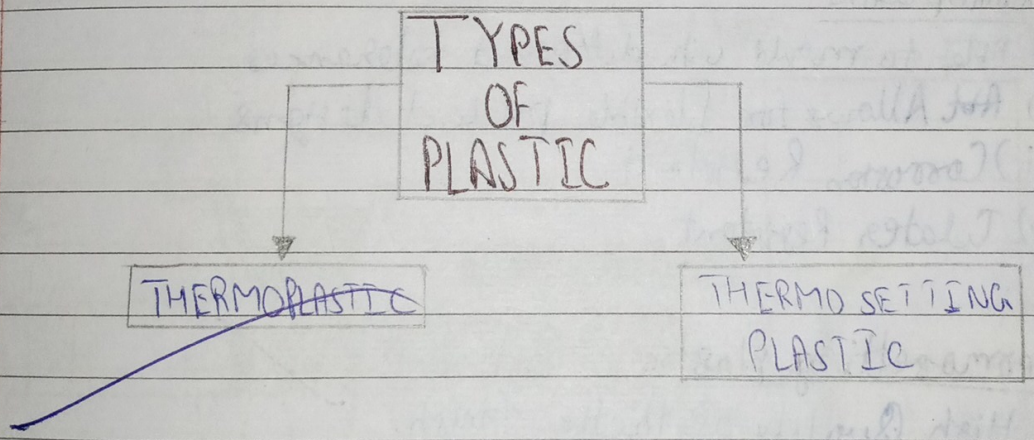
MPL
ASSIGNMENT

Q.1→ Explain the type of plastic.

Ans→ Plastic:

Plastic is defined as the material that contains an essential ingredient on organic substance of large molecular weight. It is also defined as polymers of long carbon chains.

Fossil fuels have compounds containing hydrogen and carbon (hydrocarbon) which acts as building blocks for long polymer molecules. These building blocks are known as monomers, they link together to form long carbon chains called polymers.



THERMOPLASTIC

i) The plastics which get deformed easily on heating and can be bent easily are known as thermoplastics.

ii) This can be synthesized by the process called addition polymerization.

THERMOSETTING PLASTIC

i) There are some plastics which when moulded once, can't be softened by heating. These are called thermosetting plastics

ii) These are synthesized by condensation polymerization

iii) They have low melting point and low tensile strength.

iii) They have high melting point & tensile strength.

iv) Polythene and PVC are some of the exemple of thermo-plastic.

iv) Two exemples of such plastics are bakelite and melamine.

v) These are used for manufacturing toys, combs and various types of containers.

v) It is used for making floor tiles, kitchen-ware and fabrics which resist fire.

- Advantages

→ Thermoplastic

i) Able to mould with different tolerances.
ii) Allows for flexible product designs.
iii) Corrosion Resistant
iv) Water Resistant

→ Thermosetting plastic

i) High Quality aesthetic finish.
ii) High Impact Resistant
iii) Good Electrical Insulation
iv) Can create both rubbery and hardened crystalline surfaces.

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Q.2→ Explain the injection ~~moulding~~ moulding.

Ans→ The injection moulding process is a manufacturing process used for producing parts or components by injecting molten ~~mate~~ materials into the mould cavity. Injection moulding can be performed with only one of these materials like glass, plastics, etc. and most commonly, thermoplastic polymers are used.

Parts of injection moulding machine:

1. Reciprocating Screw
2. Granules
3. Hopper
4. Heater
5. Nozzle
6. Fixed Pattern
7. Moulding Cavity
8. Moving Pattern
9. Final Product

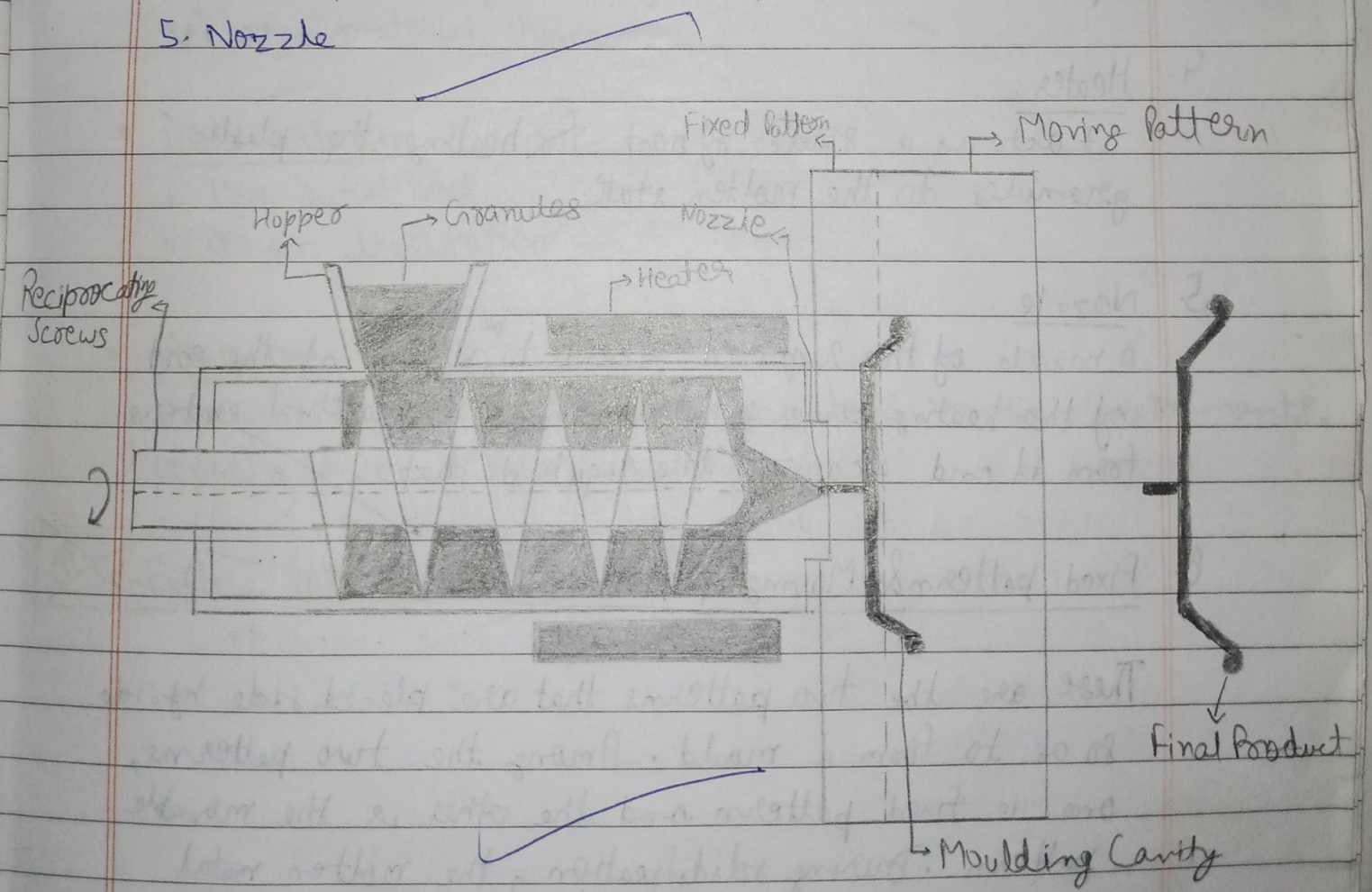


Fig. Injection Moulding

1. Reciprocating screw:

The reciprocating screw rotates by means of a motor and the reciprocating motion is provided by hydraulic system.

2. Granules:

The thermoplastic granules are to be used in the injection moulding machine to created solid components.

3. Hopper:

By the use of hopper, the plastic granules are to be poured into the moulding machines.

4. Heater:

It acts as a source of heat for heating the plastic granules to the molten state.

5 Nozzle:

A nozzle of the required size is to be placed at the end of the heating zone; so that, molten material enters from it and acquires the required shape.

6. Fixed pattern & Moving pattern:

These are the two patterns that are placed side by side so as to form a mould. Among the two patterns, one is fixed pattern and the other is the movable pattern. During solidification, the molten metal present in b/w these patterns can stay for some time and after that, the moving pattern moves aside, and thereby final product is obtained.

7. Mould Cavity:
It is the place where solidification take place b/w the fixed pattern and moving pattern and the formation of the component takes place.

8. Final Product:
Thus, the final product will be obtained after cooling.

- Advantages
i) Efficient high production
ii) Low cost per part
iii) ~~Repeatability~~ Low wastage
iv) ~~Low waste~~ Easily automated
v) Large material choice

- Disadvantages
i) High initial cost
ii) Design limitations.

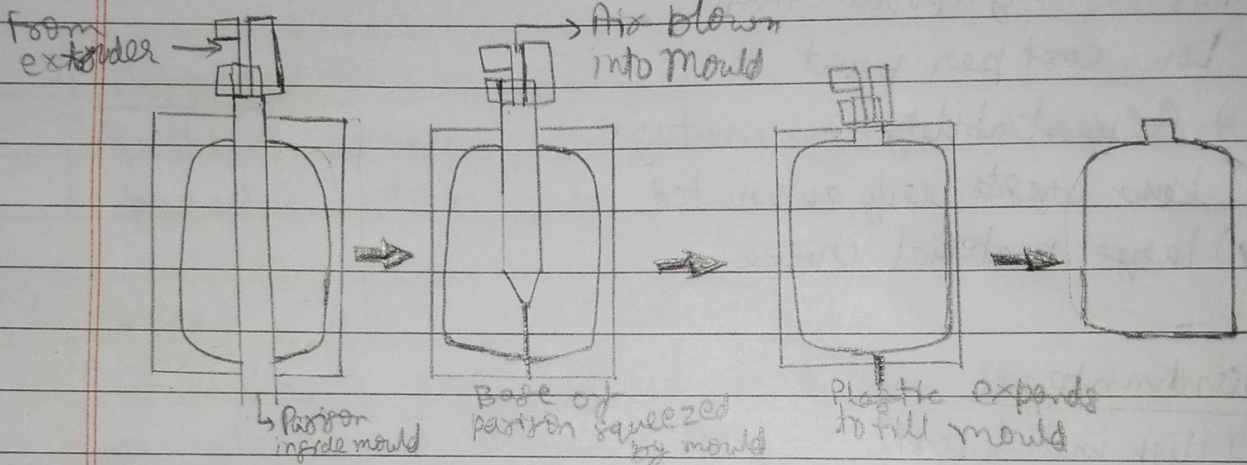
- Applications
Wire pools, packaging, bottle caps, toys, musical instruments, pocket combs, storage containers, etc.

Q.5 Explain following

Q.3→ Explain following:

(a) Blow moulding

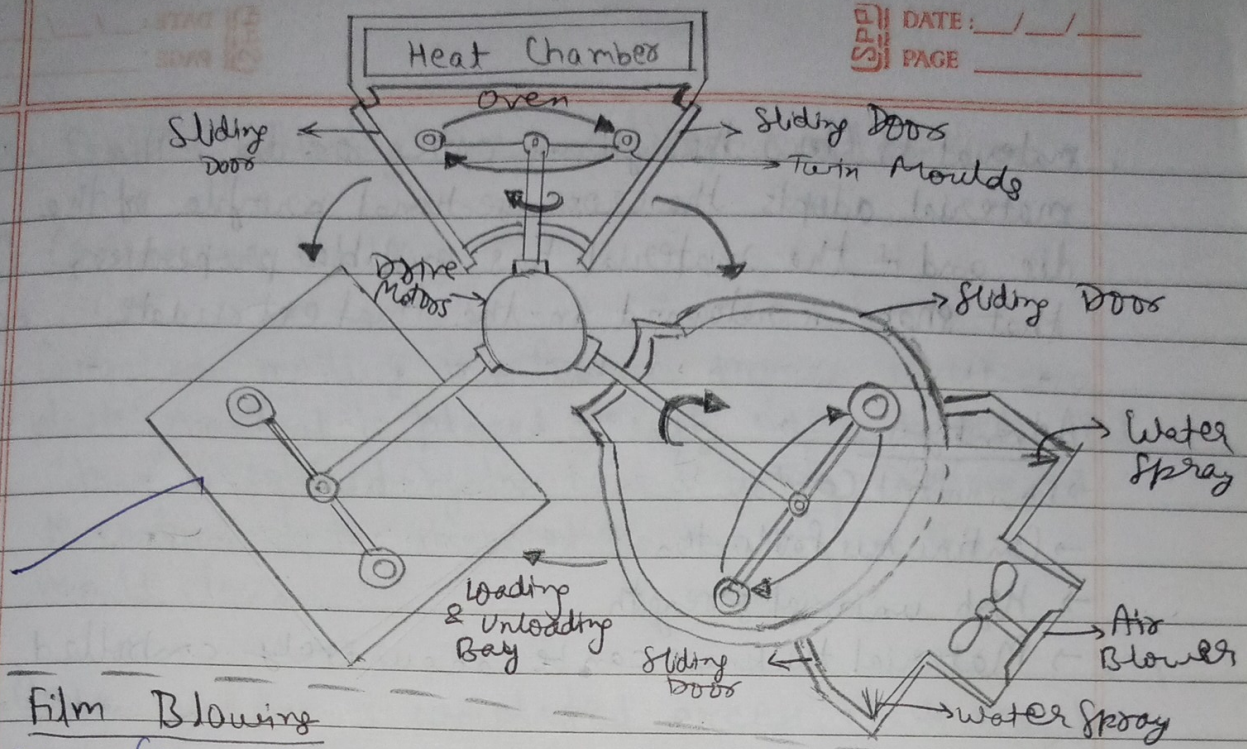
Ans→ It is a manufacturing process for forming hollow plastic parts. It is also used for forming glass bottles or other hollow shapes. In general, there are three main types of blow moulding: extrusion blow moulding, injection blow moulding and injection stretch blow moulding.



(Fig. Blow Moulding)

(b) Rotation moulding

Ans→ The rotational moulding process is quite simple. A hollow mould is filled with powdered plastic resin. The mould begins rotating bi-axially and is transferred into an oven. The mould continues to rotate as the resin melts and coats the wall of the mould. The mould is cooled until the resin hardens into the desired shape.



(c) Film Blowing

~~Blow film extrusion~~

Ans→ After exiting the die, the film tube which is still in a plastic state, is pulled upwards by nip rollers. At the same time compressed air is blown into the film tube to achieve the desired film thickness & width. Chilled air is blown on the outside of the tube.

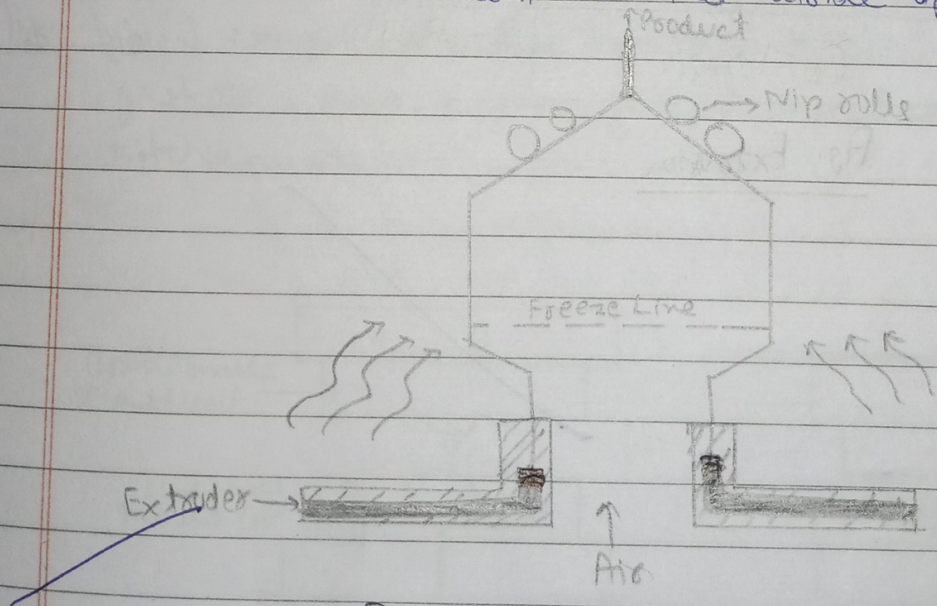


Fig. Film Blowing

(d) Extrusion

Ans→ It is a process where a material undergoes plastic deformation by the application of a force causing that

material to flow through an orifice or die. The material adopts the cross-sectional profile of the die and if the material has suitable properties, that shape is retained in the final extrudate.

Advantages

→ Low initial Cost
→ Continuous Production
→ High uniaxial strength
→ Material thickness can be accurately controlled.

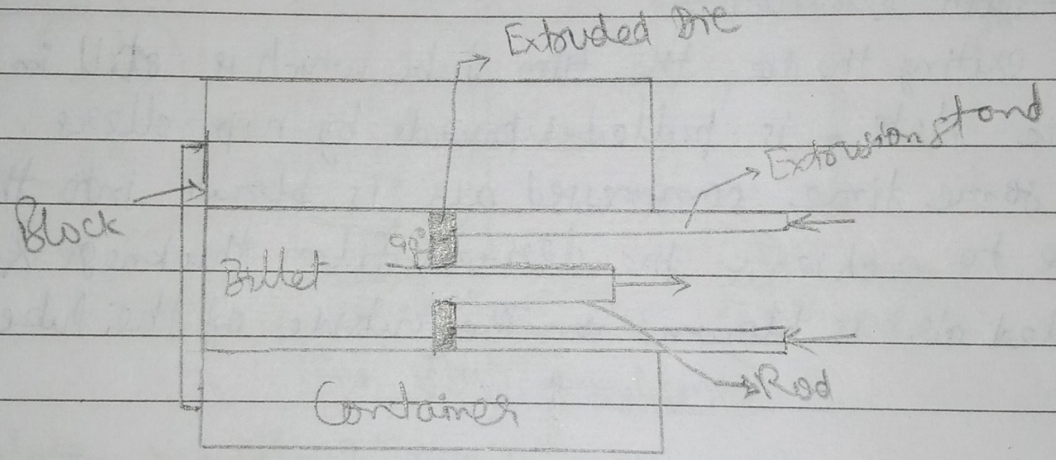


Fig. Extrusion

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Q.4→ Explain following thermosetting moulding:

(a) Compression Moulding

Ans→

- Compression moulding is a forming process in which a plastic material is placed directly into a heated metal then is softened by the heat & these forceforced to conform to the shape of the mould, as the mould closes.

- Once moulding is completed excess flash may be removed.

- This method is mostly used for thermosetting plastics but can also be applied to some of the thermoplastic materials.

Uses: Typical compression ~~molde~~ moulded parts include gaskets, seals, knobs, gears & handles for ~~kitch~~ kitchenwares.

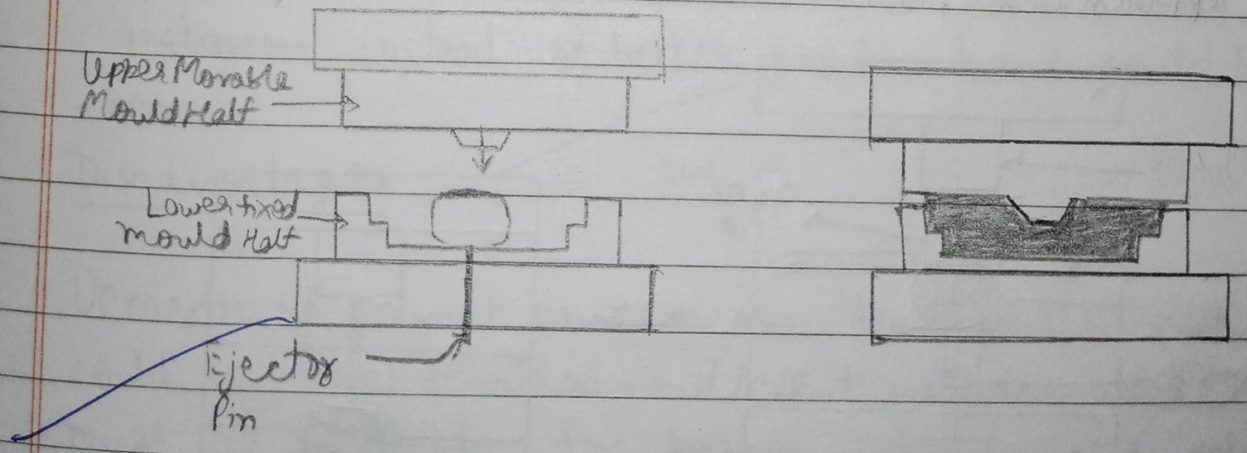


Fig. Compression Moulding

(b) Transfer Moulding

Ans→ • Transfer Moulding is a process of forming components is a closed mould from a thermosetting material that is conveyed under pressure, in a hot, plastic state, from an auxiliary chamber, called the transfer pot, through runners & gets into the closed cavity or cavities.

• Pressure is applied through piston.

• This process ranges between the compression moulding & injection moulding.

Advantages	Disadvantages
i) Lower maintenance costs than injection moulding.	i) Wastage of material.
ii) Durable & dimensionally stable parts	ii) Air can be trapped in the mould.

Use • The products made by this process includes electrical switchparts, etc, gears, wiring devices, household appliances, under hood automotive parts, etc.

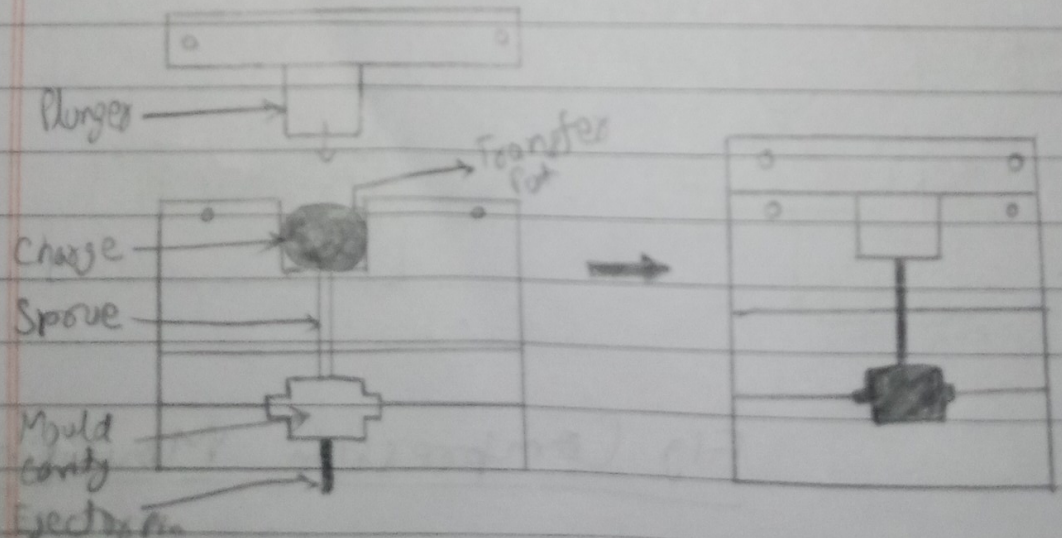
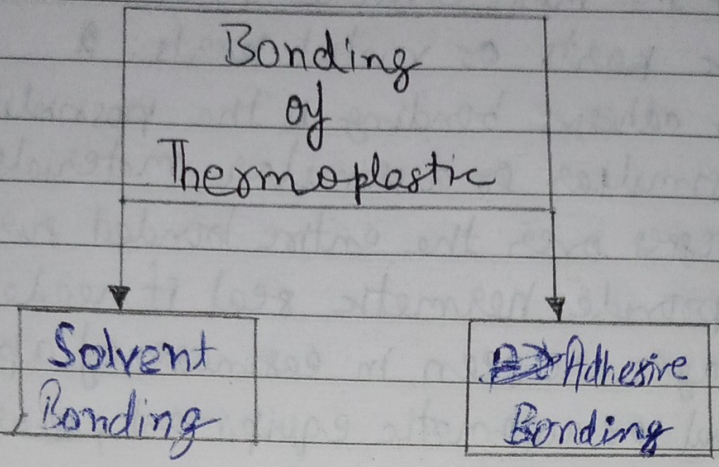


Fig. Transfer Moulding

Q.5→ Explain bonding of thermoplastic.

Ans →



1. Solvent Bonding

It is a common technique used for joining injection moulded components of amorphous thermoplastics. In this technique, the solvent dissolves the surfaces of two components and allows the material to flow together. After the solvent evaporates, it leaves a pure material-to-material bond.

Advantages

Merit of solvent bonding are good distributes stress over the bonded surface areas, can provide bond instagram instead of bosses and the bond could be hermetic.

Disadvantages

Dements of solvent bonding are that binder products could be disassembled, sufficient surface area must be available for proper joining, and solvent vapours released may be hazardous.

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2. Adhesive Bonding

- It is one of the most convenient methods of assembling thermoplastic parts or metal parts.
- Advantage of adhesive bonding is the possibility of joining of similar or dissimilar materials. Adhesives distribute stresses over the entire bonded surface area and can provide hermetic seal if needed.
- Other advantages are seen in easiness of application using manual or automatic equipment, elasticity, low costs, easy of repair, etc.
- There are five major families of adhesives, each with a somewhat unique set of characteristics. The choice of properly type of adhesive, the cure time, cure temperature, temperature resistance, application area, etc. have to be take in account.

Powder Metallurgy

Powder metallurgy is the art and science of producing fine metal powders and then making objects from individual, mixed or alloyed metal powders with or without the inclusion of non- metallic constituents.
(Or) Powder metallurgy is a branch of metallurgy which deals with the production of metal and non metal powders and subsequently manufacture of components by using these powders.

Powder Metallurgy Processes

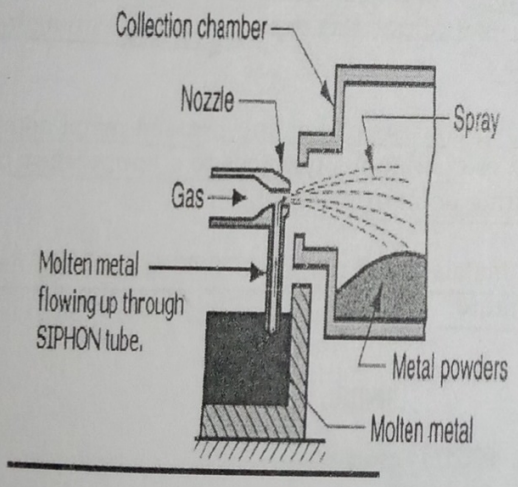
> Primary Operations

1. Producing metal powders

Various methods for manufacturing powders are

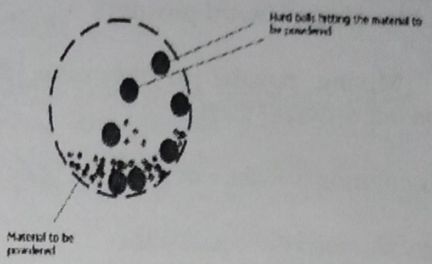
i. Atomization (for low melting point alloys)

The process of metal spraying against a stream of compressed air or inert gas is atomization. It is an excellent means of producing metal powders from many of the low temperature metals such as lead, aluminum, zinc and tin.



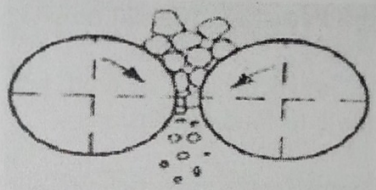
ii. Reduction

Reduction process is carried out in an atmosphere controlled furnace.In reduction process, the compounds of metals usually oxides like iron oxides are reduced with CO/H at temperature below melting point of metal. Tungsten, molybdenum, iron, cobalt, nickel powders are commercially produced by this process.



iii. Crushing (Used for brittle materials)

Process of passing the metal ~~powders~~ pasts against two rollers so that the metal ~~powders~~ pasts are crushed to required size. Crushing requires equipments such as stamp, hammers, and jaw crushers. → metal powder



iv. Milling

Milling is carried out by using equipments such as ball mill, rod mill, impact mill, disk mill etc. In ball milling, material to be powdered is collected in a container with a large number of hard steel balls. These balls hit the material and break it in powder form.

v. Shotting

The process of pouring molten metal through a sieve or orifice and cooling by dropping into water is known as shotting. This process gives spherical or pear shaped powder particles.

vi. Electrolysis.

In this method, an electrolytic cell is set up as shown in figure. The desired metal is made to act as anode. Anode slowly dissolves and gets deposited on the cathode from where the deposit is removed, washed and dried.

(Crucial for uniformity of product)

2.Mixing / blending of metal powders

Blending : Mixing powder of the same chemical composition but different sizes

Mixing : Combining powders of different chemistries

Blending and mixing is necessary for-
- Addition of lubricants coats the powders and reduces die wear and lowers pressure required for pressing of powders.
- Mixing powders of different materials
- Obtaining uniform distribution of particle sizes.

3. Compacting / Pressing of metal powders

- Pressing the powders into desired part shape as closely as possible to final dimensions

- Powders are compacted using high pressure.

Degree of pressure required depends upon-
1- Required density of final product

2- Ease with which powder particles will weld together.

Compacting processes are-
i. Die pressing

ii. Roll pressing

iii. Extrusion

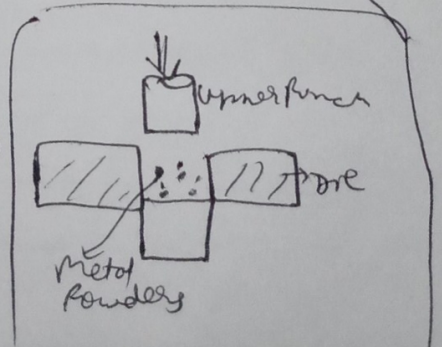
Compacting is the process of pressing metal powder into desired part (of final dimension) using high pressure.

i) Die pressing

The metal powder filled in a bottom of die cavity & apply high pressure by punch which is vertical. The powder is then compacted into a proper shape size & then ejected from die cavity. Fig Die pressing

ii) Roll pressing

The metal powder is fed b/w two rollers which compress & bind metal powder particles.



4. Presintering

- Powder metallurgy is used to make parts from materials that are very difficult to machine.

- When some machining is required on such parts, Presintering is done before actual sintering operation.

- Compact is heated for a short time at a temperature below sintering temperature

- Presintering removes lubricants and binders added to powders during blending operation.

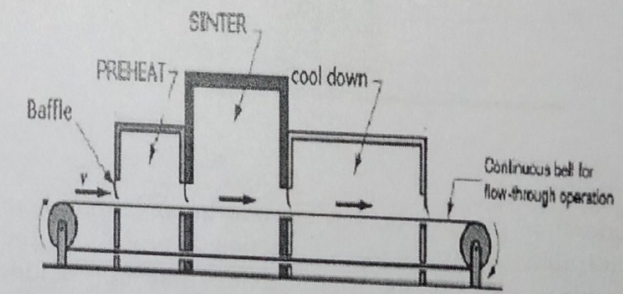
- After presintering, the part acquires sufficient strength to be handled and machined without difficulty

5. Sintering

- Sintering is the heat treatment process, to bond the metallic particles, thereby increasing strength and hardness

- Sintering consists of heating pressed metal compacts in batch or continuous furnaces to a temperature below the melting point of material.

- Most metals are sintered at 70 % to 80 % of melting temperature.



Unit-IV **Topic- Powder Metallurgy**
Subject - Manufacturing Process **Name of Faculty-**

Finishing of the final operation which improves dimensional tolerances, physical property & surface finish.

Secondary /Finishing Operations

A number of secondary and finishing operations can be applied after sintering, some of them are:

1- Sizing : cold pressing the sintered part to improve dimensional accuracy.

2- Coining : cold pressing to press details into its surface.

3- Impregnation : oil fills the pores of the part

4- Infiltration : pores are filled with a molten metal

5- Heat treating : annealing can be done for stress relief in powder metallurgy part.

6- Machining : creates geometric features that cannot be achieved by pressing, such as threads, side holes, and other details

Applications

metal

1. **Filters:** Powder metallurgy filters have greater strength and shock resistance than ceramic filters. Fiber metal filters, ***having porosity up to 95%*** and more, are used for filtering air and fluids.

2. **Cutting Tools and Dies:** Cemented carbide cutting tool inserts are produced from ***tungsten carbide*** powder mixed with a ***cobalt binder.***

3. **Machinery Parts:** Gears, bushes, and bearings, sprockets, rotors are made from metal powders mixed with ***sufficient graphite*** to give the product desired ***carbon content***.

4. **Bearing and Bushes:** Bearing and bushes to be used with rotating parts are made from ***copper powder*** mixed with ***graphite.***

5. **Magnets:** Small magnets produced from different compositions of ***powders of iron, aluminum, nickel, and cobalt*** have shown excellent performance, far superior to that cast.

Alternative Applications

(1) Self Lubricating Bearings
(2) Turbine Blades
(3) Carbon Boron Nitride Tool

Advantages

- A combination of metals and non metals powdered parts can be manufactured.

- High dimensional accuracy is achieved.

- Fine surface finish is achieved.

- No material is wasted as scrap. This process makes use of 100 % raw material unlike casting, press forming etc.

- Porous parts can be produced which is not possible by any other method.

- Highly qualified or skilled person is not required for handling powder metallurgy method.

- Large scale production of small parts with this process gives efficient results.

- Production of cemented carbide tools is possible only by this process.

- It eliminates numerous machining operations.

- Powder metallurgy parts can be easily brazed, welded, soldered.

- Process is economical as mass production process

Limitations

There are limitations and disadvantages associated with P/M processing. These include:

- High tooling costs.

- Expensive raw materials (powders).

- Relatively long parts are difficult to manufacture.

- Difficult storing and handling of powders

- Powder metallurgy is not economical for small scale production.

- Articles produced by powder metallurgy process possess poor ductility.

- Difficult to produce high purity powder.

- Due to porosity, specified mechanical properties are difficult to be obtained.

- P/M parts show poor plastic properties.

- Punches, dies, rolls etc are very costly and also very bulky to transfer from one place to another

Spinning

Metal spinning, also known as **spin** forming or **spinning** or **metal** turning most commonly, is a metal working **process** by which a disc or tube of **metal** is rotated at high speed and formed into an axially symmetric part. **Spinning** can be performed by hand or by a CNC lathe.

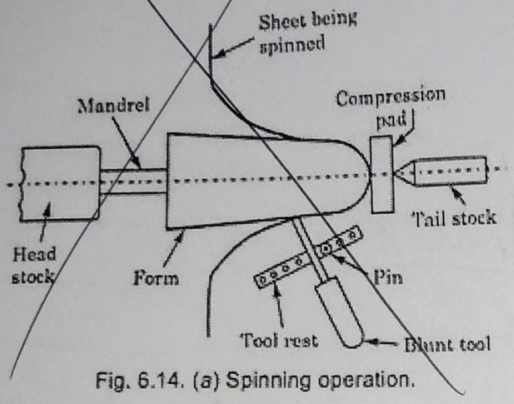


Fig. 6.14. (a) Spinning operation.

Forming

- In forming operation, sheet metal is stressed beyond its yield point so that it takes a permanent set and retains the new shape
- In this process, the shape of punch and die surface is directly reproduced without any metal flow
- The operation is used in the manufacturing of door panels, steel furniture, air-craft bodies, etc.

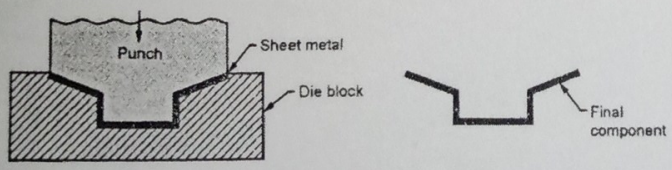


Fig. 2.21 : Forming

Embossing

- With the help of operation, specific shapes of the figures are produced on the sheet metal
- It is used for decorative purposes or giving details like names, trademarks, etc on the sheet metal

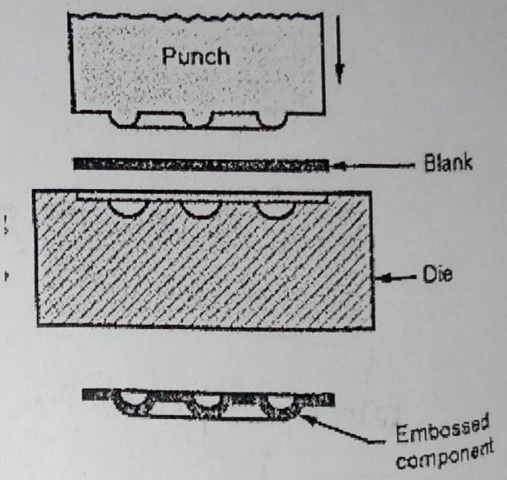


Fig. 2.20 : Embossing

Coining (squeezing)

- In coining operation, the metal having good plasticity and proper size is placed within the punch and die and a tremendous pressure is applied on the blank from both ends
- Under severe compressive loads, the metal flows in the cold state and fills up the cavity of the punch and die
- The operation is used in the manufacturing of coins, ornamental parts etc.

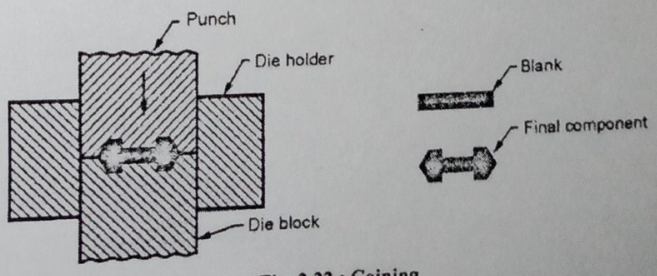


Fig. 2.22 : Coining