes | No |
| ➤ | Resin injection molding | Yes | No |
| ➤ | Simultaneous projection molding | Yes | No |
| ➤ | Vacuum molding | Yes | No |
| ➤ | Autoclave molding for prepregs | Yes | No |
| ➤ | Contact molding | Yes | No |

Question 5 : Contact molding

Contact molding is also called lamination molding.

Details of the process for a glass polyester piece :

Complete the following using a 360mm*230mm piece as an example.

Technique : Contact molding at room temperature 15 to 25 ° C

Material : Gel Coat applied by hand + Pre-accelerated polyester resin + fiberglass + MEKP*

* Methylethyketone Peroxyde

Tools :

- Wax
- Pieces of Cloth
- Brush
- Container (basin)
- Scales (to the gram)
- Catalyst Measure (pipette)
- Spiked roller
- Solvent (acetone) to clean up the tools

Preparing the piece :

N°	Operation required
1
2
3
4
5
6
7
8
9

10
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Preparing the material :

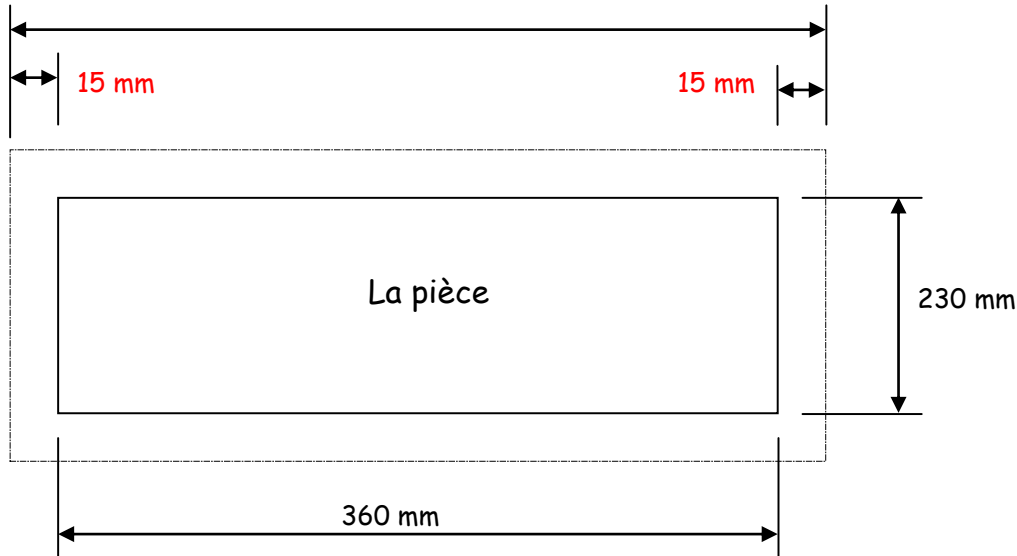
<p><u>Gel Coat :</u></p> <p>- By hand: Ratio from to g/sqm Thickness = mm</p> <p>- With a gun : Ratio from to g/sqm Thickness =mm</p>

Example.

Find the surface of the following piece : you need to obtain a 360mm*230mm rectangle but the gel coat and the resin do not spread uniformly.

We will lay : 1 mat 100, 1 mat 300, 1 roving 450

Cutting out the piece :



The dimensions of the Inscribed Rectangle (IR) and therefore the reinforcement flows will be :

IR = [.....+(2×15)] × [..... + (2×15)] **which equals to :**

IR = (width + 30 mm) × (length + 30 mm)

IR = 101400 sqmm **we convert it into sqm** because the basis weight is given in g/sqm

IR = sqm

➤ Calculation of the Gel Coat mass : 800 g/sqm by hand

Gel coat mass = ×

600 g/sqm with a gun

Therefore gel coat mass = * = g Thus **..... g**

Polymerization time :

- 45 minutes for the Gel phase
 - 1 hour for the setting
 - 1 H 30 for the full setting
 - 2 H 00 to unmold
 - 21 days for a complete polymerization
- Clean tools during polymerization.

Preparing the reinforcements (Mats – Roving)

Mats : We lay the surface mat (basis weight 100 g/sqm) during the Gel phase

Nomination	Basis weight (g/sqm)	Thickness (mm)
Mat 100 (surface)
Mat 300

Roving : in order to obtain a mechanical resistance

Nomination	Basis weight (g/sqm)	Thickness (mm)
Roving 450

Calculation of the reinforcement mass :

Reinforcement mass = ×

\downarrow $E_n \text{ (m}^2\text{)}$
 \downarrow $E_n \text{ (g/m}^2\text{)}$

Hence for our example :

Mass of the Mat 100 = × = g

Mass of the Mat 300 = × = g

Mass of the Roving 450 = × = g

Preparing the resin :

Type of reinforcement	Relation	Ratio (no unit)
Mats	
Roving	

Calculation of the resin mass :

Resin mass = *

\swarrow \searrow
3 for the mats

2 for the roving

Our example :
 Resin mass for the Mat 100 = × ... = g
 Resin mass for the Mat 300 = × ... = g
 Resin mass for the Roving 450 = × ... = g

Preparing the catalyst (To use when utilizing the Gel coat and resin. It allows to start and accelerate the polymerization.)

Gel Coat and resin are also called matrixes

Type of Matrix	Percentage
Gel Coat %
Polyester resin%

Calculation of the catalyst mass : MEKP = Methylethyketone Peroxyde

MEKP mass = ×
 2% for gel coat
 1,5% for resin

With our example :
 Mass of the catalyst to be put into the Gel coat = (.....×.....) / = g
 Mass of the catalyst to be put into the resin to « set » the Mat 100 :
 Catalyst mass = (.....×.....) / = g
 Mass of the catalyst to be put into the resin to « set » the Mat 300 :
 Catalyst mass = (.....×.....) / = g
 Mass of the catalyst to be put into the resin to « set » the Roving 450 :
 Catalyst mass = (.....×.....) / = g

Lamination :

Lamination requires a lot of technique to obtain good-quality composites with excellent mechanical features.

Lamination Technique :

Spread the (catalyzed) in a uniform layer on



Apply

Impregnate with 1/3 of the remaining resin

..... with the brush

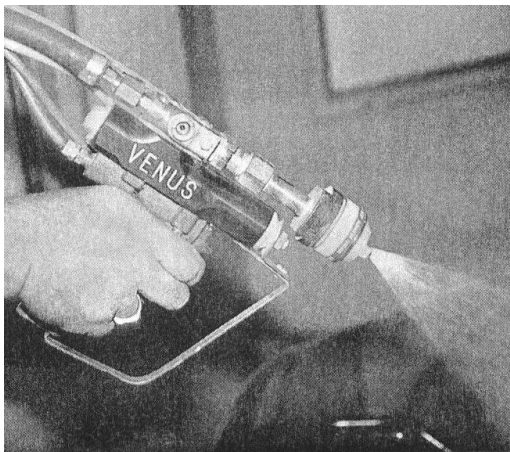
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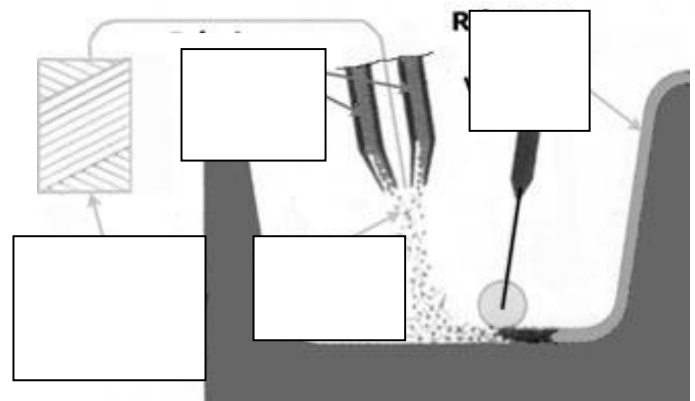
Repeat for the next reinforcements.

Question 6: Simultaneous Projection Molding

Explain the principle and fill the blanks.

In this process, derived from contact molding, we lay material with a _____ that cuts the glass roving and _____ it on the mold at the same time as the resin. The degassing operation is processed _____ like contact molding. This technique also requires a meticulous preparation of the mold surface (____) and the application of a _____



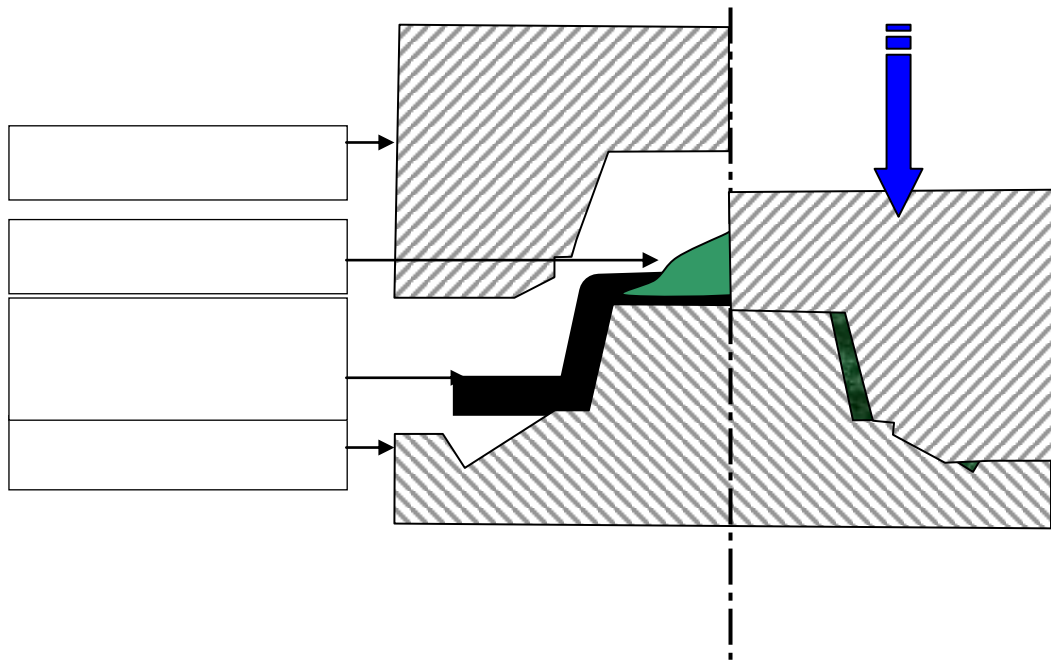


Simultaneous Projection

Question 7: Low-Pressure Molding

Complete :

Molding made by cold compression of a reinforcement between _____ and _____.
 Polymerization occurs at room temperature.



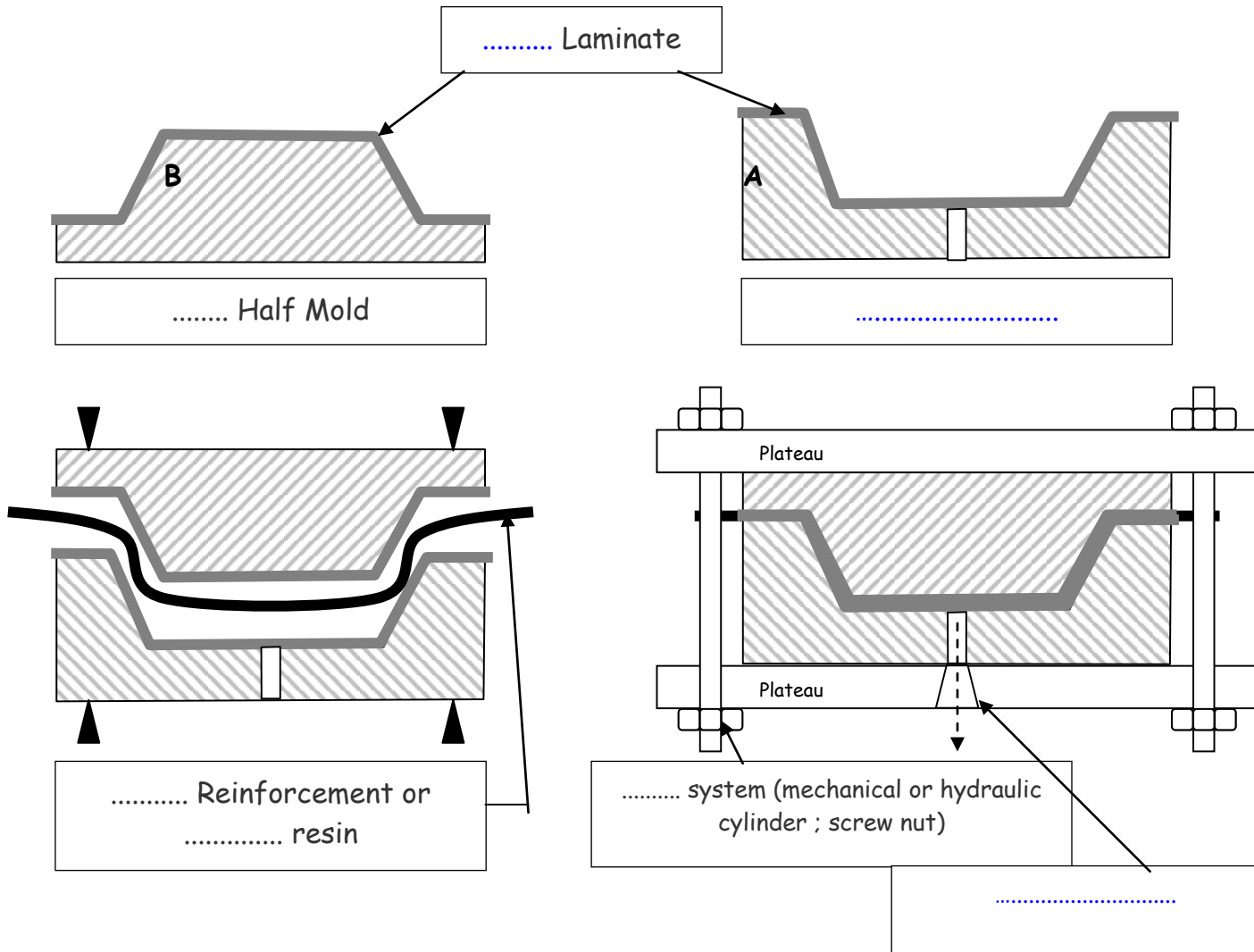
Cold press : Using the resin exothermicity of its polymerization to build up the calorific energy in the mold.

Molding pressure : inferior to _____ b.

Pace : _____ to _____ pieces per hour.

Question 8: Press Contact Molding

Complete:



Advantage	Inconvenient
<ul style="list-style-type: none"> • Two faces 	<ul style="list-style-type: none"> • draping