Metal Forming processes, Dt - 12-07-24

production :-

In technical sector production means to convert resources into final products.

Technology :-

It is refers to the way of producing a final product.

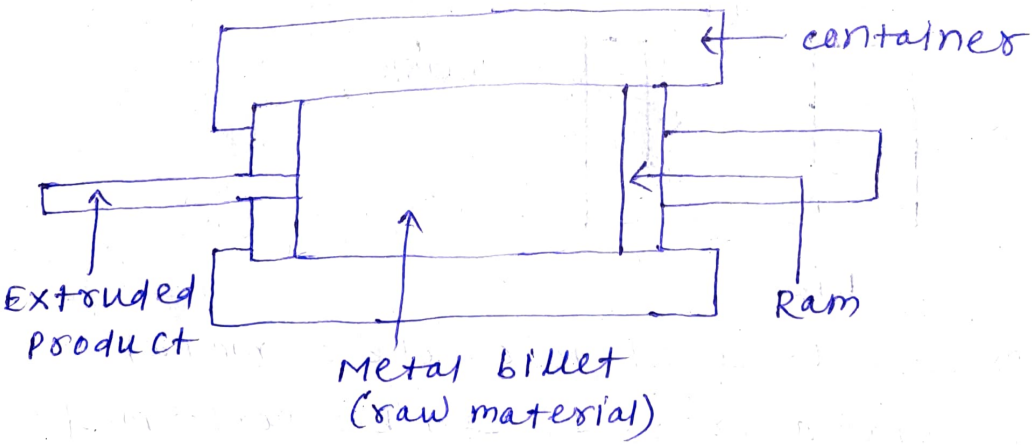
Extrusion :-

Extrusion is a metal forming process in which a material undergoes plastic deformation by the application of a force causing that material to flow through ~~an~~ a die.

classification of Extrusion

1) Direct Extrusion / forward extrusion
2) Indirect Extrusion / backward extrusion
3) Impact Extrusion

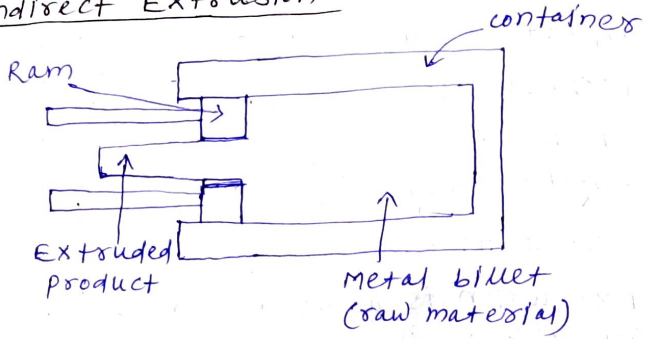
1) Direct Extrusion



In this type of extrusion process metal is forced to flow in the direction of feed of punch. The punch move towards die during extrusion. This process required

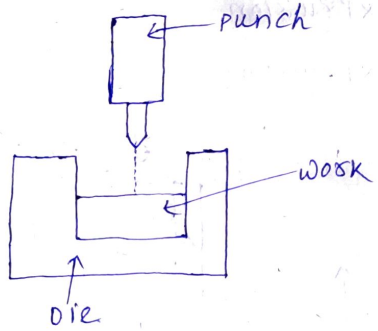
higher force due to higher friction between billet and container.

2) Indirect Extrusion



In this process metal is flow towards opposite direction of plunger movement. The die is fitted at opposite side of punch movement. In this process the metal is allowed to flow through annular shape between punch and container

3) Impact Extrusion



This process is used to create a metal product via a press. It can be performed with a hydraulic press or mechanical press. The press is responsible for forcing a metal slug through a die. As the metal slug passes through a die, its deformed.

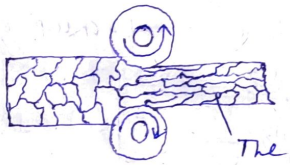
ROLLING

Rolling is a metal forming process in which the cross-sectional area is reduced by passing through the work piece (ingot) through a pair of rolls.

Types of Rolling Mills

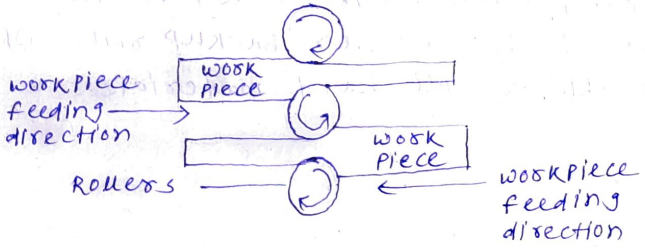
1) Two high rolling mills
2) Three high rolling mills
3) Four high rolling mills
4) Cluster rolling mills

1) Two high rolling mill



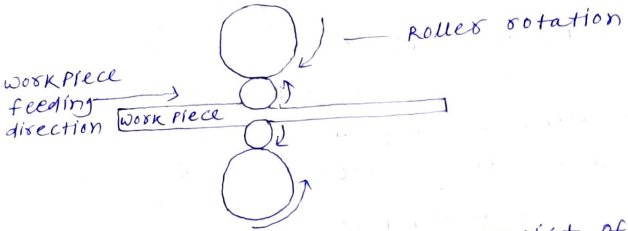
The two high rolling mill means there are two rollers attached to the metal.

2) Three high rolling mills



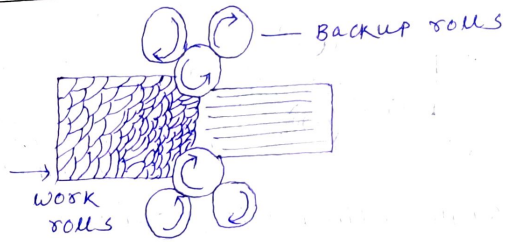
Three high rolling mill means there are three rollers which are attached to the metal but working two metal at same time.

3) Four high rolling mill



The four high rolling mills consist of two small size rolls & two big size rolls. This mill is used for reducing material to extremely small thickness. The big size rolls work as backup rolls.

4) cluster rolling mill



A cluster rolling mill is a special type of rolling mill in which each of the two working rolling mill backup by two or more of the larger backup rolls which are able to roll hard materials.

Differentiate between cold Rolling process and hot rolling process

Cold Rolling Process	Hot Rolling Process
- The material to be rolled is below recrystallization temperature.	- The material to be rolled is above recrystallization temperature.
- The role radius is smaller.	- The role radius is larger than used in cold rolling.
- very thin section (0.02mm) can be made in case of aluminium foils.	- very thin section (>1.25mm) are not obtained by hot rolling.
- The heavy reduction area is not possible.	- The heavy reduction area can be obtained.
- cold rolling increase hardness, generate cracks & reduce ductility.	- Hot rolling refine grain size structure, blow holes, increase toughness.
- Pressure is applied less due to high temperature.	- Pressure is applied more due to normal temperature.

Chapter-02, WELDING, Dt-13-07-24

Welding :-

Welding is a fabrication process, where two or mor than two metals are joint together with the help of metallurgical fusion and permanent joint is known as welding.

This process is basically of two types :-

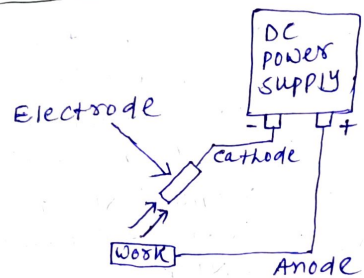
Fusion welding

- It requires only heat.
- Joint area is heated to ~~Plastic~~ molten state.
- It requires ~~lower~~ higher temperature.
- Filler material is required.
- Ex- arc welding, gas welding, resistance welding.

pressure welding

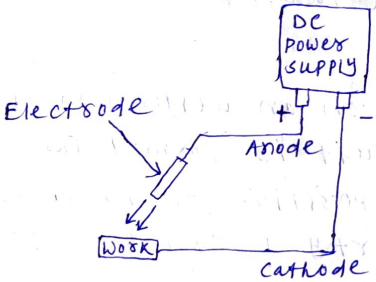
- It requires heat and pressure.
- Joint area is heated to ~~molten~~ plastic state.
- It requires ~~higher~~ lower temperature.
- No need of filler material.
- Ex- roll welding, friction welding, diffusion welding

1. straight polarity (DCEN)



→ In this the electrode forms the negative terminal and the workpiece positive. The electrons move from the cathode (electrode) to the anode (workpiece). This generates around 67% of welding heat at workpiece and 33% at electrode.

2. Reverse polarity (DCEP)



→ In this, the electrodes forms the positive terminal and the workpiece negative. This generates around 33% of the welding heat at workpiece and 67% at electrode.

ELECTRODES

The electrodes used for providing heat in arc welding are of two types, consumable and non-consumable electrodes.

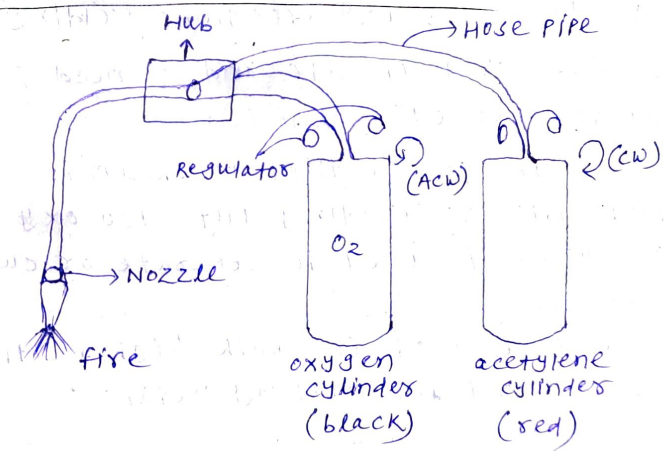
consumable electrodes

→ A consumable electrode itself melts down during welding and subsequently deposits on the weld bead.
→ Electrodes act as filler metal (no additional filler is supplied).
→ consumable electrodes are made of steel, cast iron, copper, brass, bronze or aluminium.

Non-consumable electrodes

→ A non-consumable electrode does not melt down or deposit on the weld bead.
→ So, filler is required to supply separately.
→ Non-consumable electrodes are made of carbon, graphite or tungsten.

OXY ACETYLENE WELDING



Oxy Acetylene welding is a type of gas welding that is used to join the metals. In the name oxy Acetylene welding, we can observe two words oxy and acetylene the word oxy meant oxygen and acetylene is the odour-less hydrocarbon gas. so, the combination of oxygen and acetylene both are used to weld the metal.

Working principle

→ The temperature of the flame is about 3500 degrees centigrade. It uses the gases like oxygen and acetylene to weld the material.

→ In this process the welding torch produces the high-temperature flame with the help of oxygen and acetylene. Due to high flame the metal gets weak and melted, meanwhile, a filler material is used to fill the gap between work-piece.

Advantages of oxy acetylene welding

→ It is easy to operate and no need for highly skilled technician.

→ This type of welding is cheaper.

→ Not only for welding but also oxy acetylene is used to separate or cut the materials.

→ It can be used for both high melting metals and low melting metals.

Dis-advantages of oxy-acetylene welding

→ It requires specialized equipments.

→ oxy acetylene welding is not suitable for all materials.

→ It does not have a dedicated flux shielding system.

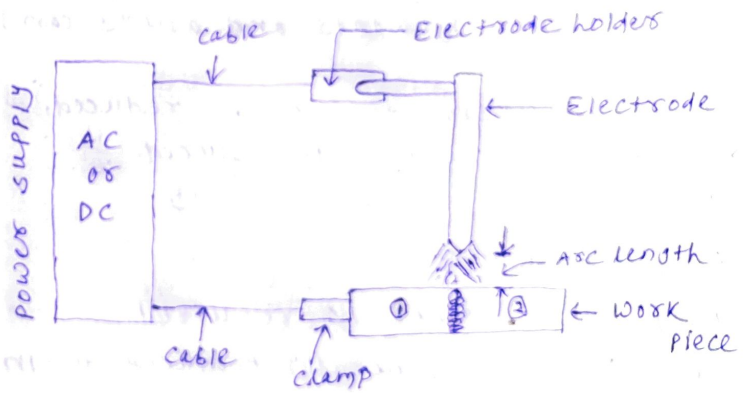
Application of oxy acetylene welding

→ It is used in the industries like metal joining and metal cutting.

→ It is used in the automobile repairs to join the damaged parts.

→ Fabricating workshops and industries.

ARC WELDING



→ It is a fusion welding process where the heat is generated by the application of arc.

→ In this process metals are heated upto the melting temperature by creating an electric arc and then allowed to solidify to form a welded joint.

→ In this welding process both AC DC current are used.

Working principle

→ In electric arc welding the end of the metal pieces to be joined are heated locally to the melting temperature, by creating an electric arc and then allowed to solidify to form the welded joint.

→ The arc is a flame of intense heat, generated by passing electric current through a highly resistant air gap between the electrode and the workpiece.

Advantages of arc welding

→ Large variety metals and alloys can be welded.
→ Time of construction can be reduced.
→ cost of construction is reduced.
→ Equipment is not very costly.

Disadvantages of arc welding

→ High skills worker is required.
→ More waste is generally produced during arc welding.
→ welding results in distortion of material.

Application of arc welding

→ Used in the welding of sheet metals
→ Used in the manufacture of aircraft & aerospace.
→ Used in the industries like construction automotive, mechanical
→ Used for welding thin, ferrous and non-ferrous metals.

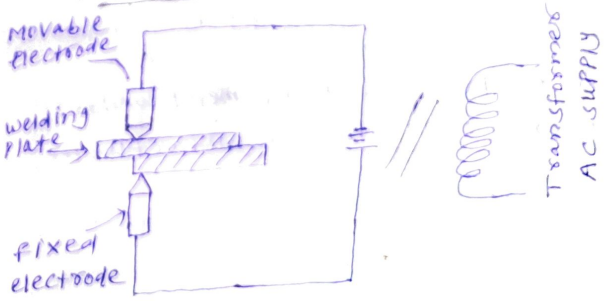
RESISTANCE WELDING

Electric resistance welding (ERW) is a welding process in which metal parts in contact are permanently joined by heating them with an electric current

It is classified into various types such as :-

1) spot welding
2) seam welding
3) Butt welding
4) Flash Butt welding
5) projection welding

① spot welding



Working principle

→ Spot welding is a fast and efficient process for joining metal. Two metal sheets are pressed together, and an electrical current passes through the contact point, generating intense heat that fuses the sheets together, creating a strong bond.

→ one end of the winding is connected to the movable upper electrode and the other end to the fixed electrode.

Advantages of spot welding

→ suitable for various metal & alloys.
→ Minimal distortion of workpieces.
→ No need for consumable filler material.
→ cost-effective
→ strong and durable welds.

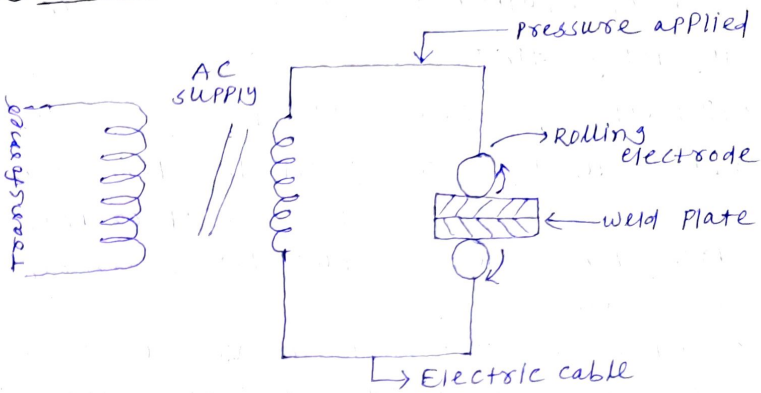
Disadvantages of spot welding

→ It is limited to thin material.
→ creates visible weld marks.
→ High initial equipment costs.
→ Not suitable for welding dissimilar materials.

Application of spot welding

→ Automotive industry for body and chassis assembly.
→ Aerospace industry for sheet metal components.
→ Electrical and electronics manufacturing.
→

② Seam welding



Working principle

→ In this welding the current is switched on and the metal pieces pushed together to travel between the revolving electrodes.
→ The metal between the electrodes get heated to welding heat and welded continuously under the constant pressure of rotating electrodes as it passes between them.

Advantages of seam welding

→ Gas tight as well as liquid tight joints can be made.
→ The overlap is less than spot or projection welding.
→ No need to use filler material.

Disadvantages of seam welding

→ The welding process is restricted to a straight line or uniformly curved line.
→ The metal sheets having thickness more than 3mm can cause problems while

Welding.

→ cost of equipment is high as compared to spot welding set.

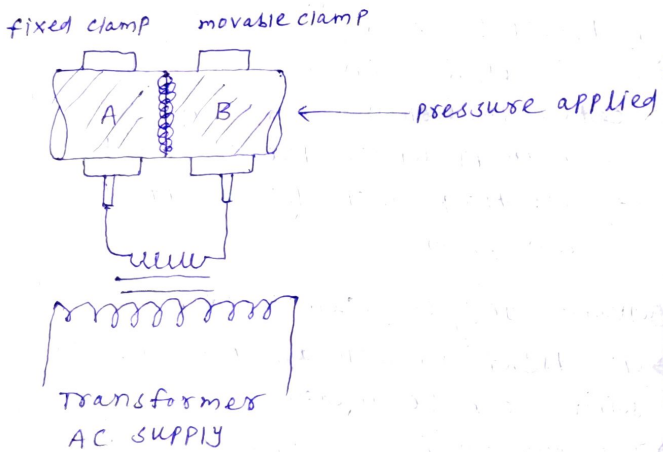
Application of seam welding

→ It is used in manufacturing process of various types of pressure tight or leak proof tanks such as fuel tanks, aircraft tanks etc.

→ Used for welding parts of vessels that need to be air tight and water tight.

→ Used for making lap joints.

③ Butt Welding



Working principle

→ Butt welding is a welding process where we can joint two workpiece without any electrode.

→ The metal pieces usually bars and rods of the same cross section area are held in clamps and developed resistance to flow current. Its joined through the collapse between the metal within certain temperature and heat it can be done.

Advantages of Butt welding

→ It provides distortion control.

→ It produces welds of high strength with complete fusion.

→ It is applicable to a wide variety of metal.

Disadvantages of Butt welding

→ It might be prone to prosity or craking.

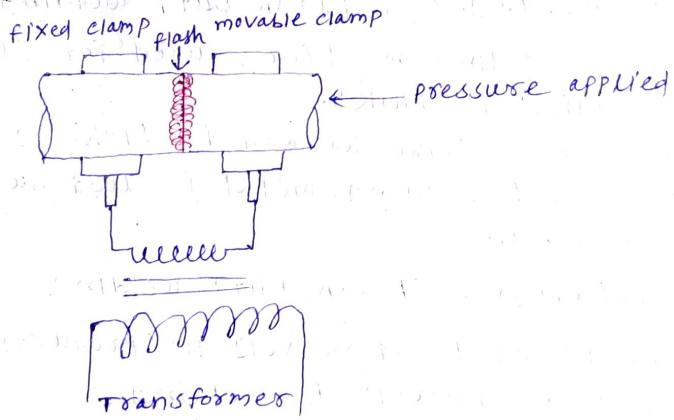
→ Required a skilled worker to ensure high-quality joints.

Application of Butt welding

→ Butt welding is used, where the metal pieces are joined end to end or edge to edge.

→ It is also used for welding pipes, wires and rods.

④ Flash Butt welding



Working principle

→ In this method, first the current is switched on and then the ends of the pieces to be welded are bought closer until they finally come in contact with each other.

→ once the ends come in contact with each other they forces the generated heat to which temperature raises to fusion point and at this moment the ends pressed against each other by mechanical pressure.

Advantages of Flash Butt welding

→ It is comparatively much quicker than butt welding.

→ A flash welding joint is stronger than the butt welding joint.

→ Flash butt welding is very cheap.

→ Flash welding can be used for welding metals having different melting temperatures.

Disadvantages of Flash Butt Welding

→ The welding machines used for flash welding is bulky.

→ chance of fire hazard is high.

→ In flash welding, metal is lost during flashing.

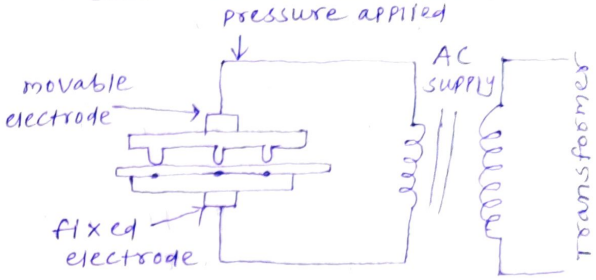
Application of Flash Butt welding

→ It is used extensively in production work, particularly in welding rods and pipes.

→ It is used in automobile construction on the body, axis, wheels and other parts.

→ It is also used in welding motor frames, transformer tanks.

⑤ Projection Welding



Working principle

→ In this welding process, projections at the desired location on the surface of one workpiece located. Thus the surfaces of the workpieces are in contact with each other at the projection. As per the current is switched on the projections are melted and the workpiece pressed together to complete the weld.

Advantages of projection welding

→ A number of welds can be made simultaneously.

→ In projection welding, more than one welds are done at a time. so, more output is obtained.

→ There is no limitation on the metal thickness.

Disadvantages of projection welding

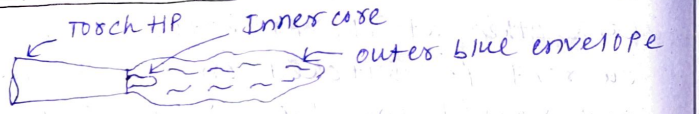
→ It required highly skilled workers.
→ Equipment used for projection welding are expensive.
→ The process of projection formation is complicated and time consuming.

Application of projection welding

→ projection welding is used in automobile industries, ship building works and sheet metal works.
→ It is also used for welding the parts of refrigerator, condensers etc.
→ It is used to weld nuts and bolts to sheet components.

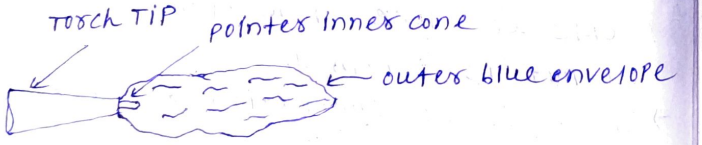
TYPES OF FLAMES

1) Neutral flame



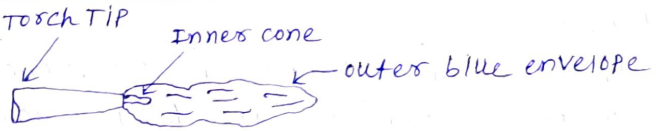
The inner zone has white colour and has temperature about 3100°C and outer zone has blue colour and have temperature about 1275°C.

2) oxidizing flame



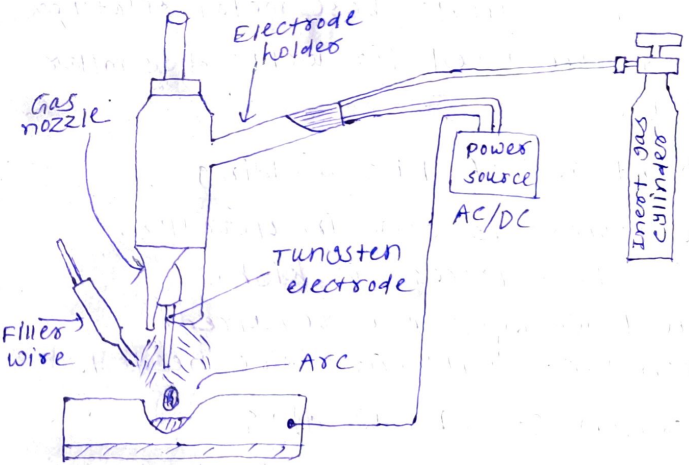
The inner zone has very bright white colour and has temperature of about 3300°C. The outer flame has blue in colour.

3) Carburizing flame



The inner zone has white colour, the intermediate zone is red in colour and outer zone is blue colour. The inner zone temperature is 2900°C.

TIG (Tungsten Inert Gas) welding



Working principle

→ In this welding process the arc is stuck between a non consumable electrode and base metal.
→ The electrode is held in a special type

of electrode holder that apart from holding the electrode it also carries a passage around the electrode for flow of inert gas to provide shield around the arc.

→ This shield protects the electrode, molten metal and the heated area of base metal from atmospheric contamination.

→ It is also known as GTAW (Gas Tungsten Arc welding).

Advantages of TIG welding

→ NO flux is required in TIG welding.
→ TIG welds are stronger, more ductile.
→ There is a little base metal splatter.
→ It is also used for welds dissimilar metals.

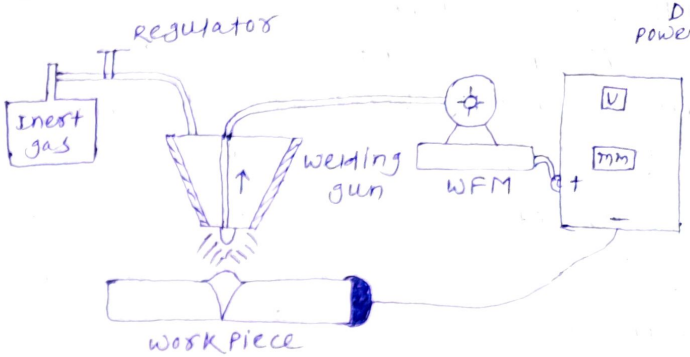
Disadvantages of TIG welding

→ The process is slow in operation.
→ The cost of process is high.
→ Skilled workers are required.
→ Expensive equipments are needed.

Application of TIG welding

→ It is used in aerospace industry.
→ It is used in automobile industry.
→ It can also be used for combining dissimilar metal.
→ Used for welding aluminium, magnesium alloys, stainless steel, nickle alloy etc.

MIG (Metal Inert Gas) WELDING



→ It is also known as GMAW (gas metal arc welding).

Working principle

→ In this process DC power source connected to electrode and workpiece.
→ The torch is used in this process where the wire electrode fed through the torch (welding gun) at a constant speed and the torch is also connected to the hose pipe carrying shielding gas.
→ Usually argon is used as shielding gas and sometimes mixture of argon and oxygen is used.

Advantages of MIG welding

→ The flux is not required
→ High welding speed.
→ Deeper penetration is possible.
→ Provides higher deposition rate.

Disadvantages of MIG welding

→ Equipments used is costlier.
→ Not suitable for outdoor works as strong wind may break the gas shield.
→ Regular gas changes are necessary.

Application of MIG welding

→ Widely used in air-craft and automobile industries.
→ Used in fabrication work of pressure vessels and steel structures.
→ Used for welding carbon and alloy steel
→ Heavy constructions such as building materials and bridges.

Differentiate between TIG and MIG welding process

TIG welding	MIG welding
→ It uses non-consumable electrode.	→ It uses consumable electrode.
→ Filler rod is used.	→ No separate filler rod is used.
→ suitable for thin section (>6mm) and sheet metals.	→ suitable for thick plates (<5mm).
→ Metal deposition rate is low.	→ Metal deposition rate can be achieved.
→ Deep penetration cannot be produced.	→ It can produce deep penetration.
→ TIG welding is simple as compared to MIG welding.	→ MIG is more complex as compared to TIG.

Welding defects, causes & Remedy

1) Slag inclusion

Cause - Low amperage, Improper technique slow travel rate
Prevention - Increase amperage, increase travel rate
Repair - Remove by grinding and other mechanical process

2) Undercut

Cause - high amperage, wrong electrode angle, long arc length electrode is too large for the base metal
Prevention - clean metal before welding
Repair - weld with smaller electrode, sometimes must be low hydrogen with preheat.

3) Porosity

Cause - Inclusion of atmospheric gases, sulfur in weld metal, surface contaminants
Prevention - slower speed to allow gases time to escape

4) Incomplete fusion

Cause - low amperage, fast travel speed, short arc gap, unclean base metal
Prevention - Eliminate the potential causes
Repair - Remove & reweld, being careful to completely remove the defective area

5) Cracks

Cause - low ductility of weld, solidification shrinkage
Prevention - when finishing move back the

electrode to fill up the cracks, increase creater fill time by power source.

6) Overlap

Cause - Improper welding technique, steep electrode angle, fast travel speed

Prevention - overlap is a contour problem. Proper welding technique will prevent this problem.

7) Underfill

Cause - Improper welding technique

Prevention - Apply proper welding techniques for the weld type position. Use stripper beads before the cover pass.

Repair - simply weld to fill. May require preparation by grinding.

8) Spatter

Cause - high arc power, damp electrodes

Prevention - reduce arc power, reduce arc length, use dry electrodes

Repair - remove by mechanical process

9) Incomplete Penetration

Cause - low amperage, low preheat, tight root opening, fast travel speed, short arc length

Prevention - correct the contributing factors

Repair - Back gauge and back weld

10) Excessive convexity

Cause - amperage and travel speed

Prevention - observe proper parameters and techniques

Repair - must blend smoothly into the base metal

11) Arc blow

Remedies

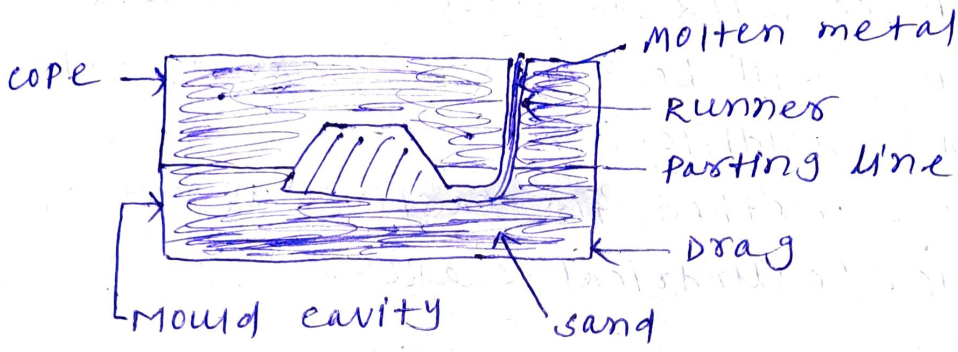
Use AC electrode where possible

Try welding away from earth clamp connection. Try splitting the earth clamp and connect to both side of the joint.

Chapter-03, CASTING

CASTING

It is a process in which molten liquid metal will be allowed to solidify in a pre-defined mould cavity. After solidification by breaking the mould, required shape of the object can be obtained.



Basic steps of casting

1) Making a mould cavity.
2) Material is first liquified by properly heating in a suitable furnace.
3) Liquid poured into the prepared mould cavity.
4) Allow to solidification.
5) Product taken out of mould cavity from and make to shape.
6) Inspection of any kinds of defects

Types of casting

1. Die casting

→ In die casting the molten metal is forced into mould cavity under high pressure.

→ Die casting is most suitable for nonferrous metals with relatively low melting point

such as lead, zinc

→ The mould called a die is made of two parts, one is fixed and other is movable.

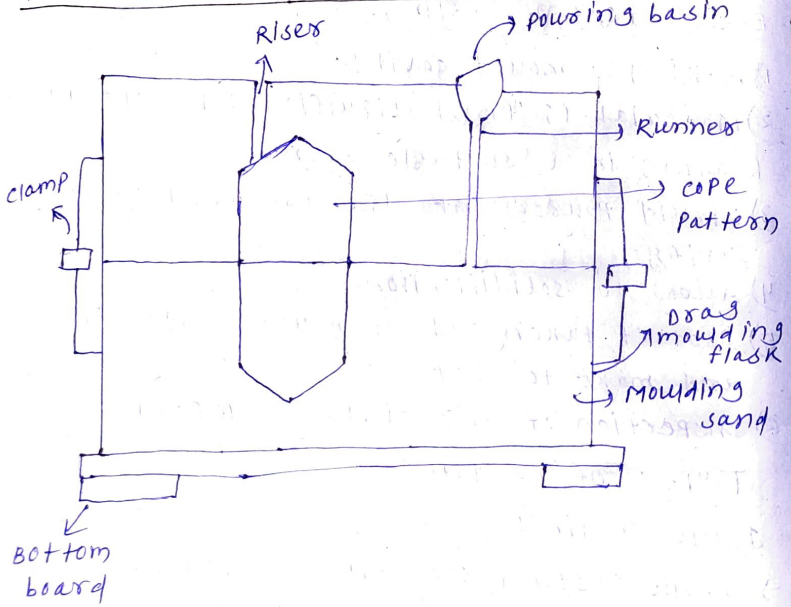
2. centrifugal casting

→ It is the process in which metal is poured into a mould which is rotate about its center rapidly.

→ Due to centrifugal force a continuous pressure will be acting on the metal during solidification.

→ It is a method for casting object of circular / cylindrical shape.

procedure of sand moulding



→ Dry facing sand is sprinkled over the board and pattern to provide non-sticky layer.

→ Facing sand also used to provide better surface finish to cast product.

→ Moulding sand is a mixture of silica, clay and moisture in correct proportion.

Different types of moulding sand

Moulding sands are crucial in the metal casting process and they come in various types, each with unique compositions and properties here are some common types

1. Green sand

composition

silica sand (70-85%), clay (8-15%)
water (2-4%). Additives (0-5%)

Properties

→ Plasticity - the water and clay provide plasticity allowing the sand to be easily shaped.

→ strength - good green strength to hold the shape of the mould.

→ permeability - allow gases to escape during the casting process.

→ Reusability - can be reuse after reconditioning

2. Dry sand

composition

silica sand (85-95%), binder (clay or other organic/inorganic material)

Properties

→ High strength - improved strength compare to green sand due to drying
→ Smooth surface finish - produce better surface finish on casting
→ Less Permeable - lower permeability as compared to green sand.
→ Less reusable - not as easily reusable as green sand due to the drying process.

3. Loam sand

composition

silica sand (50%), clay (25%), water (25%)

Properties

→ High Plasticity - extremely plastic and can be used for large casting.
→ strength - good green strength
→ Low permeability - suitable for creating large moulds with intricate shapes
→ Reusability - can be reused after reconditioning but it typically single use due to its specialized nature.

4. Facing sand

composition

High quality silica sand, fine graphite or coal dust, binder (clay or other organic materials).

Properties

→ High refractoriness - resists high temperature
→ smooth surface finish - provides a good finish on the casting surface.
→ Used only for surface layer - applied to the surface of the mould to improve casting quality.

5. Backing sand

composition

Reused moulding sand, binder (optional, depend on previous usage)

Properties

→ Lower quality - used for the bulk of the module.
→ Good strength - sufficient strength to support the mould.
→ High reusability - frequently reused, providing cost savings.

6. Parting sand

composition

fine dry sand, talc or other non-sticky materials

Properties

→ Non-sticky - prevents moulding sands from sticking to pattern.
→ High refractoriness - resists sticking at high temperature
→ Easy application - sprinkled on patterns and parting surfaces.

7. core sand

Composition

High quality silica sand (70-80%), binder (sodium silicate or resin, 20-30%)

Properties

→ High strength - needed to maintain shape during the casting process

→ Refractoriness - can withstand high temperature

→ Smooth surface finish - provides a good surface finish for cores.

Different pattern and allowance

1) solid or single piece pattern

Description - a simple single piece of pattern used for straight forward shapes

Use - suitable for simple casting with no undercuts

Allowance - shrinkage allowance, machining allowance

2) split or two-piece pattern

Description - made in two parts, split along the parting lines

Use - used for complex casting that cannot be made with a single piece pattern

Allowance - shrinkage allowance, machining allowance, draft allowance

3) cope and drag pattern

Description - a split patterns with cope and drag parts for creating the upper and lower halves of the mold.

Use - used for large or complex casting

Allowance - shrinkage allowance, machining allowance, draft allowance and rapping allowance

4) Match Plate Pattern

Description - split patterns mounted on opposite sides of a plate.

Use - used for mass production in machine molding

Allowance - shrinkage allowance, machining allowance and drafting allowance

5) Gated Pattern

Description - Patterns with gating systems (runners and gates) attached

Use - used to facilitate the flow of molten metal into the mold

Allowance - shrinkage allowance, machining allowance and drafting allowance

6) Loose Piece Pattern

Description - Patterns with loose pieces that can be removed separately

Use - used for casting with undercuts or intricate details

Allowance - shrinkage allowance, machining allowance and draft allowance

7) sweep Pattern

Description - a form of pattern rotated around a central axis to creates symmetrical shapes

Use - used for large, symmetrical shapes like cylinder

Allowance - shrinkage allowance, machining allowance

8) Skeleton Pattern

Description - a framework pattern used for large castings.

Use - used where a soil pattern would be impractical due to size

Allowance - shrinkage allowance, machining allowance

9) Segmental Pattern

Description - a pattern made in segments for circular objects

Use - used for large cylindrical objects like pipe

Allowance - shrinkage allowance; machining allowance

10) Shell Pattern

Description - a thin shell pattern used for intricate design

Use - used in investments casting or shell molding

Allowance - shrinkage allowance, machining allowance

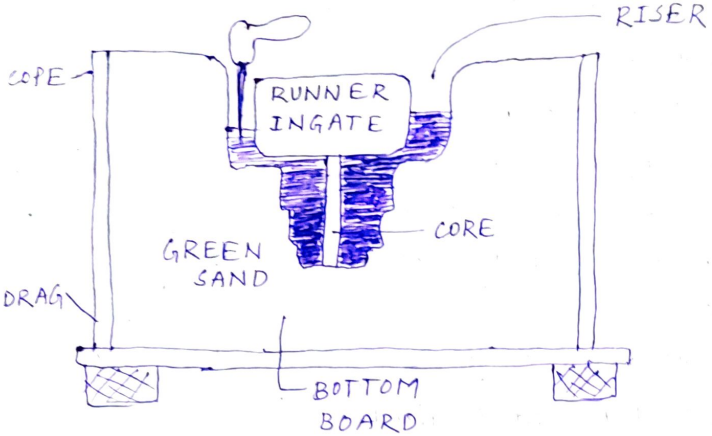
Types of casting

1) sand casting
2) shell mould casting
3) Investment casting
4) centrifugal casting
5) permanent mould casting
6) Die casting
7) continuous casting

1. Sand Mould casting

steps to be followed by sand mould casting

1. Pattern making
   cope, drag, pattern types (wooden box)
2. Input of sand
   wet sand, hammering of sand, fixing of sand
3. Mould making
   Desire shape, core making
4. Runner pin, riser pin, pouring basin
5. close the setup by drag making
6. Entering of molten metal into the setup
7. Give some time to solidify
8. Dislocate the cope and drag
9. Take out the final product
10. If needed do surface finish
11. check the defects



Different types of moulding sand and their properties

1. Green sand
→ sufficient moisture
→ silica and clay (15-30%)
→ water (8%)
→ Ferrous and nonferrous metal

2. Dry sand
→ when moisture is removed from green sand it is known as dry sand.

3. Loam sand
→ Mixture of 50% sand and 50% clay water
→ Used for large and heavy metals
→ EX - Turbine parts, hopper

4. Facing sand
→ only silica and clay used

5. Parting sand
→ only sand use (pure silica)

6. Backing sand/floor sand
→ The backing sand is old

Casting defects

1) Porosity defects

These are internal die casting defects that are difficult to spot. These are small holes, voids or pockets of air on the metal. Porosities occur whenever air is trapped in metal during casting process.

Gas porosity

1) Pinholes :- These are small holes occur in upper part of a die casted part.

2) Blowholes :- They are larger holes that occur inside the cast workpiece. pinholes are not visible to naked eye.

3) Openholes :- These are type of blowholes that appear on the surface of workpiece. They occur due to air trapping when metal is poured into mold.

Causes

- Involved gas in metal alloy filling
Metal casting involved filling dies with molten metal alloy at high pressure and speed. The turbulences often occur due to blind areas in the gating system.

- Released hydrogen from molten alloy
This is one of the main cause of porosity in casting. The moisture in air or smelting tool may enter the molten metal or steel alloy, thereby further

decomposing into hydrogen.

- Gases from mold release agent

Upon contact, the molten metal alloy often heats up mold release agents. As a result they decompose and produce gas that ends up causing porosity.

Remedies

- Ensure clean and dry metal alloy ingots are used to prevent hydrogen
- Use suitable casting parameters, including injection speed and pressure.
- control the smelting tempt to prevent overheating.

Shrinkage porosity

It is different from there round, smooth surfaces of gas porosity, they occur as jagged, angular deges.

Open shrinkage defects

They occur on the cast products surface as dips or holes. The air is drawn inside the mold when the metal alloy shrinks unevenly will create an open shrinkage.

Closed shrinkage defects

These appears as holes inside casting where there is eneven heating of the molten metal. They can occur in micro or macro forms.

Causes

- Too low injection pressure
- Poor runner and gating system
- Extremely high pouring temperature
- Uneven pattern of metal solidification
- High concentration of the metal in specific areas of the mold.

Remedies

- clean the metal surface to remove contamination.
- Increase the metal injection pressure
- Insert cooling coils, ribs or internal chills to ensure proper heat dissipitation

2) Sinks

A sink is a press-down impact on the casting surface that does not copy the mold design. sink appear on the casting surface when there is a sub-surface cavity present. since sink reflect light easily, you can easily identify these casting surface defects by visual inspections.

Causes

- Low injection pressure
- Poor feeding effects due to short pressure holding time.
- The uneven wall thickness of casting often leads to uneven shrinkage upon solidification.

Remedies

- Improve die cavity's venting performance.
- Increase metal injection pressure.
- Optimize the structural design of the casting to ensure when even wall thickness
- Avoid overheating the die cavity and give the metal more pressure-holding time.

POWDER METALLURGY

The powder metallurgy process consist of mixing elemental or alloy powder, compacting the mixture in a die and then sintering or heating the resultant shape in a controlled atmosphere. Powder metallurgy is a highly developed method of manufacturing ferrous and nonferrous materials. It is a chipless working process. This process is cost effective in producing simple and complex part in manufacturing.

Process

Powder production
↓
Powder characterization & testing
↓
Mixing - blending
↓
Processing - compacting
↓
Sintering operation
↓
Finishing operation
↓
Finished P/M parts

Limitations of Powder Metallurgy

→ The density of compact is not uniform.
→ The residual porosity left in sintered parts make rough.
→ Producing parts of large size and weight is quite expensive due to costly dies.

→ Health problems from atmospheric contamination of the work place.

→ It is difficult to compress some metal powders and also difficult to procure some metal powders.

→ Hazardous explosion may take place.

Advantages of Powder Metallurgy

→ It eliminates/minimize machining.

→ High prodⁿ rates from 500-1000/hour can be achieved.

→ Defect free components with uniform structure can produce.

→ Parts with closed dimensional tolerance and good surface finish can be produced.

→ Process can be fully automated hence unskilled labour can be employed with reduces labour cost.

Q. What are the different types of casting?

Ans- **Sand casting**

Sand casting is mainly used for forming hot liquid metal or alloys into intricate objects. The molds are made of sand and it use drag and cope.

The sand used in sand casting is made of silica. After casting the mold may be reused or destroyed depending on the design created. We can use sand casting in making products like part of ships, jewellery etc.

Die casting

Die casting is a widely used permanent mould metal casting process in which molten metal is forced into the mould called die at pressure, where it solidifies into a metal cast. It is also known as pressure die casting.

Depending on the parts complexity, size and material the final piece is either single or multi casts. Dies can have either a single cavity, multi cavities or a unit die in which multiple dies are combined.

Die casting are used in automotive housing appliance components and toys etc.

Investment casting

Investment casting is a manufacturing process in which a wax pattern is coated with a ceramic material. once the ceramic coating material is dry and hardened the wax is melted out and leaves an internal cavity the shape of final product. Molten metal is poured into the cavity where the wax pattern was. The metal solidifies within the ceramic cavity cools and the ceramic is removed from the metal casting.

Investment casting used for making turbine blades, marine parts and other industrial components.

Centrifugal casting

The centrifugal casting method is the method to produce pipes by pouring molten metal into a rapidly spinning cylindrical mold in which centrifugal force form the rotation exerts pressure on the molten metal.

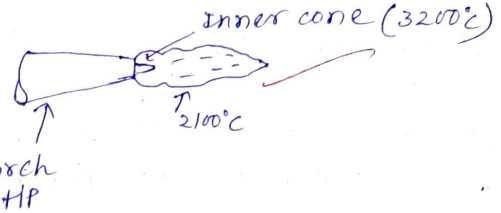
It is a quick, precise and cost-effective method that produces strong & reliable parts.

centrifugal casting has many applications such as automotive, aerospace, railway piping etc.

diagram?

Q2 What are the types of flame used in oxy-acetylene welding?

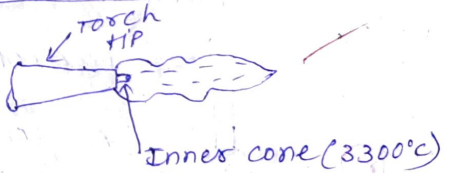
Ans- 1) Neutral flame



A neutral flame is obtained when equal volume of oxygen and acetylene are mixed in the welding torch and burnt at the torch tip. The inner zone has white colour. The temperature of neutral flame is of the 3260°C.

It is used for mild steel, stainless steel, copper, cast iron.

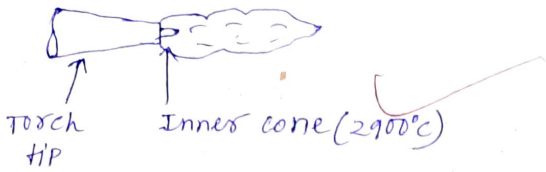
2) oxidizing flame



The oxidizing flame is produced when excess oxygen is supplied over the acetylene gas. A oxidizing flame can be recognised by the small cone, which is shorter in length. The temperature is about 3300°C.

It is used to weld copper based metal, ferrous metals and cast iron etc.

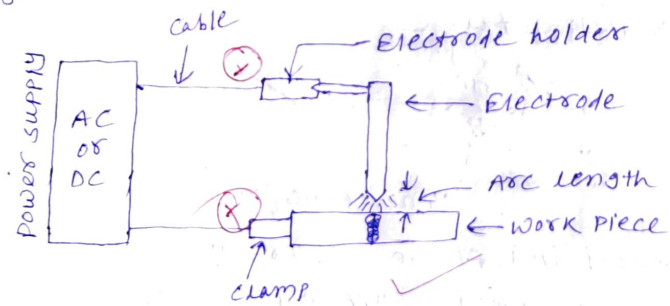
3) Carburising / reducing flame



A carburising flame is obtained when an excessive acetylene is supplied over the oxygen which is required. A carburising flame is recognized by the acetylene feather which exists between the inner cone and the outer envelope.
This type of flame is used for welding low alloy steel, low carbon steel, lead etc.

Q3. Explain arc welding process ?

Ans-



→ It is a fusion welding process where the heat is generated by the application of arc.
→ In this process metals are heated upto the melting temperature by creating an electric arc and then allowed to solidify to form a welded joint.
→ In this process both AC and DC current are used.

Working Principle

→ In electric arc welding the end of the metal pieces to be joined are heated locally to the melting temperature by creating an electric arc and then allowed to solidify to form the welded joint.
→ The arc is a flame of intense heat generated by passing electric current through a highly resistant air gap between the electrode and the workpiece.

Advantages

→ Large variety metals and alloys can be welded.
→ Time of construction can be reduced.
→ cost of construction is reduced.
→ Equipment is not very costly.

Disadvantages

→ High skilled worker is required.
→ More waste is generally produced during arc welding.
→ Welding results in distortion of material.

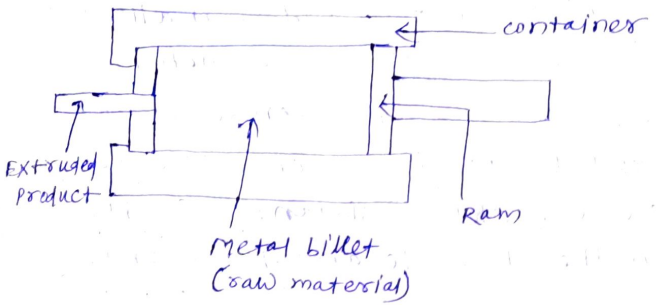
Application

→ Used in the welding of sheet metals
→ Used in the manufacture of air craft and aerospace.
→ Used in the industries like construction automotive and mechanical.

→ Used for welding thin, ferrous and non-ferrous metals.

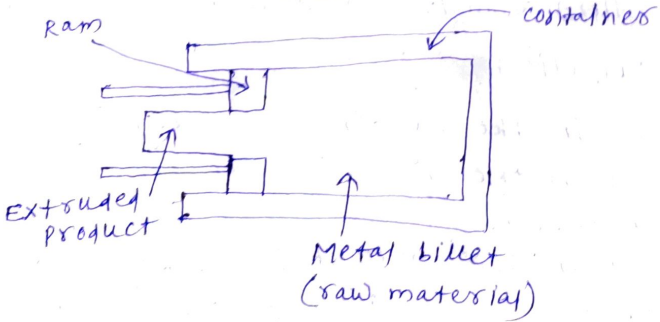
Q4. Write down short notes on direct and indirect extrusion.

Ans - Direct extrusion



Direct extrusion is also called forward extrusion and it is the most general extrusion process. Its work operation includes the placement of the billet in a container, which is heavily walled. Ram or screw is used to push the billet and ram, there is a dummy block, which is reusable and is used for keeping them separated.

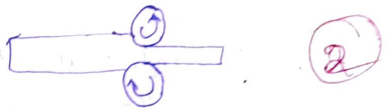
Indirect extrusion



Indirect extrusion is also called backward extrusion and in this process the die is constant whereas the billet and container move together. The final and maximum extrusion length is decided by the stem's column strength. As the billet movement is along with the container, all the frictional forces are easily eliminated

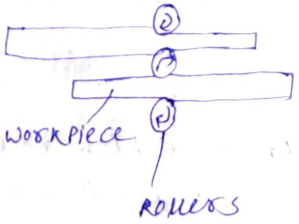
Q5. Describe different types of rolling mill.

Ans - Two high rolling mill



It has two horizontal rolls revolving at the same speed but in opposite direction. The rolls are supported on stands. The space betn the rollers can be adjusted by raising or lowering the upper roll. In this type of roll, the work can be fed from one direction only.

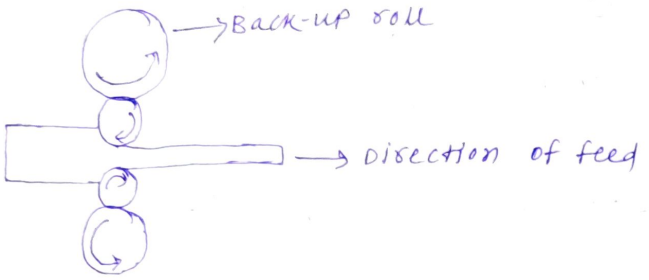
Three high rolling mill



It consist of three horizontal rolls arranged one over another. The upper and lower rolls rotate in the same direction.

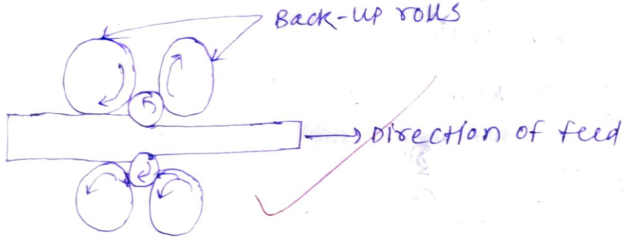
It is not as flexible as two high rolling mill because once the rollers are adjusted vertically they remain fixed in their position.

Four high rolling mill



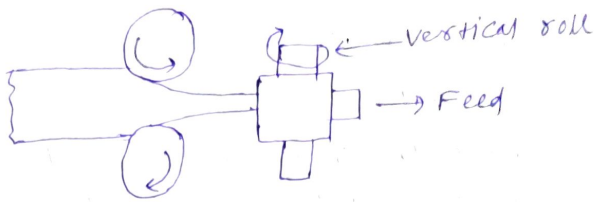
It consist of four horizontal rolls, two of smaller diameter and two of larger diameter, arranged directionly one over the other. The working rolls apply pressure on metals. The back up roll prevent deflections of the working roll.

Cluster rolling mill



This is a special type of four-high rolling mill generally used for cold rolling. Two smaller rolls which exert pressure on the metal are backed up by more number of rolls than in four high rolling mills.

Universal rolling mill



In this type of rolling mill both horizontal and vertical rolls are used to reduce the work piece.

Sample
14/11/24

Q). What are the types of sand used in casting.

Ans - The different types of sand used in casting are:-

1) Green sand

It is also known as tempered sand. It is a mixture of natural sand with clay (18-30%) and moisture (6%). This sand is suitable for moulding process without any further conditioning for producing small and medium size simple casting.

2) Loam sand

This type of sand contains maximum % of clay upto 50% and dried hard. It contains other ingredients like lime sand, graphite fibrous, reinforcement.

3) Synthetic sand

It contains natural sand, with or without clay, binders moistures.

4) Parting sand

It is used without binders and moistures to avoid sticking of green sand with pattern.

5) Core sand

This type of sand has high silica mixed with minerals, mineral oil.

6) Molasses sand

It contains molasses as binder. This type of sand used for core making and small casting having intricate shape & section.

7) Natural sand

It contains binding material 5-20% clay. Natural sand needs only water 5-8% for mixing before making the mould.

8) Facing sand

A facing sand mixture for green sand moulding consist of 25% prepared and fresh sand, 70% old sand, 5% coal. It has thickness of 2-3 cm.

Q2. What are the defects in welding?

Ans - The different types of welding defects are:-

1) Weld crack

It can appear on the surface, in the weld metal or the area affected by the intense heat.

→ It cause by using hydrogen when welding metals.
High welding speed but low current.
Poor joint design.

→ Preheat the metals as required.
Remove impurities
Use appropriate metal.

2) Porosity

porosity occurs as a result of weld metal contamination. The trapped gases create a bubble-filled weld that becomes weak and can with time collapse.

→ It cause because of presence of moisture.
Improper gas shield
Use of too high gas flow

→ Use dry electrodes and materials
Use correct arc distance
Use a proper weld technique.

3) Undercut

This welding imperfection is the groove formation at the weld toe, reducing the cross-sectional thickness of the base metal. The result in the weakened weld and workpiece.

→ This cause due to too high current.
Incorrect filler material
poor weld technique.
→ Use proper electrode angle
reduce the arc length
Use of proper current

4) Incomplete fusion

This type of welding defects occur when there is a lack of proper fusion between the base metal and the weld metal.
→ This cause due to low heat input.
Surface contamination
Electrode angle is incorrect
→ Reduce deposition rate
Use correct electrode angle

5) Slag inclusion

Slag is a vitreous material that occurs as a byproduct of stick welding and submerged arc welding. It also occur when the flux melts in the weld.
→ It cause because of improper cleaning.
The weld speed is too fast
welding current is too low
→ Increase current density
Reduce rapid cooling
Adjust the electrode angle
Adjust the welding speed

6) Spatter

Spatter occurs when small particles of the weld attach themselves to the surrounding surface. It is an common occurence in gas metal arc welding.
→ It cause because of arc is too long
Incorrect polarity
Voltage setting is too low
→ Reduce arc length
Use proper polarity
Increase electrode angle

8. write down the difference between progressive die and compound die.

progressive die	compound die
→ It performs one operation at a time in each station.	→ It performs more than one operation at a time in each station.
→ It is simple in design.	→ It is complicated in design.
→ It is less expensive to construct.	→ It is more expensive to construct
→ It is slower in operation.	→ Faster in operation than compound die.
→ It is used in making simple parts.	→ It is used in making complex parts.