

LECTURE NOTE ON ADVANCE MANUFACTURING PROCESS

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CHAPTER-02

-° Modern Machining Processes °-

Introduction :-

- * Comparison with traditional machining.
- * Ultrasonic machining principle, Description of equipment, application.

Advanced manufacturing Process :-

- * It is the use of innovative ideas or technology to improve product or process.

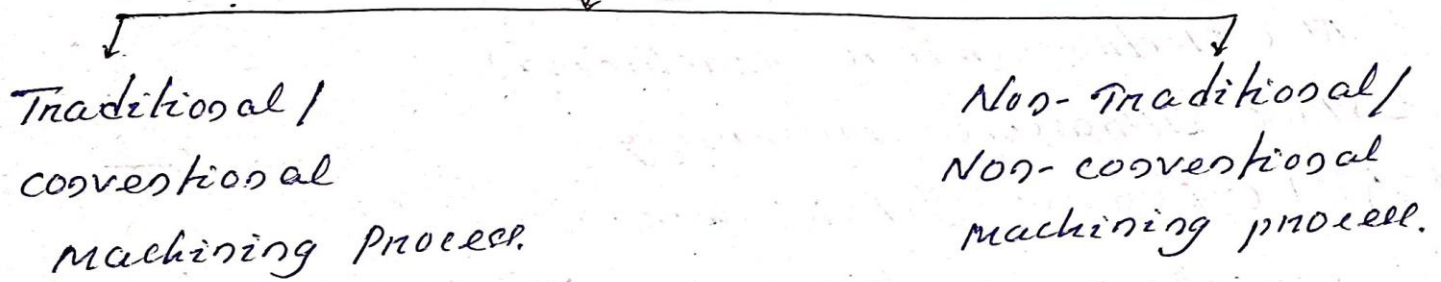
Manufacturing :-

- * Manufacturing is a science or technology through which the raw material is converted into finished product.
- * To manufacturing there are various steps, these steps are known as manufacturing process.

Machining :-

- * Machining is a process by which we cut the raw material to our required shape and size.

Machining



Traditional machining Process :-

- * In this machining there must be physical contact between tool and workpiece is required to remove the excess material from the workpiece to obtain the desired shape and structure.
- * In this only mechanical energy is involved during mechanical process.

- * Micro chip formation takes place when material is removed.
- * Ex: Boring, Grinding, Turning etc.

Non-Traditional Machining Process:-

- * In this machining there is no any physical contact bellow tool and work piece is required to remove the excess material from the work piece to obtained the desired shape and structure.
- * In this various energy like- Thermal, Mechanical, electrical, chemical are involve to remove material from work piece.

* Complex structure is easy to produce.

* Important types of non-traditional machining:-

- (i) EDM (Electrode Discharge Machining)
- (ii) LBM (Laser Beam machining)
- (iii) EBM (Electron Beam machining)
- (iv) ECM (Electrochemical machining)
- (v) USM (Ultrasonic machining)
- (vi) AJM (Abrasive Jet machining)

2) Conventional machining	Non-conventional machining
* Macroscopic chip Remove.	* Microscopic level.
* Direct contact of tool and work piece	* Direct contact is not there between tool and work piece.
	* Ex: LBM - Laser AJM - Abrasive.
* Tool life is less.	* Tool life is more.

* Mechanical energy / forces.

* Less capital cost.

* Finished Accuracy less.

* Skilled / unskilled operators can operate.

* More Noise produce.

* Accurate prototype can't be made of any product / material.

* USM - Ultrasonic - - - - -

EBM - Electron

LBM - Laser.

Different type of energy.

* High capital cost.

* More Accuracy / finishing.

* Only skilled workers can operate.

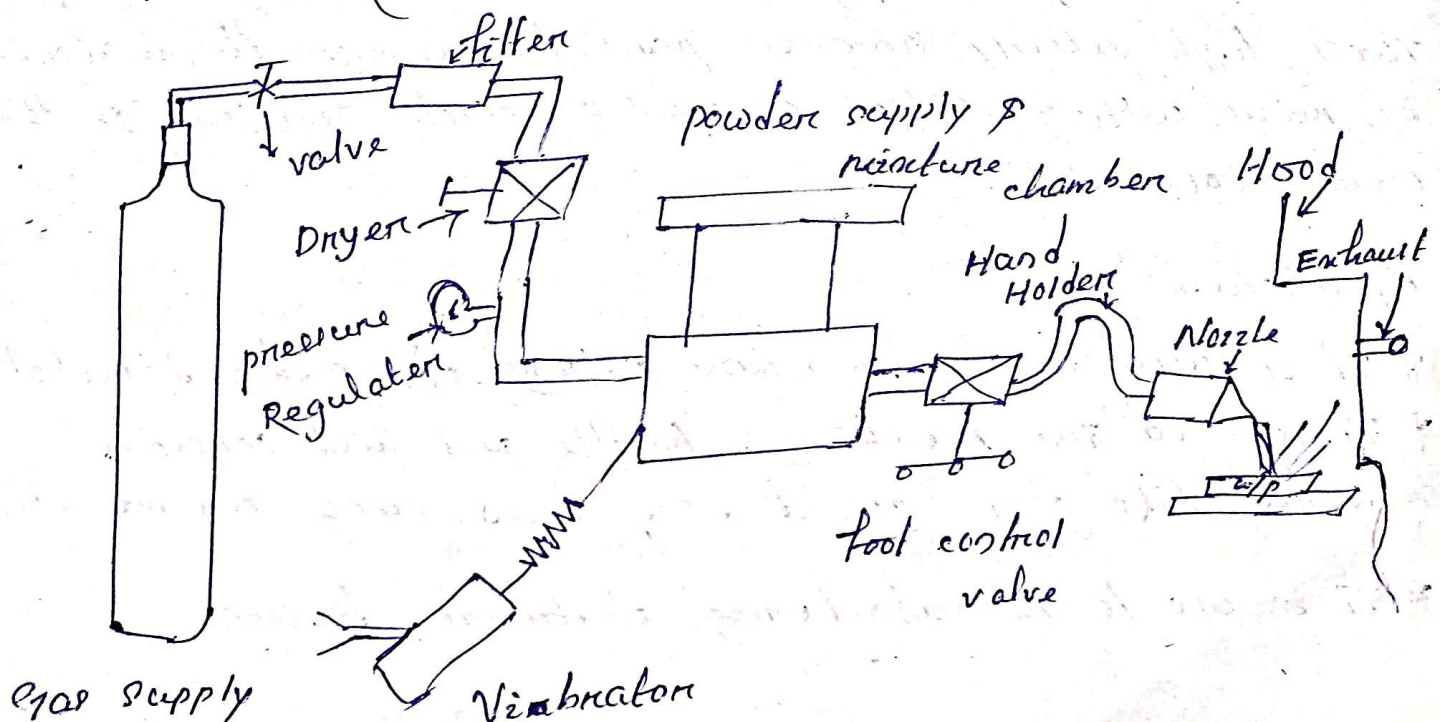
* Quite, No Noise produce.

* Accurate prototype, can be made of any product / material.



Abrasive Jet Machining :-

* AJM is a non-traditional machining process which is mostly used in machining of hardened metals. In this machining process a flow stream of abrasive particles (like Al₂O₃, Silicon carbide, diamond powder, glass particles) are forced to strike on workpiece at ~~which~~ high velocity. These high velocity abrasive particles remove metal by brittle fracture or erosion from workpiece.



Working Process :-

* First air or gas (Nitrogen, carbon dioxide etc.) is compressed into gas compressor. There the density & pressure of gas increase.

* Now these compressed gas send to filtration unit, where dust and other suspended particle removed from it.

* These clean gas sends to drier, which absorb moisture from it.

* Now this clean & dry gas sends to mixing chamber where abrasive feeder feed abrasive particle in it.

(Abrasive particle is about 20 to 50 micrometer grit size)

* The high pressuring (about 850 kpa) abrasive particles carried gas send to nozzle (diameter of nozzle about 0.25 to 0.80 mm) where pressure energy is converted into kinetic energy. The velocity of abrasive particle leaving the nozzle is about 150 to 300 m/s.

* The stand off distance between workpiece and nozzle (tungstone) is about 2mm.

* Now these high velocity abrasive particles strike on w/p. These high velocity abrasive particles remove the material by micro cutting action as well as brittle fracture of the work material.

Application :-

* It is used in drilling and cutting of hardened metals.

* It is used for machining brittle and heat sensitive material like glass, quartz, sapphire, mica, ceramic etc.

* It is use to manufacturing electronic devices.

Advantages :-

- * High surface finish.
- * It can machine heat sensitive material.
- * It is free from vibration.
- * Tooling cost is low.
- * Thin sections can be machined easily.

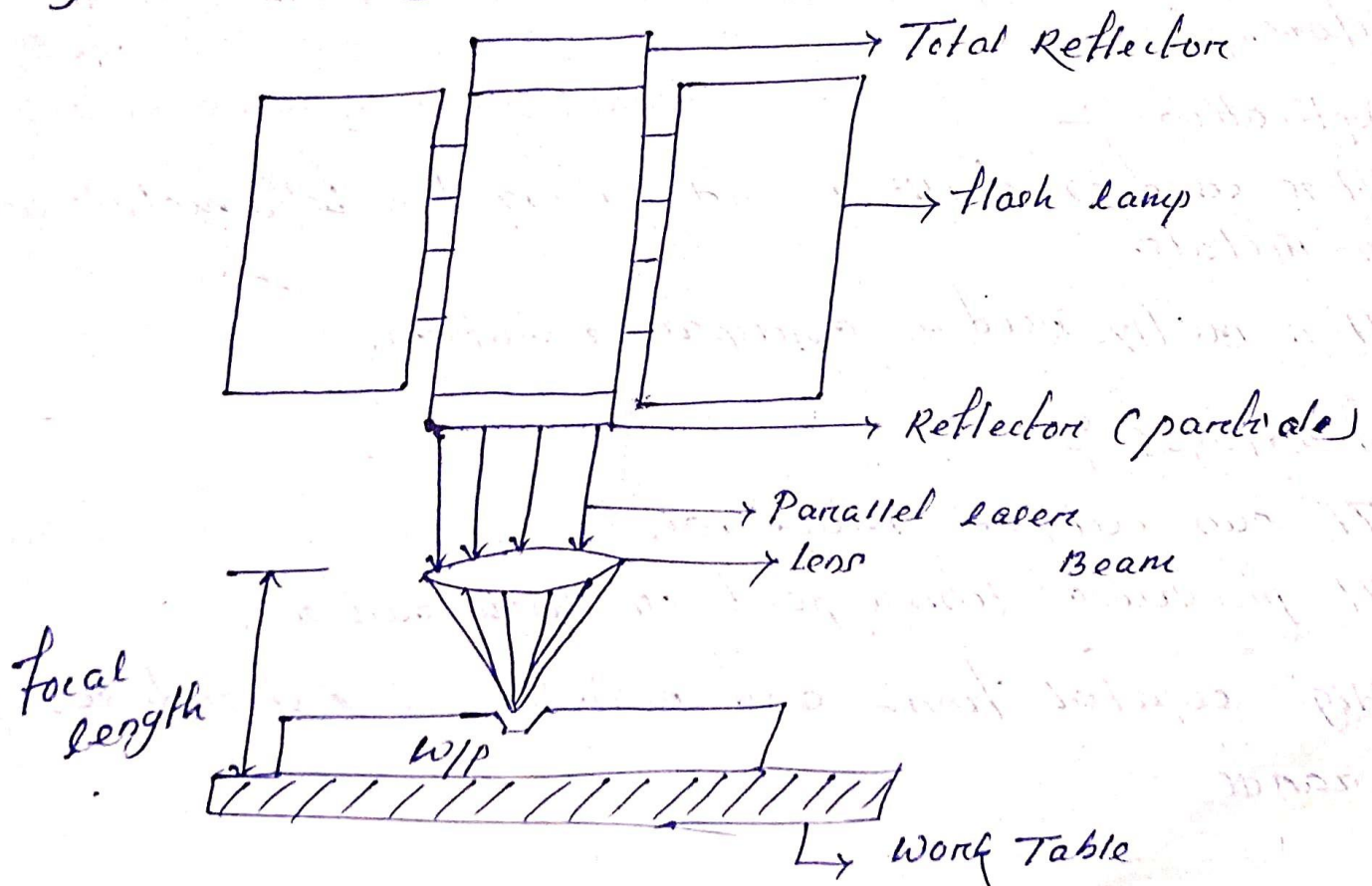
Dis-Advantages :-

- * Low metal removal rate.
- * Nozzle life is limited so it needs frequency replacement.
- * Abrasive particles cannot be reused in this process.
- * It cannot be used for machine ~~shaft~~ shaft and ductile material.

Ans 3

Laser Beam machining :-

- * It is a thermal machining process which uses laser beam to produce heat. In this machining process metal is removed by melting and vaporization of metal particles from the surface of the workpiece. It is a non-conventional machining process in which no tool is used. It is used to machine both metallic and non-metallic materials. It is mostly used in cutting and drilling operations.



Working process :-

- * First laser material CO_2 or other gases filled laser discharge tube.
- * Now switch on the power supplied which is connected by flash lamp.
- * This lamp produces light energy which is used to excite electrons of atoms.
- * The atoms of laser material absorb energy from the light energy produced by flash lamp. It leads to jump of orbital electrons of atoms from low energy level to high energy level. This is an unstable condition of atoms.
- * This energy initially builds up in laser material. When the atoms absorb sufficient energy, they start emitting energy continuously.
- * This laser light is collected by the focus and directed towards the workpiece.
- * Now the laser impinging on the workpiece starts the machining process by melting or vaporizing material from the contact surface.

Application :-

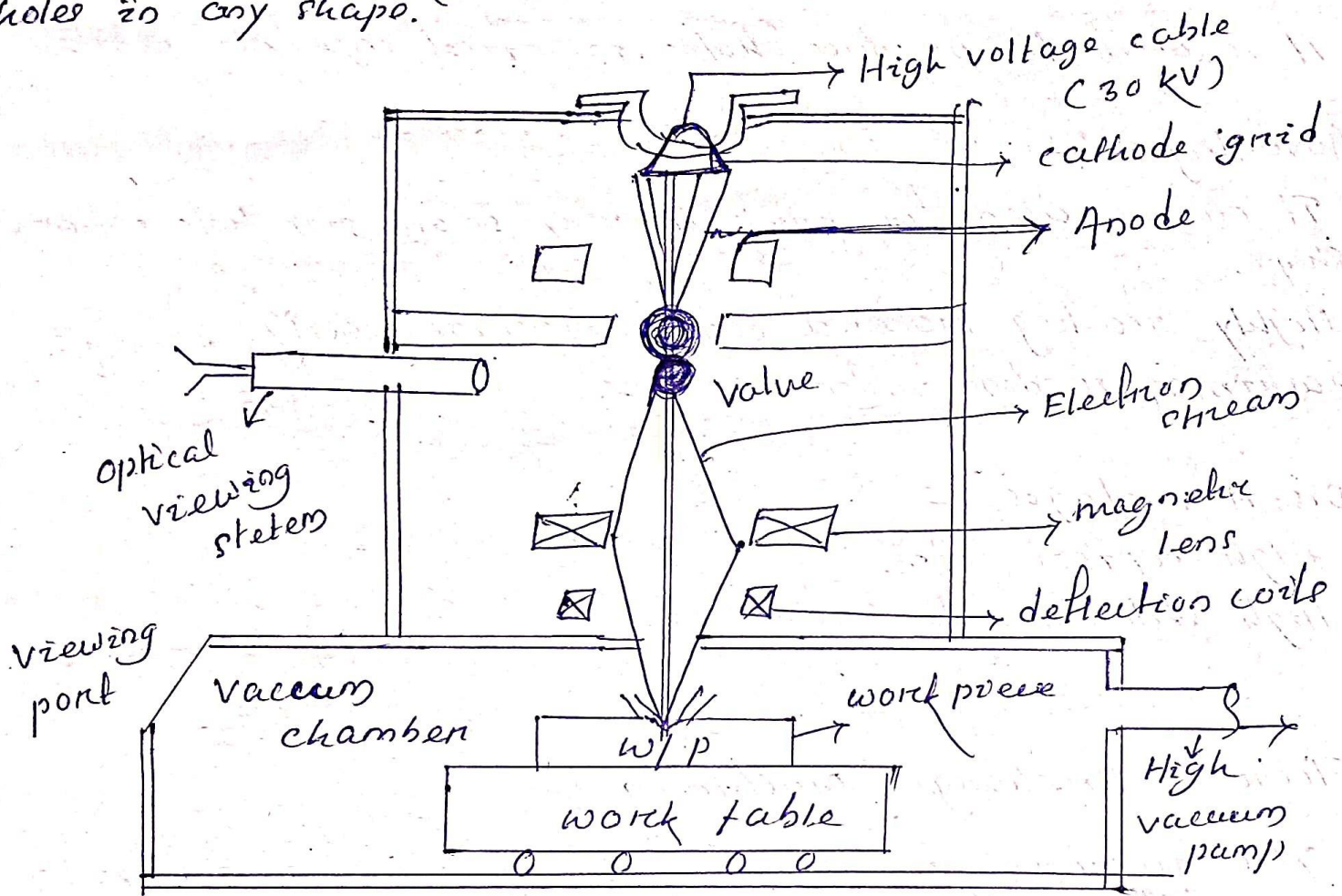
- * It is used in drilling and cutting for both metals and non-metals.
- * It is mostly used in aerospace industries.

Advantages :-

- * It can cut all materials.
- * It produces finished parts on high surfaces.
- * High capital cost and maintenance cost and safety hazards.

Electron Beam Machining :- (Ans)

* It is a non-traditional machining process in which no physical tool is used. This machining process works on basic principle of conversion of kinetic energy of electron into heat energy. When a high speed electron impinges on a work piece, they convert its kinetic energy into heat energy. This heat energy is used to vaporize materials at contact surface. This process is carried out in vacuum otherwise the electron will collide with air particles and lose its energy before impinging on work material. It is mostly used to drill holes in any shape.



Working process :-

- * First electron gun produces high velocity electron particles. These electron particles move towards an anode which is placed after cathode tube.
- * Now this high intense electron beam passes through magnetic ~~lens~~ lenses. There are a series of lenses which take place of only one convergent electron passes through it. It absorbs all divergent electrons and low energy electrons. It produces high quality electron beam.

* The electron beam now passes through electron magnetic lenses and deflecting coil. It focus the electron beam at a spot.

* Two high intense electron beam impinges on the w/p where K.E of electron convert into thermal energy. This whole process take place in a vacuum chamber otherwise these electron collide with air particle between path and lose its K.E.

Application :-

* It is used to produce very small size hole about 100 micro meters to 2 millimeter.

* It is used to produce holes in diesel injection nozzle

Advantages :-

* It can be used for producing very small size hole in any shape

* Highly reacting material can be machine easily because machining is done under vacuum

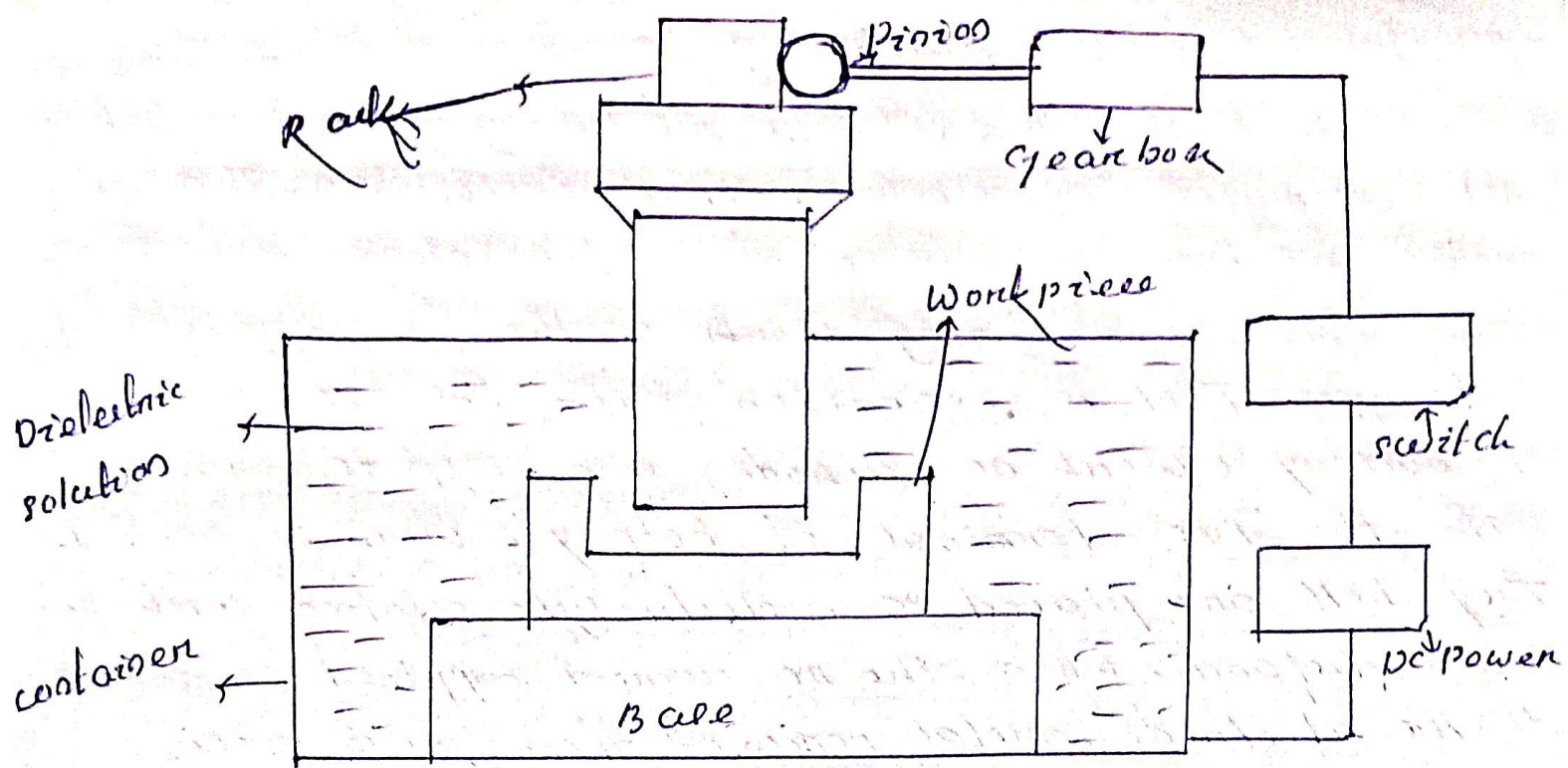
Dis-Advantages :-

* High capital cost.

* High skill operator required.

Electric Discharge Machining :-

* This machining process uses electric spark to remove metal from work piece. This spark generated by this process produces heat, which remove metal by erosion & evaporation. This process is done in a dielectric fluid. In this machining process both the work piece and tool must be made by conductive material.



Working process :-

- * First both work piece and tool are submerged into dielectric fluid. The dielectric fluid help to control the arc discharge. This also removes suspended particles of workpiece and tool from the work cavity.
- * Maintain a very small gap (about 0.5 mm) between the workpiece and the tool.
- * A high frequency current supplied to electrode which produces a spark between the tool and workpiece.
- * The metal removed from the w/p due to erosion and evaporation.
- * The chips or suspended particle between the tool and w/p should be removed to prevent them to form bridge that causes short circuit. This is done by continuous supply of dielectric fluid.

Advantages :-

- * Every conductive material can be cut this process.
- * Hardened w/p can be machined easily.

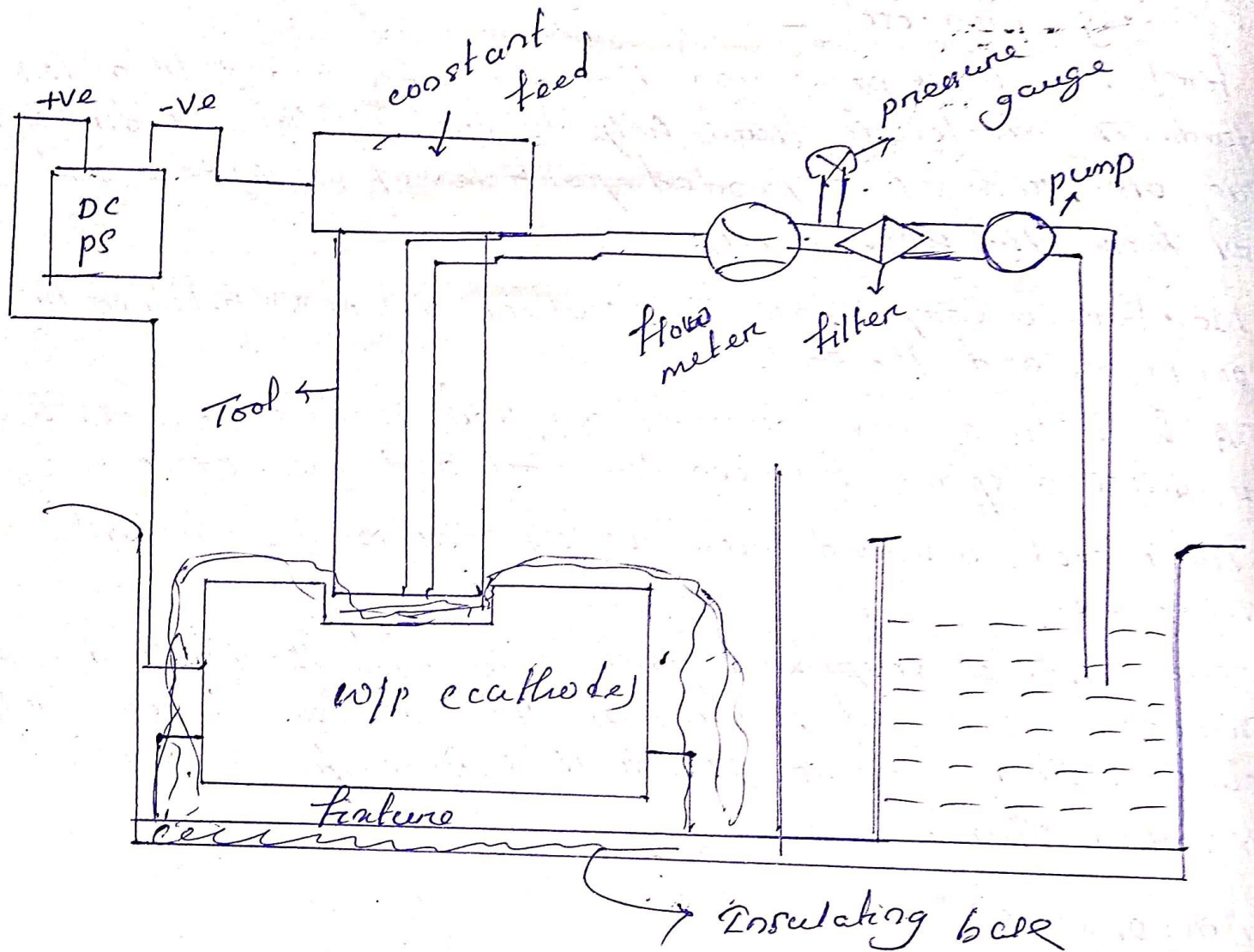
Dis-Advantages :-

- * In this machining process high tool wear occurs.

Electro chemical Machining :-

* ECM is a non-traditional machining process in which metal removed by electrochemical dissolution. This process can take an inverse of electroplating process.

Electro chemical machining works on the Faraday law of electrolysis. Tool is connected with the "-ve" terminal of battery (work as cathode) and w/p is connected with the "+ve" terminal of battery (work as anode). They both are placed in a electrolyte solution with a small distance. When the DC current supplied (3 to 30 V) to the electrode, metal removed from work piece.



Working Process :-

- * To ECM, Generally NaCl into water takes electrolytes.
- * The tool is connected to "-ve" terminal and work is connected to "+ve" terminal.
- * When the current passed through electrodes reactions occur at anode on w/p and the cathode on tool.



- * Positive ions move towards the tool and negative ions towards the work piece.
- * The hydrogen ions move towards tool. At the hydrogen reaches to the tool, it takes some electrons from it and converts into gas form. This gas goes into environment.

Application :-

- * It is used to machining disk or turbine rotor blade.
- * It can be used for slotting very thin walled coils.

Advantages :-

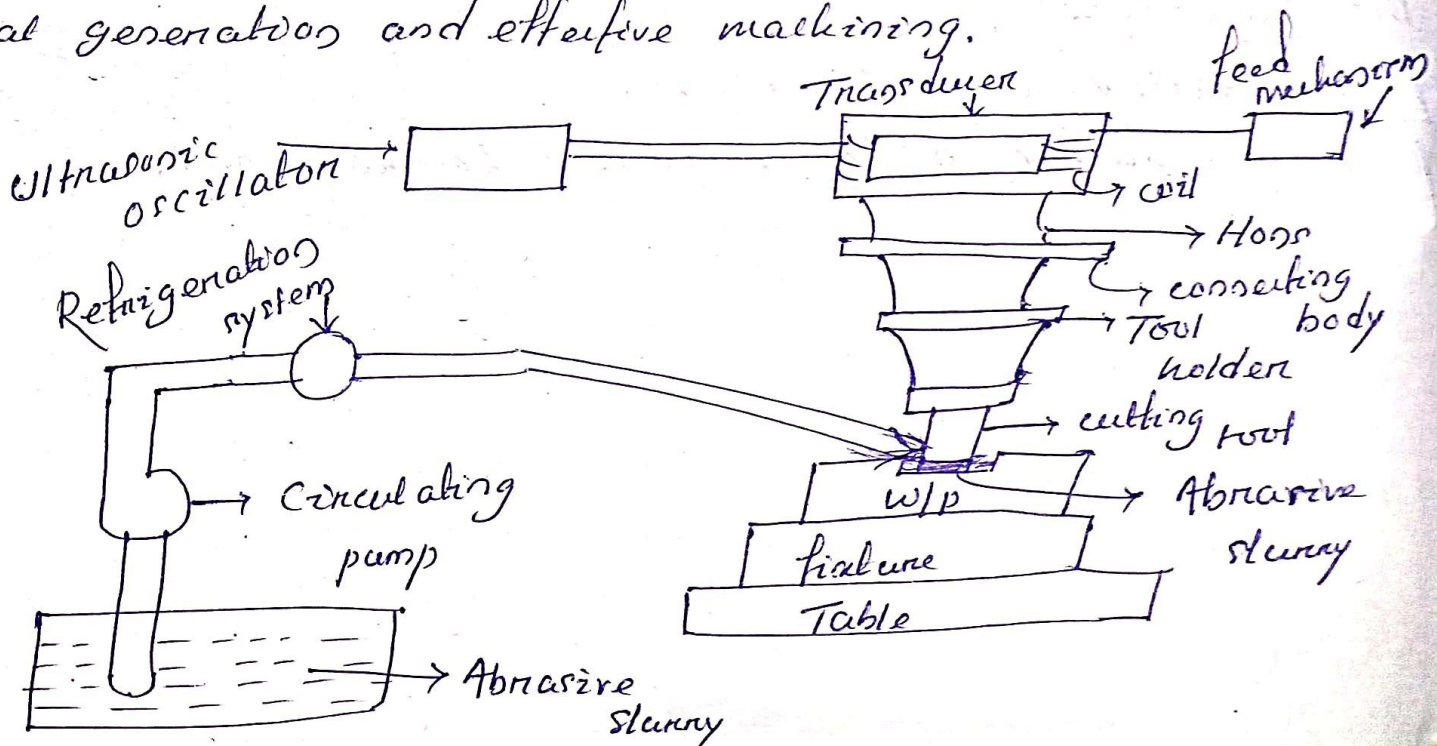
- * It can machine very complicated surface.
- * ECM has high surface finish.

Dis-Advantages :-

- * High initial cost of machine.
- * Non-conductive material cannot be machined.

Ultrasonic Machining :-

* It is a non-traditional machining process which is used to machine brittle and hard material. In ultrasonic machining, ultrasonic waves are produced by means of magnetostrictive effect which are converted into mechanical vibrations. Ultrasonic machines generate high frequency 20000 to 30000 Hz. This process is used in many industries to remove metal due to its lower cost, no heat generation and effective machining.



Working Process :-

- * First the low frequency electric current passes through electric supply. This low frequency current converts into high frequency current through some electrical equipment.
- * This high frequency current passes through transducer. The transducer converts this high frequency electric signal into high frequency mechanical vibration.
- * This mechanical vibration passes through booster. The booster amplifies this high frequency vibration and sends it to horn.
- * Horn which is also known as tool holder, transfers vibration to tool which makes tool vibration at ultrasonic frequency.
- * An abrasive slurry is used to supply abrasive slurry like aluminium oxide, silicon carbide etc. which is a mixture of abrasive grain and water in between tool and workpiece interface under a pressure.
- * At tool vibration, it makes abrasive slurry to vibrate at this high frequency. The abrasive slurry strikes to the W/P and removes metal from it.

Advantages :-

- * Workpiece after machining is free from stress.
- * Extremely hard and brittle material can be easily machined.
- * Very good accuracy and surface finish can be obtained.
- * The operational cost is low.

Dis-Advantages :-

- * The tool life is low.
- * Power consumption is quite high.
- * ~~It~~

* The metal removal rate is low and cannot be used for large machining cavities.

* The slurry may have to be replaced frequently.

Chapter - 2 Plastic Processing

Plastic Processing :-

1. Processing of plastics
2. Moulding processes
Injection Moulding
Compression Moulding
Transfer Moulding
3. Extruding, casting, calendaring
4. Fabrication Methods - Sheet forming, Blow Moulding, Laminating plastic (Sheets, rods and tubes), Reinforcing.
5. Applications of plastic.

Plastic :- It is synthetic organic material which is moulded into any desired shape under pressure and heat.

Uses :-

(Application)

- Automotive
- Electrical appliances
- Communication sector like TV, Radio etc.
- Safety glass
- Laminated gears, pulleys etc.

Properties of plastic :-

1. Light weight
2. Easily casted, drilled etc.
3. Good toughness
4. Good strength
5. Corrosion resistance.

6. Wear and tear should be good.
7. Good Thermal efficiency.

Classification of plastics :- (Types of plastic)

1. Thermosetting plastic
2. Thermoplastic Materials.

(i) Thermosetting plastic :- (Polymerisa

Those material which are formed into desired shape under heat (124°C to 177°C) and pressure which results in permanently hard materials.

Use :- (i) cooking pot, knobs, bottle caps, Lamp sockets, telephone etc.

(ii) Thermoplastic Materials :-

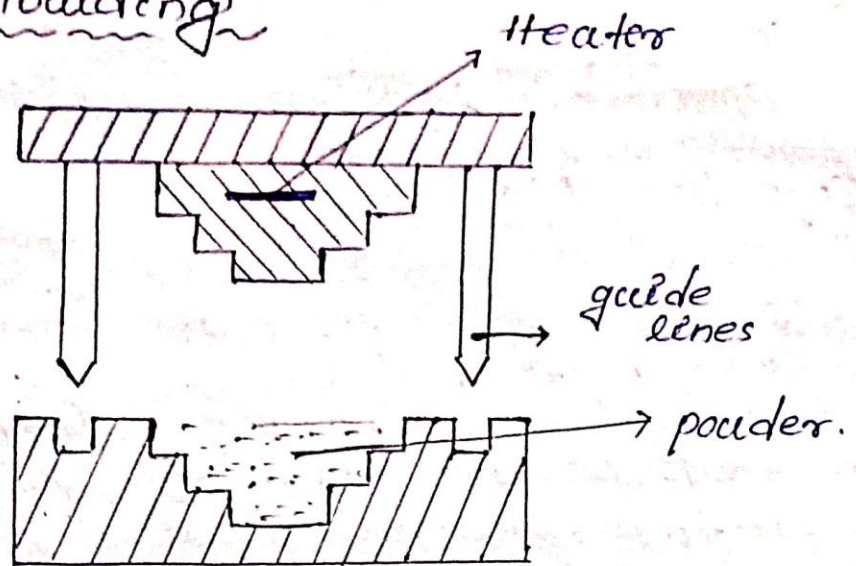
The plastic which do not become hard under pressure and heat. There is no chemical change, Remains soft.

Use :- Bags, packaging, Toys, dustbin etc. Roof light.

Plastic Moulding Techniques :-

- (i) compression Moulding
- (ii) Injection Moulding
- (iii) Transfer Moulding.
- (iv) Extrusion Moulding.
- (v) Blow Moulding.
- (vi) Slush Moulding
- (vii) Cast Moulding.

(i) Compression Moulding



⇒ Material used in powder form which is placed into the die.

The upper half of the die compress the material which melt and fill the die cavity.

In these we can use both Thermosetting and Thermoplastic.

Advantages :-

- (i) It is simple process
- (ii) It is rapid process
- (iii) Increase production
- (iv) useful for small component
- (v) different types of shape can be produced.

Disadvantages :-

- (i) Initial cost is high
- (ii) Design of die is a problem
- (iii) Skilled worker is required.
- (iv) Only used for small components.

Application :-

- (i) Gas keb
- (ii) handle of electric iron
- (iii) screw on bottle iron

- (iv) Knobs
- (v) seal
- (vi) Gear and handles.

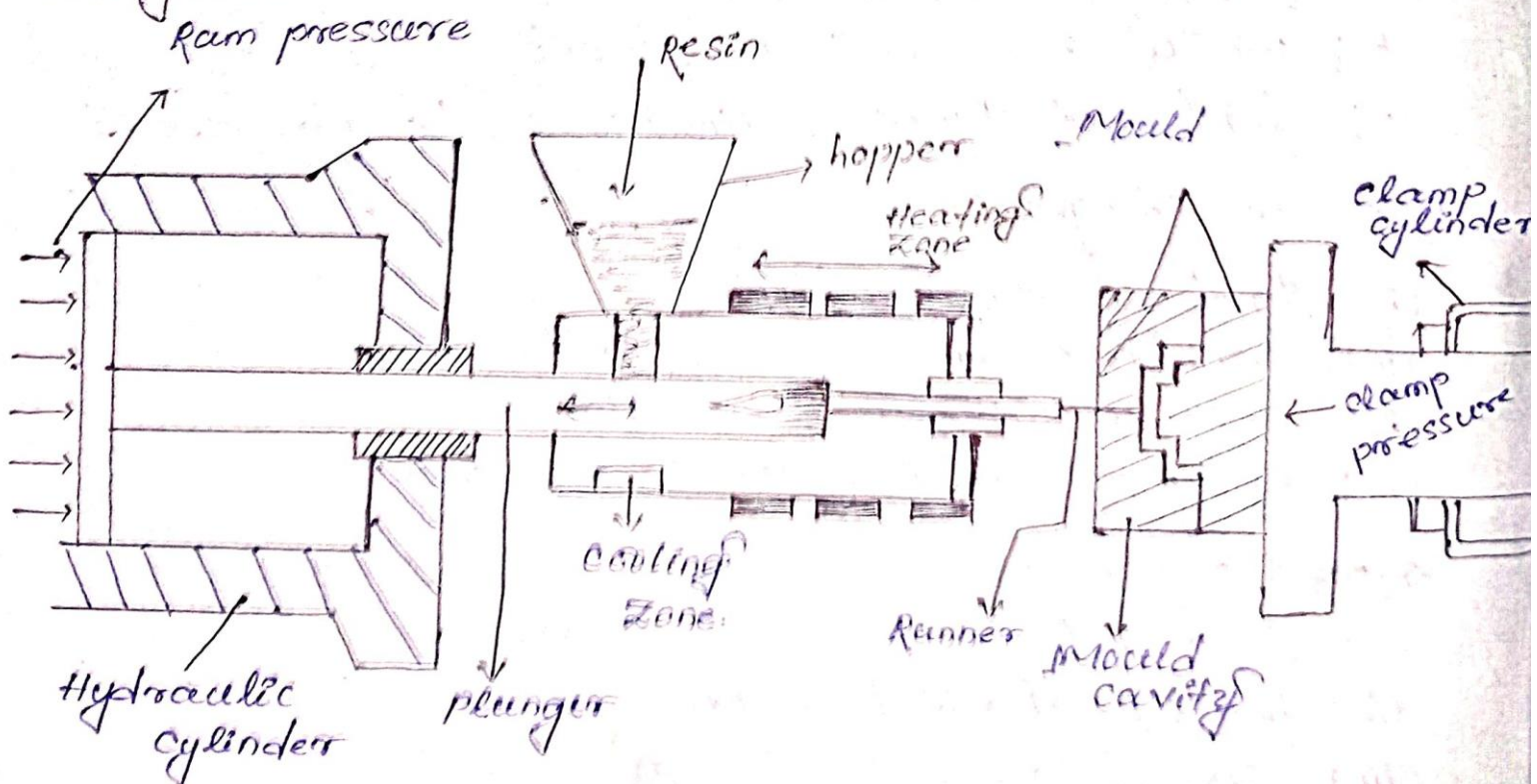
Injection Moulding

This is the most successful and widely used moulding method for thermoplastics. In this method thermoplastic material in powdered or granular form is compressed in a pressure chamber and then pushed into a heating chamber material may be pushed by means of a plunger or by means of a reciprocating screw. Soften material now forced through a nozzle to a cold having cavity of desired shape.

This method has following advantages over compression moulding :-

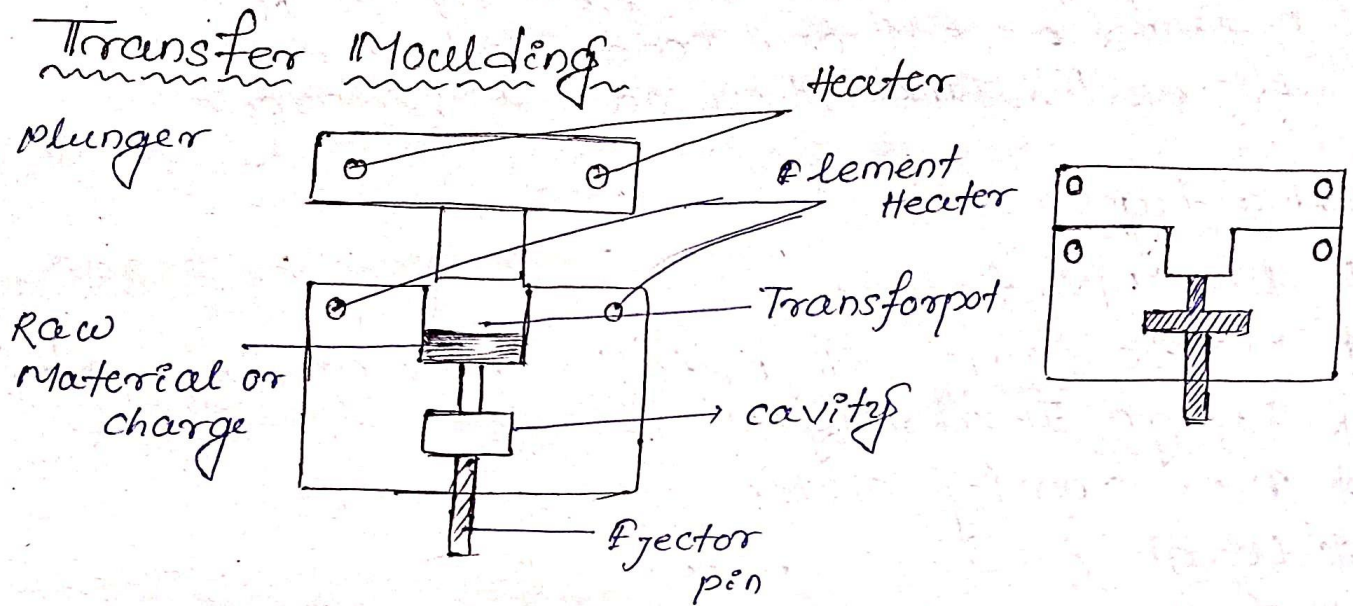
1. Less time required.
2. More economical for mass production
3. Material wastage is low.

Diagram



Application of plastics

Some of the applications include buildings construction, Luggage, safety - helmets, Seating, Kitchen, tensils etc, plastic is sustainable and Long - Lasting. plastic is light weight yet strong is resistance to rot and corrosion and has strong weatherability due to its ability to achieve tight seal.



It is a modified form of compression Moulding

→ Material - Thermoset polymer.

This process is particularly suitable for intricate shapes that having varying wall thickness.

→ The uncured Thermosetting charge / material is loaded into heated transfer pot or chamber immediately above the mould cavity.

→ After the thermosetting charge / Material reaches the proper temperature, it is injected into heated, closed mould.

→ Depending on the type of machine used, a ram, a plunger or a rotating screw feeder forces the thermosetting charge / material to flow through the narrow channels into the mould cavity.

- Because of internal friction this flow generates internal heat, which raises the temperature of the material and homogenizes it.
- Curing then takes place by cross linkings
- After the curing, the transfer ram is retracted while the moulded part is ejected from the mould.
- The sprue and the leftover metal with the ram is called ~~at~~ call are scrap and need to be discarded since they cannot be recycled.

Advantages

- * Low Maintenance cost.
- * plastic parts with metal inserts can be made.
- * Design Flexibility.
- * Dimensionally stable.
- * Large production rate.
- * Fast setup time and lower setup costs.

Disadvantages

- * Wastage of material.
- * production rate lower than injection ~~and~~ moulding.
- * Air can be trapped in the mould.
- * Runner are scrap - Not economical.
- * High moulding pressures are required. compared to compression Moulding.

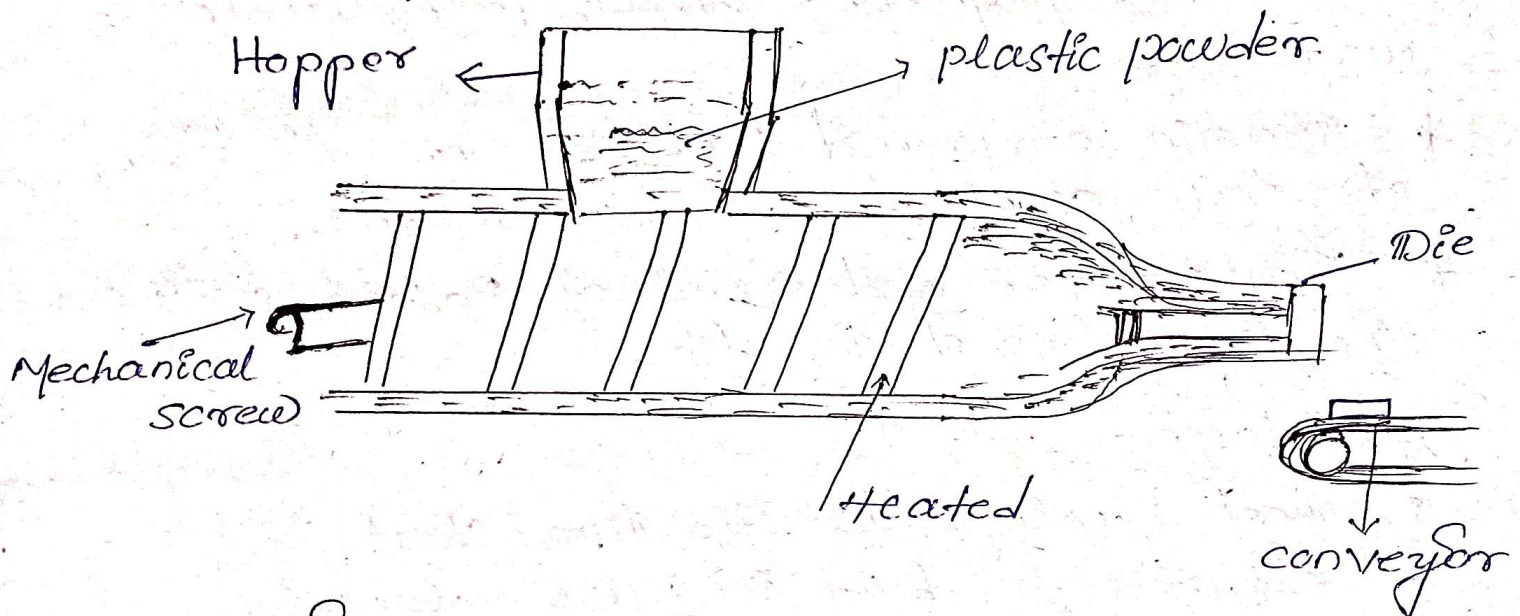
Application

- * Electrical and Electronic components
- * Rubber and silicon parts.

Extrusion Moulding ::

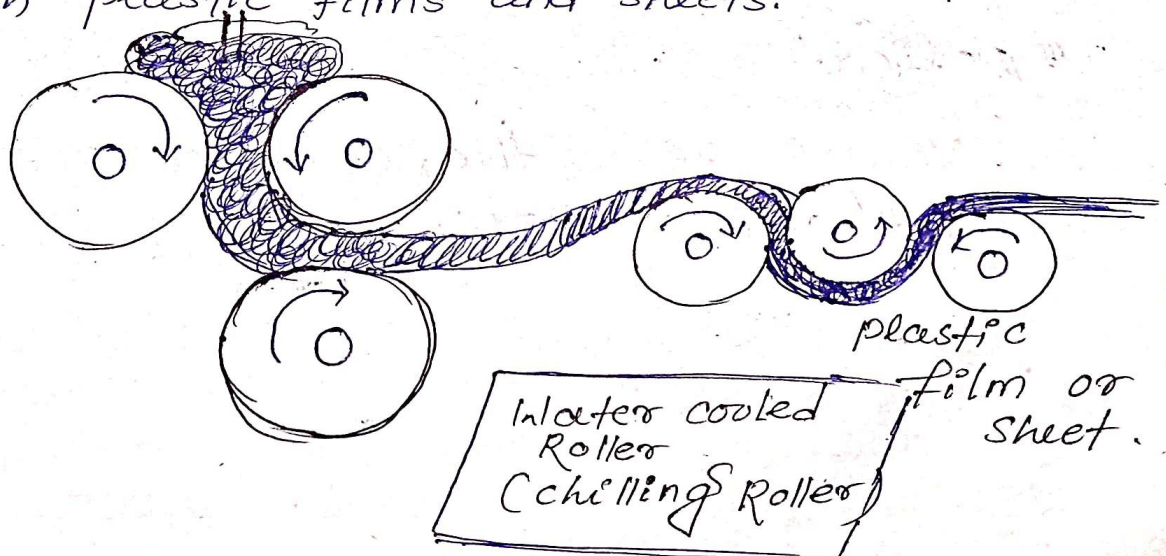
Extrusion Means continuous flow of through a die. This Method is similar to injection Moulding and used for thermoplastic material. In this Method powdered or granular thermo plastic Material is fed into a hopper and forced by spiral screw into the heating chamber.

The soften Material from the heating chamber is forced through a die. The finished product coming out of the die, is cooled by blow of air or spray of water and then taken out. This Method is mainly used for making Long tubes, sheets, pipes, ropes etc.



Casting Calendring

It is a plastic forming process. By this process Thermoplastic Material is being process by which plastic films and sheets.



Heated plastic compound :-

(polymer mixer) Resin filler + plasticizer + colour pigment) is passed through a series of hot rollers.

Plasticizer - Ex: Glyceryl triacetate
polyethylene glycols.

Resin - Metal powder

Filler - a composition used to fill the pores and grain especially of a wood surface before paint

Colour pigment - which is insoluble in water.

* Plastic compound squeezed into the form of thin sheet of uniform thickness.

* Temperature and Speed of Rollers influences the properties of the film.

Advantages

1. Best quality plastic film / sheet
2. Adapted for heat sensitive polymer.

Disadvantages

Risk of air pocket.

Application :-

Vinyl floor tile, cellulose acetate sheet and film etc.

Blow Moulding

→ It is a forming process - plastic processing Method.

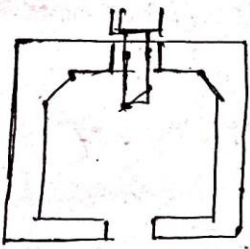
→ Used only for Thermoplastic.

Material used:- polysulfone, polystyrene, butadiene, styrene, polyvinyl chloride (PVC) polycarbon and high-density polyethylene (HDPE)

→ This process taken a few second.

→ Blow moulding machines are capable of producing up to 20,000 containers in an hour.

A parison is a piece of plastic shaped like a tube with a hole at one end which allows compressed air to pass through.



Advantages :-

- * Low Tooling cost
- * Textures can be added to the surface of product.
- * Intricate shapes can be formed such as screw heads on bottle.

Disadvantages :-

- * Trimming required
- * Limited to hollow parts.
- * Defect may be seen.

Application

- Bottle
- Drums
- Garbage cans
- Food storage container.

Laminating of plastics

High pressure Laminating

Low pressure Laminating

High pressure Laminating

Layers Join



Fibrous



paper



Thermo Setting

Resin

Reinforce

Process

→ Prepare Varnish



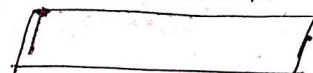
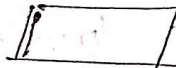
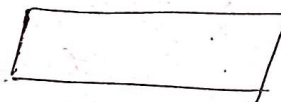
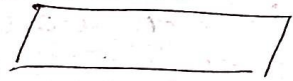
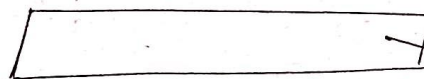
Solvent Add Resin



→ paper/Nylon

→ solve Add Ram

→ Dry it
and Reqd size from it



→ Metal plate
Heating and
press

Metal ple

Low pressure Laminating

laminating of p/c

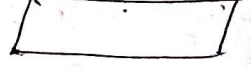
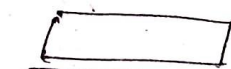
→ pressure range - 32 kg/cm²

→ Thermo setting Resin/plastic Resin

→ Reinforced material - paper, cotton

→ pigments - Different colour

→ Filler - clay, calcium carbonate.



Thermo
Setting
Resin

Chapter 3

Additive Manufacturing Process

(1) Need for Additive Manufacturing

Additive Manufacturing Removes Limits on Design & saves production & supply chain costs by enabling more parts to be produced on demand, within hours & in desired quantity. It greatly reduces stock & the need to make mould.

(2) Fundamentals of Additive Manufacturing

It uses 3 Dimensional printing technology in order to create parts and assemblies without tooling.

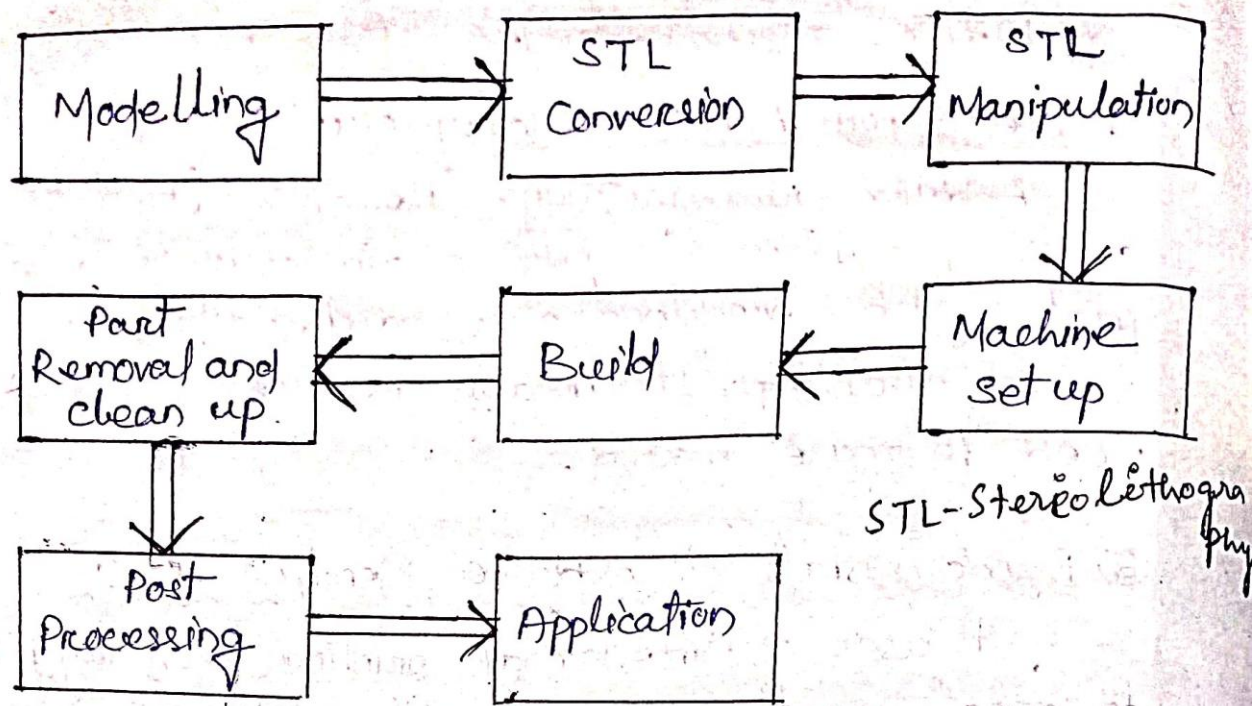
It reduces design risk, provides efficiencies for the manufacturing process and is used for low-production part runs. It is the process of creating an object by building it one layer at a time. It is the opposite of sub-tractive manufacturing in which an object is created by cutting away at a solid block of material until the final product is complete.

Basic steps

- (1) Using CAD software to design a Model
- (2) Pre Processing
- (3) Printing
- (4) Post Processing.

(3) AM Process Chain

It is also known as 3D printing, rapid prototyping or freeform fabrication is the process of joining materials to make objects from 3D model data usually layer upon layer, as opposed to subtractive manufacturing methodologies such as machining.



(4) Advantages and Limitations of AM

Advantages :-

- (1) The cost of Entry continues to fall
- (2) You'll save on material waste and energy.
- (3) Prototyping costs much less.
- (4) Small production runs often prove faster and less expensive.
- (5) You don't need as much on hand inventory
- (6) It's easier to recreate and optimize legacy parts.

Disadvantages :-

- (1) Slow Build rates
- (2) Cost of entry with additive manufacturing the cost of entry is still prohibitive to many organisations and in particular, smaller business.
- (3) High production cost.
- (4) Considerable effort required for application Design.
- (5) Discontinuous Production.

(5) Classification of AM Process

(1) VAT Photopolymerisation. It uses a vat of liquid photopolymer resin, out of which the model is constructed layer by layer.

(2) Material Jetting

(3) Binder Jetting

(4) Material Extrusion.

(5) Powder Bed Fusion.

(6) Sheet lamination.

(7) Directed Energy Deposition

(6) Difference :-

Parameter	AM Machining	CNC Machining
(1) Material	AM include development of polymeric material, waxes and paper laminates.	CNC used for machining soft materials or medium density fiber board, machinable waxes etc.
(2) Speed	Higher, takes few hours to make part.	Lower, takes weeks to develop same part
(3) Complexity	Complex operation	Easy operation
(4) Efficiency	Higher	Lower
(5) Accuracy	More accurate	Comparatively less
(6) Programming	It won't be built properly if correct programming is done.	In correct programming can badly damage the machine and may even be safety risk.

(7) Application of Bio engineering

Prominent biomedical Engineering application includes the development of bio compatible prostheses, various diagnostic and therapeutic medical devices ranging from clinical equipment.

to micro-implants, common imaging equipment such as.

MRI and EEG, regenerative tissue growth

(8) Concept of Flexible Manufacturing Process

It is a production method that is designed to easily adapt to changes in the type and quantity of the product being manufactured. Machines and computerized system can be configured to manufacture a variety of parts and handle changing level of productivities.

(9) Web Based Rapid Prototyping System

The process, of iteratively mocking up an interface and validating it with users stakeholders and even your teammates.

If have been developed and employed to implement remote service and manufacturing for rapid prototyping enhance the availability of RP&M facilities and improve the capability of rapid product development for a large no. of small and medium sized enterprise.

Capstain	Turret Lathe
(1) It is a light duty machine. (2) The turret head is mounted on the ram and the ram is mounted on the saddle.	(1) It is a heavy duty machine. (2) The turret head is directly mounted on the saddle and the saddle slides over the bed ways.

(2) The length wise movement of turret is less

(4) The saddle will not be moved during machining.

(5) Short work piece only can be machined

(6) It is easy to move the turret head as it slides over the ram.

(7) As the construction of lathe is not rigid heavy cut cannot be given.

(3) The saddle is moved along with the turret head during machining.

(4) The lengthwise movement of turret is more.

(5) Long work piece can be machined.

(6) It is difficult to move the turret head along with saddle.

(7) As the construction of lathe is rigid, heavy cut can be given.

2(P)

(11) Rapid Prototyping Process :-

It is the fast fabrication of a physical part, model or assembly using 3D computer aided design (CAD). The creation of the part, model or assembly is usually completed using additive manufacturing or more commonly known as 3D printing.

Ex:- kitchen stove.

It is used to summarize different methods and manufacturing processes that serve the fast and flexible production of prototypes and series part. It implies to use non conventional tools directly reading the available CAD.

It can be used at any stage of the product development cycle for any component.

Application of Aerospace Industry

Typical aerospace applications include Aeronautical engineering, satellite communication, guidance and tracking systems, destructive and non-destructive materials testing, propulsion and engine testing, surveillance and electronic warfare impact studies, Mechanical testing and vibration analysis.

It allows aerospace engineers to generate detailed 3D models of air craft and aerospace system, It is a vital tool for them.

Application of Design thinking In Automotive Industry

As it's core Design thinking is a human centered approach that offers a reliable way to anticipate industry and consumer change while quickly inspiring and implementing new idea, It's include, mechanical testing, vibration analysis ignition monitoring.

Concurrent Engineering

It is a method of designing and developing products in which the different stage run simultaneously rather than consequently it reduced cost.

feature of concurrent engineering.

(1) doing things simultaneously.

(2) Focusing on the process

It decrease product quantity
also the time to market leading to improved
productivity and Reduce cost.

Chapter - 4

Special Purpose Machine (SPM)

* Concept

SPM are those machines which are designed and tailored made as per the customer specific requirement.

These machines are not available off the shelf. As these are not covered Manufacturing programs.

Examples: - 1) Assembly work benches
2) conveyor

General Elements of SPM

Examples of these elements are nuts, bolts, keys, axles, shafts, couplings, bearings etc.

The elements that are used only in the specific type of machine are called as special purpose elements.

* Ideal for mass production

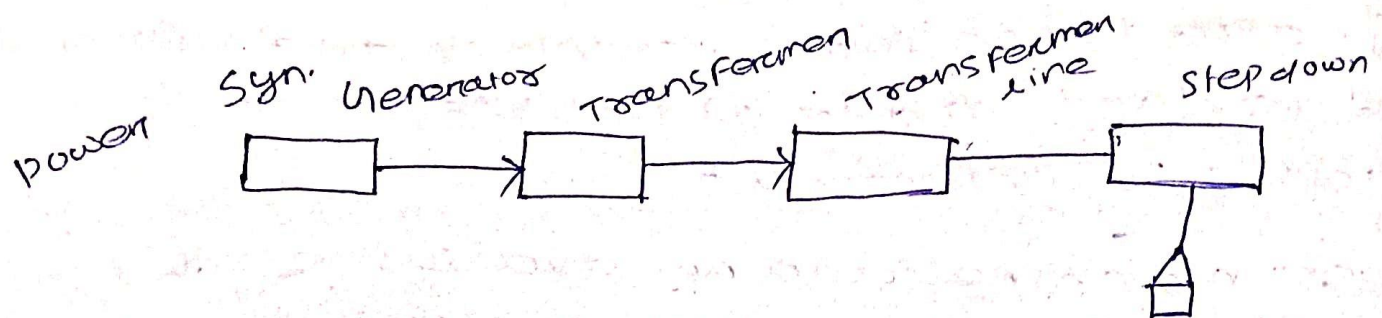
* Hydraulically operated automatic job clamping system.

* 4 spindle units - two vertical & 2 horizontal.

* Auto cycle through of limit switch & PLC.

1- ϕ induction motor :-

* Requirement :-



General Elements of SPM :-

Special-purpose machine elements :-

These are mechanical elements that find specific use in machine design. Example of such part are the turbine in a jet engine, blades in a fan, piston, crank shaft etc.

Productivity improvement by SPM

- 1) Examine problems as a team.
- 2) Prioritize Employee Training
- 3) Invest in Better Tools
- 4) Ongoing machine maintenance
- 5) Optimize your inventory
- 6) Data Tracking
- 7) Streamline supplier communication
- 8) Automate process.

Principle of SPM design :-

SPM is divided upon the principle of minimization of cost, improved productivity & improve safety, better safety, which passes with high initial investment, higher maintenance cost. It is a part of multi tasking machine.

- 1) minimization of cost.
- 2) improved productivity
- 3) improved safety
- 4) Better safety which passes with high initial investment, higher maintenance cost.

Advantages of SPM

- 1) Increase in productivity.
- 2) Less time consuming.
- 3) Reduced maintenance & servicing cost.
- 4) Increase in production rate & tool life.
- 5) Less complicated
- 6) High durability
- 7) Effective in mass production.

Dis Advantages of SPM :-

So special care & maintenance ^{an} would also be required for such machines. Such machines might also be more expensive than regular machines as they are specially designed. A perfectly cranked SPM requires minimal work force and human support.

SPM

1) only specific operations can be performed.

(it suitable for performing similar operation)

2) initial cost is more

3) Rate of production is high.

4) semi-skilled labour can operate the machine.

5) inspection cost is low

6) suitable for mass production.

7) specialized tools are required.

8) spare parts are not easily available

UPM

1) A number of operation can be performed.

2) initial cost is low

3) rate of production is low

4) skilled labour

5) inspection cost is high

6) suitable for limited production of jobs

7) General purpose tools are required.

8) spare parts are easily available.

SPM

Special purpose machine tools are designed and manufactured for specific jobs and as such never produced in bulk.

TYPE OF MAINTENANCE

① Reactive Maintenance :-

It is the process of repairing assets of standard operating conditions after poor performance or breakdown is observed. The primary benefits to reactive maintenance are lowers costs and it requires less staff to implement

ex:- Do you change a light bulb before its turn out.

Broken down Machines are either Replaced or Repaired.

2. Preventive Maintenance :-

It refers to any regularly scheduled Machine maintenance intended to identify problems and repair them before failure occurs. preventive maintenance split up into 2 predominant types

- (i) Time Based
- (ii) Usage Based

③ predictive Maintenance

It is a type of Maintenance that directly tracks an assets health, status and performance in real time. It is aimed at reducing costly, in expected breakdown and offers the manufacturer the opportunity to plan maintenance.

4. Proactive Maintenance

~~It includes all activities involved in keeping a system equipment in working order~~

It is a Maintenance Strategy that corrects the source of underlying equipment conditions. The goal of proactive maintenance is to reduce unplanned →

down time, equipment failure and risks associated with operating faulty equipment

5. Reliability Maintenance.

It includes all activities involved in keeping a system equipment in working order. It ensures that the machine will operate for some time should there be proper condition.

✓ Repair Cycle Analysis

Repair cycle refers to the stages through which a repairable item passes from the time of its removal or replacement until it is reinstalled or placed in stock in a serviceable condition.

✓ Repair Complexity

The complexity of Repairing, Adjusting and Aggregating of extensions in Abstract Argumentation. In Maintenance complexity can be define as based on technical and Managerial aspects of a Maintenance project.

Maintenance Manual of

Maintenance Records.

Maintenance Manual refers a document that contains all the necessary details on the upkeep of equipment and property.

The maintenance Manual provides maintenance personal with the information necessary to maintain the system effectively.

Maintenance Records

It includes the information of the asset, maintenance type, address of the location, date, description of the maintenance parts replaced etc.

It is useful to keep track of the maintenance records of your assets for easily trackings of the performance of assets.

Equipment of Maintenance Log

- ① Name of the asset
2. Serial Number
3. Equipment Manufacturer and its contact details.
4. Date of purchase.
5. Date of first use
6. Operator responsible for the asset.
7. Location of facility.
8. Date of Maintenance.

House Keeping in Maintenance

The function of house keeping should be to keep rooms clean, sanitary and welcoming but also to put the industry's best face forward at all times, maintaining halls and floors free from slip and trip hazards and removing of waste material and other fire hazards from work area.

Q2) TPM (Total productive maintenance)

It is a strategy that operates according to the idea that everyone in a facility should participate in maintenance, rather than just the maintenance team.

ex:- Machine operators do routine cleaning, greasing, lubrication, inspection and replacing parts.

It is the process of using machine equipment, employees and supporting processes to maintain and improve the integrity of production and quality of the system. TPM helps to.

Frame maintenance as a business advantage.

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