Materials Processing

Description

Materials processing is defined as the series of steps or "unit operations" used in the manufacture of raw-**materials** into finished goods. The operations involve a succession of industrial processes with various mechanical or chemical procedures, usually produced in large quantities or batches.

The purpose of cutting, forming, joining and surface processing of materials is to make products suit our needs.

Major Types Of Materials Processing

1. Material forming
2. Material cutting
3. Material joining
4. Material surface processing

Material Forming

Material forming refers to the process of turning materials into appropriate shapes. There are many ways of material forming, e.g. Bending, Pressing, Rolling, Moulding, Casting and Lamination.

1. **Bending**

a) **Metals -** Metallic sheets can be beaten into different shapes by using hand tools, as well as by applying mechanical bending operations.

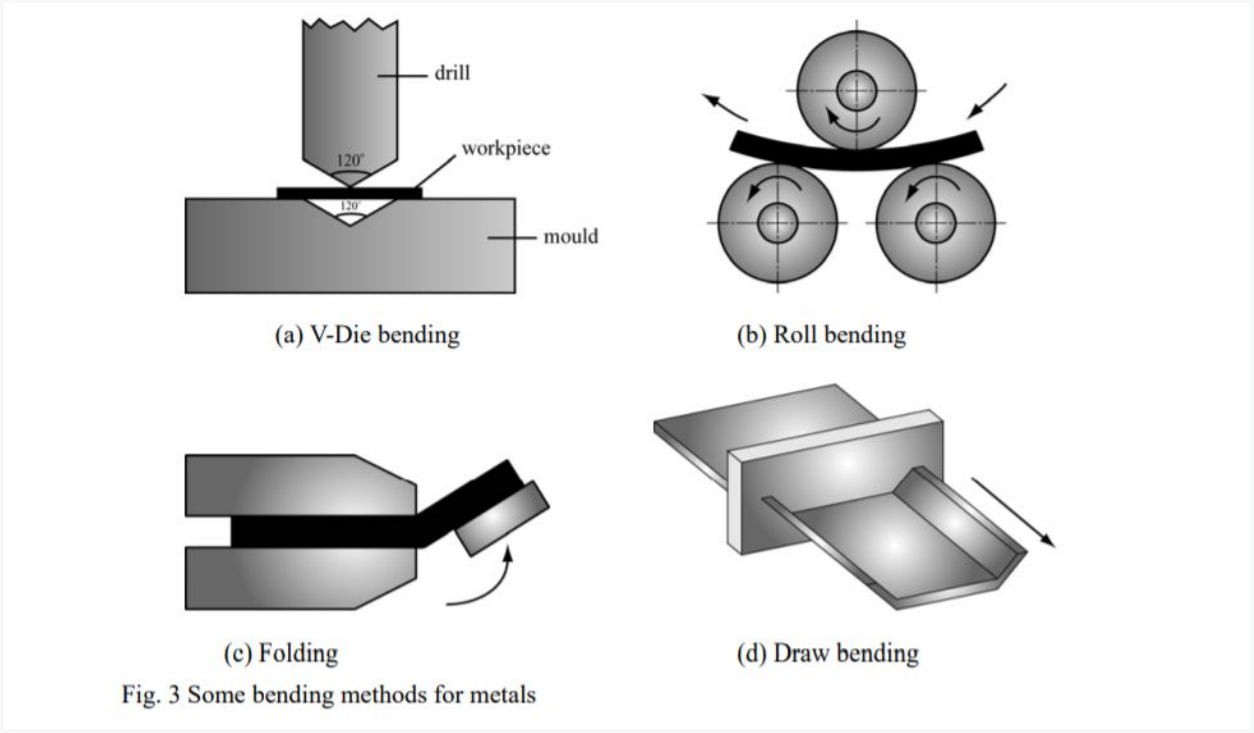


Fig. 3 Some bending methods for metals

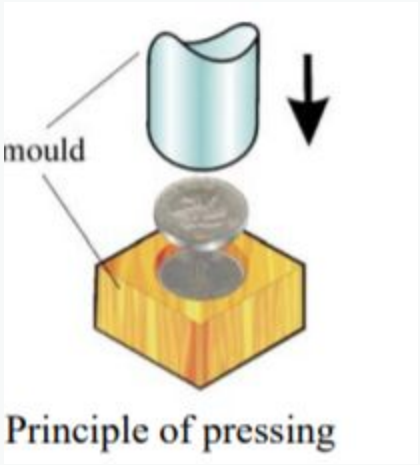
b) Timber / Wood-Timbers can be bent by steam bending or board clamping. Under steam bending, timbers are heated and softened by steam cases, and then immediately placed in a mould and clamped for a long time until dry to have their shapes fixed. Board clamping refers to the bending process of clamping glued laminated veneer with mortise-and-tenon moulds. The laminated veneer will form curved pieces after the glue dries.

c) Plastic - Thermoplastics can be bent by heating. For example, acrylic is a common thermoplastic. When heated to about 170C in an oven or by using an electric rod heater, acrylic will soften and can be bent into desired shapes.

2. Pressing

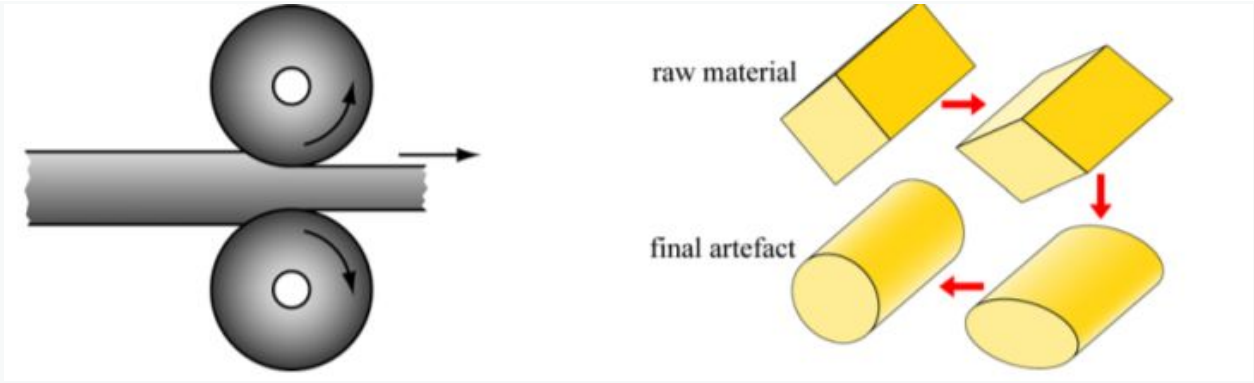
Pressing is to stamp metals into desired shapes. Firstly, heat and soften metallic materials. Then use a hydraulic press to drive the stamping tool so that metals can be pressed into artefacts with different shapes and thickness . Desired appearances can be cast on the material surface if such appearances are produced on the surface of the

stamping mould. For example, coins are minted from metals.



3. Rolling

The theory of rolling is to reduce the thickness or to change the cross-section of a long workpiece by using a set of rollers. Rolling is usually classified as Cold Rolling and Hot rolling.



4. Moulding

Moulding refers to the process that changes the form of plastics into desired shapes by the use of moulds. Moulding methods include mould forming, blow moulding, vacuum moulding, compression moulding and injection moulding etc.

a) **Mould forming -** Mould forming is to fill thermosetting plastics such as polyester resin into the moulds. When the resin hardens, shapes can be fixed and artefacts can be released from the moulds.
b) **Blow moulding -** Blow moulding can blow thermoplastic strips (e.g. polyvinyl chloride) into desired shapes. Clamp the plastic strips tight, heat and soften

them. Then blow in air using a blowing machine and press the strips into the shape of the mould.

c) **Vacuum moulding -** Vacuum moulding turns thermosetting plastic strips into desired shapes using atmospheric pressure.
d) **Compression moulding -** Compression moulding can produce plastic bottles rapidly and automatically. Heat and soften materials with compression moulding machine. Then fill the materials into the mould. Bind and hold tight the ends. Blow in air and press into the shape of the mould . Plastic bottles are then produced after the hardening of the materials and removal of excessive parts by the machine.
e) **Injection moulding-** Injection moulding is an automatic method for mass production of plastics. Plastic materials are first heated and softened in the machine and then injected into the moulds . Artefacts can be produced when the materials are hardened. Merits of this moulding method are that costs can be lowered by means of mass production and the quality of products is higher. Moreover, products do not need further processing and they require less plastic consumption. This is why injection moulding is widely adopted in the industry.

5. Casting

Casting is to fill melted metals into moulds and to get the artefacts after hardening. This method can produce metallic products with high complexity in shape such as blades of propellers, sculptures and water pumps.

a) **Sand casting-** Sand casting is to produce sand mould by using sand.
b) **Mould casting -** Similar to injection molding but instead of plastic material the material injected is metals of low melting point.

6. Lamination of materials

Lamination refers to the process of cohering multi-layered materials with thermosetting plastics, e.g. thin wood skins, paper, cloth, etc. Soak paper or cloth in thermosetting plastics (e.g. resin). By using a compressor to press and heat the materials, laminated plastic sheets (e.g. Formica) can be produced.

Assignment

1) **Identify six products and write down how each product was made in the context of Material forming process(submit by end of day)**