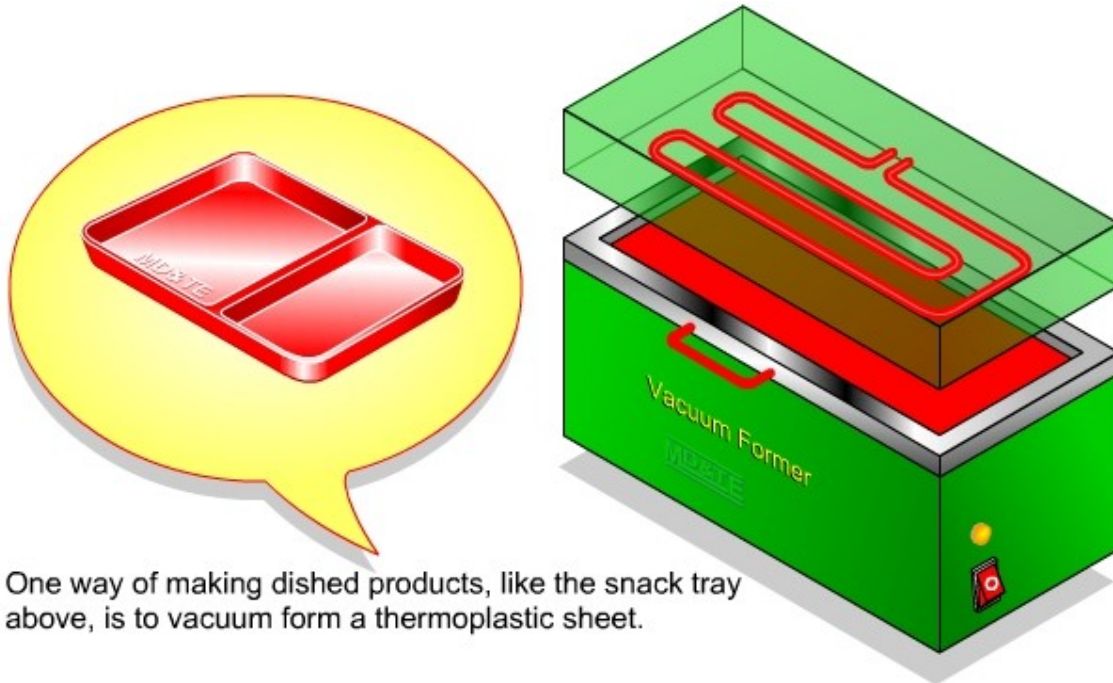


Vacuum Forming

Introduction

Thermoplastic sheet materials such as acrylic can be softened by heat. When a thermoplastic sheet has been softened, it can be bent, twisted, rolled and stretched. After the thermoplastic has cooled down, it becomes rigid and remains in its new deformed shape.

This makes thermoplastic sheet materials suitable for vacuum forming, compression moulding using a plug and yoke and line bending.



One way of making dished products, like the snack tray above, is to vacuum form a thermoplastic sheet.

Typical Materials Used In Vacuum Forming (source: British Plastics Federation).

- Acrylic (PMMA)
- Acrylonitrile Butadiene Styrene (ABS)
- Polyester Copolymer (PETG)
- Polystyrene (PS)
- Polycarbonate (PC)
- Polypropylene (PP)
- Polyethylene; sheet and foamed sheet (PE)
- Polyvinyl Chloride (PVC)

Vacuum Forming Process

The vacuum forming process consists of heating a thermoplastic sheet material until it is soft and then drawing it over a mould or pattern using the power of air pressure.

A pattern is first made using a resistant material such as Medium Density Fibreboard (MDF). The sides of the pattern are chamfered so that the vacuum formed plastic sheet can be pulled off it easily. Small holes may be drilled through the pattern at corners and at bends. The small holes enable air to be drawn from all parts of the pattern. The vacuum effect draws the softened plastic sheet tightly around all parts of the pattern.

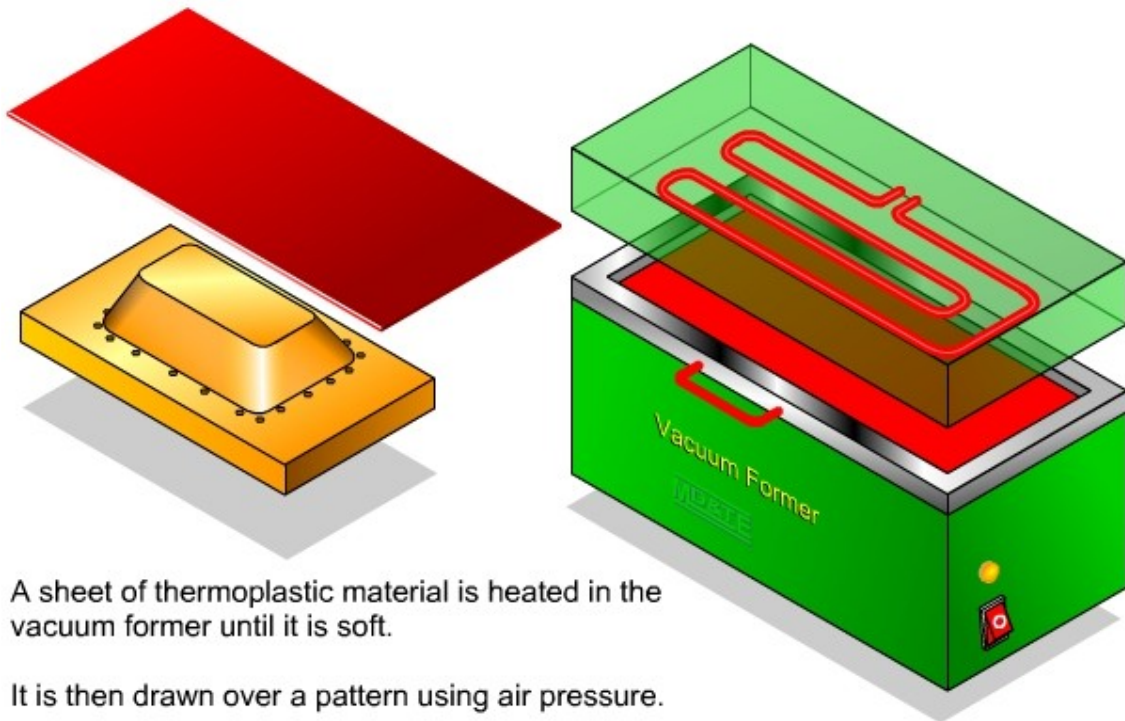
Complex shapes such as model car bodies may be modelled in clay. Plastic sheet materials may be vacuum formed over a clay pattern whilst the clay is still a little soft. This allows the clay to be pulled and scraped out of the vacuum formed plastic after the vacuum forming operation.

Patterns with "under-cuts" may be made from clay because the soft clay can still be removed from the vacuum formed plastic. Clay patterns can be used once only because they are usually damaged or completely destroyed during removal from the vacuum formed plastic.

Vacuum Forming Procedure

A pattern is placed in the vacuum former and lowered into the machine. Next, a thermoplastic sheet material is clamped on the vacuum former and heated until it softens. When the thermoplastic sheet has softened, the vacuum former is used to **blow** a little air under the softened plastic sheet to stretch the plastic slightly so that it will stretch more evenly over the pattern when it is being vacuum formed.

The pattern is raised and the vacuum is quickly applied for a few seconds to pull the softened plastic sheet around the pattern. Next, the heater is switched off. When the vacuum formed plastic has cooled and hardened, the clamps are released and the vacuum formed plastic is removed from the vacuum former. The waste material is trimmed off and the edges of the vacuum forming are smoothed and finished.



A sheet of thermoplastic material is heated in the vacuum former until it is soft.

It is then drawn over a pattern using air pressure.

Step 1



Make a pattern from a resistant material, e.g. MDF

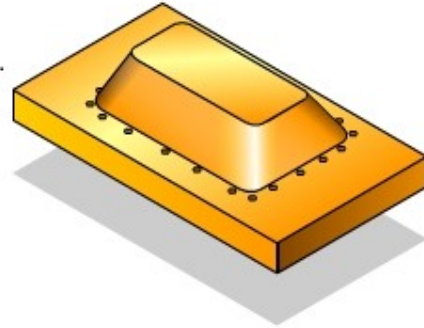
Step 2



Chamfer the edges, like this

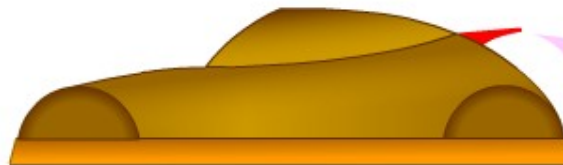
Here is an example with tiny holes drilled in the base.

The holes help the vacuum draw the plastic tightly into bends and corners and prevent air from being trapped in pockets.



Or, model irregular shapes in clay on an MDF base.

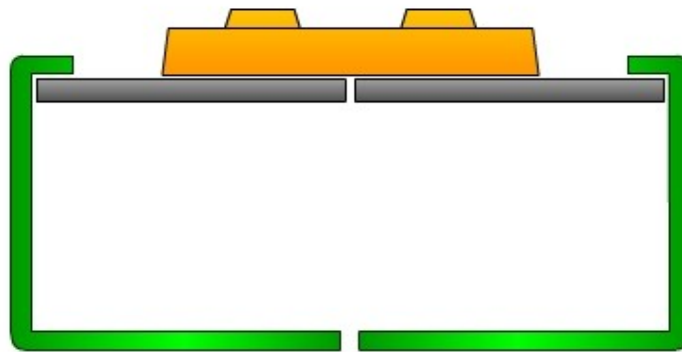
Vacuum form over the pattern while the clay is still soft enough to be scraped from the vacuum formed plastic.



Beware of making shapes that would stretch the vacuum formed plastic too much and caused wrinkling.

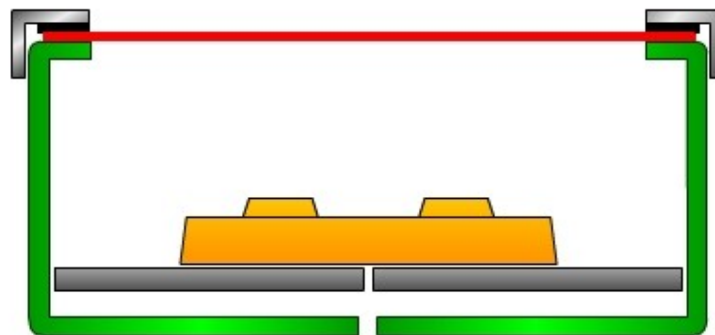
Step 3

Place the pattern in the vacuum former and lower the table



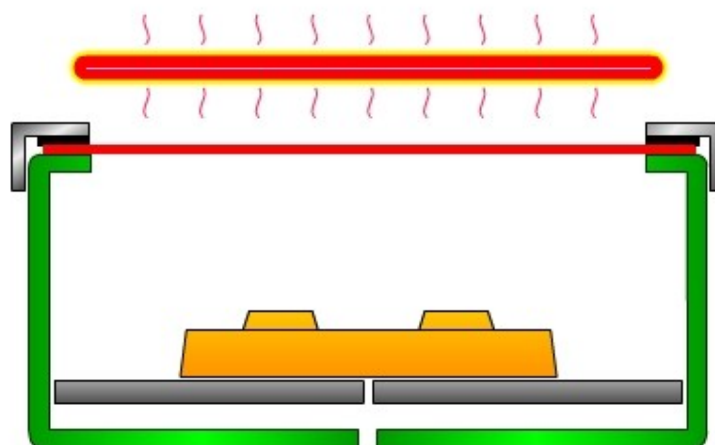
Step 4

Place a thermoplastic sheet on the vacuum former and clamp it in place.



Step 5

Heat the plastic sheet until it softens.

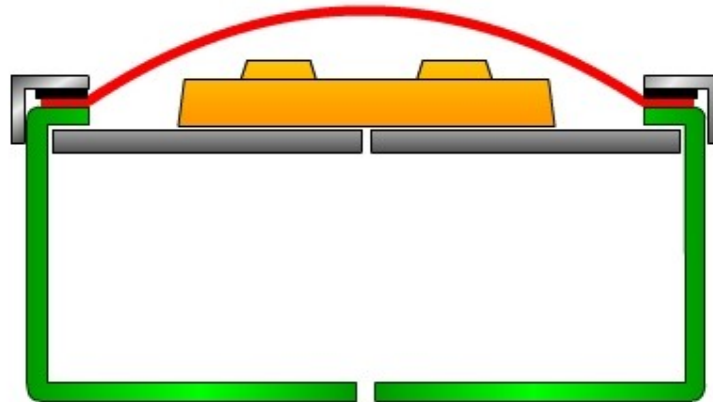


Step 6

Remove the heat.

Apply a little air pressure.

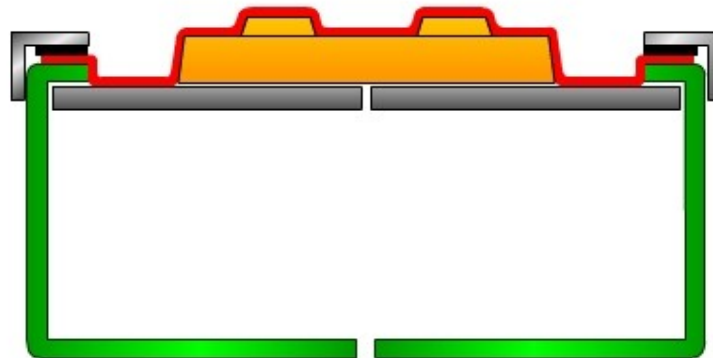
Raise the pattern.



Step 7

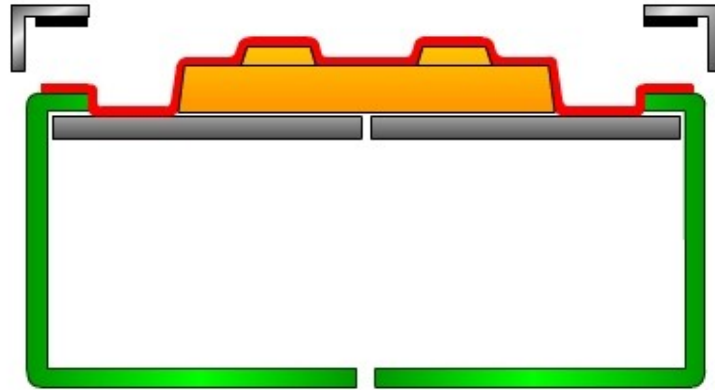
Apply the vacuum for a few seconds.

Allow the plastic to cool and harden.



Step 8

Open the clamps and remove the vacuum formed plastic.



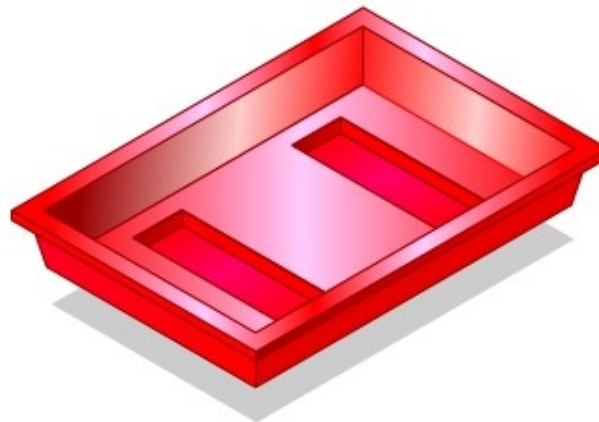
Step 9

Trim off the waste material



Step 10

Smooth rough edges with a file.



Please refer to **CLEAPSS**, Model Risk Assessments for Design and Technology in Secondary Schools and Colleges, Part 1.062 COSHH Regulations.