GOVT CO-ED POLYTECHNIC

BYRON BAZAR RAIPUR (C.G.)

LAB MANUAL

Branch :Mechanical Engineering

Year &Semester : 2nd Year & 4th Semester

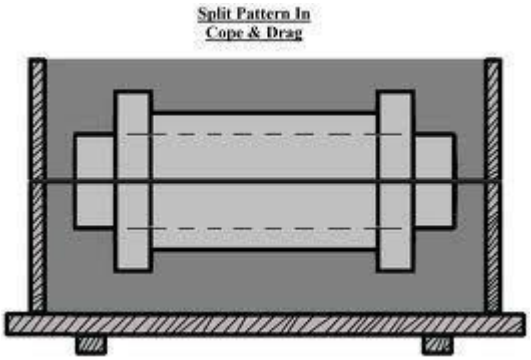
Manufacturing process

CONTENTS

1. Design and making of Pattern

Aim: To prepare a split wooden pattern detailed below with allowance.

Tools Equipment & Material: Steel rule, outside caliper, Mortise Chisel, inside chisel, peering chisel, Firmer Chisel, Wood rasp half round file, outside gauge, outside chisel, Try square, Handsaw, Mallet, Sandpapers, Teak Wood given size



Procedure: Match the two rectangular wood pieces of stock and fix them together by wood screws at either end in the excess portion of wood. This must give a firm clamping of the wood pieces to turn into single piece.

In body portion of the pattern mark a center link using marking gauge and extend it to the dressed end. Using the race with counter sunk make indentations at the center of each and to form locations for the head stock and tail stock center.

The wood stock is turned on the wood turning lathe using appropriate gauge and finally finished the dimensions.

Sanding paper No. ½ or No.0 does smooth finishing

The sand paper should be moved laterally on the rotating work.

Precautions:

1. The tools are kept sharp to cut freely without burning and also without much pressure to cause chipping.
2. Maintain proper turning angles.
3. Be alert to avoid accidents.

Result: The Required Split pattern is prepared

OBSERVATION

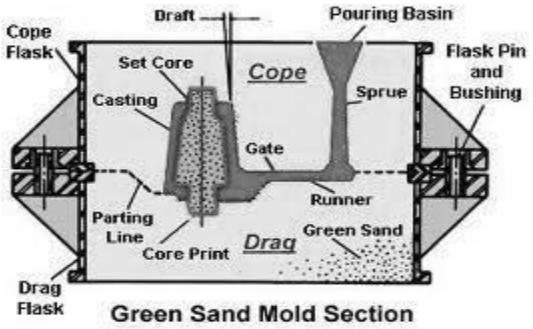
2. Mold Preparation, Melting and Casting

Aim: To prepare a green mould for casting using only two boxes.

Tools And Pattern: Wooden pattern is made in two halves, dowelled together, the division passing through the center of the grooves; cope and drag moulding tools parting sand, brick dust etc.

Stage Sketches:

The mould can be prepared by using three boxes without any difficulty. However the same can be prepared using two boxes using an ingenious method known as false-core method.



Green Sand Mold Section

Procedure:

1. One half of the pattern is molded in the bottom box, the parting being cut an incline as shown. The other half pattern is then placed in position and sand poured and rammed to form the second parting with a slope down wards from the upper flange of the pulley
2. The top box is next placed on the bottom box and properly located. Sand is poured and rammed without damaging the false core.
3. The top box is gently removed; the upper half pattern is gently taken out from the top box.
4. The top box is replaced on the drag and the entire mould is turned upside down. The bottom box, which now is at the top, is gently lifted and the remaining half of the pattern is withdrawn.
5. The bottom box is replaced and the mould id inverted. The spruces are removed, pouring basin is cut and the mould is finished after piercing holes (vents).

Observations:

1. After ramming using moulds hardness tester check the mould hardness on all the four sides of the pattern.
2. Locate the rumen and riser 90^0 exactly.

Precautions:

1. Ramming should be uniform to impart uniform strength to the mould.
2. Apply parting sand at the partitions for esy separation of boxes.
3. Locate the two halves of pattern properly to avoid mismatch.

Result: Sand mould is prepared for the given pattern.

Melting Procedure For Aluminum Alloys:-

The charge materials, chemicals should be free from moisture, oil, and corrosion powder and should be preheated before charging. The calculation of charge should be done considering the melting loss of each element in the melting furnace for final desired analysis.

1. The furnace crucible should be clean and red hot for charging.
2. Aluminium alloys get readily oxidized and form dross, using proper covering top with flux and chemicals help to reduce this. Different proprietary chemicals are available for different alloys.
3. Melting should be done under steady conditions without agitation. Stirring is done to reduce gas pickup.
4. Once melting is complete, degassing using solid chemicals like hexachloro-ethane which evolves chlorine by purging with nitrogen or argon gas is done to remove the dissolved hydrogen. Hydrogen is evolved from moisture.

$$3H_2O+2Al \rightarrow Al_2O_3+6H$$

Hydrogen absorbed by liquid metal causes serious porosity in casting during solidification.
Degassing should be done in the temperature range 730^0 C to 750^0 C

5. Liquid metal after degassing is treated with sodium containing chemicals to improve mechanical properties.
6. Liquid metal once ready should not be super heated. Agitated or kept long in the furnace which will cause dressing and gas pickup. Dross should be skimmed properly before pouring.
7. Alloys containing magnesium should be melting carefully as it is highly reacting. Special fluxes and chemicals like sulphur are used to inhibit the reactivity and prevent spontaneous ignition, melting loss and dross.

Casting Defects Due To Improper Melting:

1. Improper chemical analysis: Incorrect charge, calculations, including wrong estimates of melting losses, metal recovery, excessive losses due to improper fluxing and slogging operations, improper covering of non-
Ferrous melt causes this defect.

2. Gassy metal/hydrogen pickup/pinhole porosity: unclean melting causes formation and absorption of hydrogen into liquid metal. As casting solidifies, the absorbed hydrogen losses solubility and forms cavities inside casting.

3. Oxygen absorption

Excessive oxygen furnace operations in atmosphere following oxidation during melting cause this defect. It also causes loss of costly metal added in the charge.

4. Slag inclusions

Improper fluxing and slag removal slag particles to be mixed in the metal being poured. Careless pouring, lip pouring for alloys with fluid slag causes slag particles to enter casting.

5. Cold shut, misrun, unfilled castings

Low pouring temp, delay in pouring, due to many folds being poured, loss of heat from lable, due to improper covering failure of ladle opening in the bottom pouring cause premature solidification of metal causing defects.

6. Sand fusion, metal penetration, rough surface

Excessive pouring temp of liquid causes damage to the casting surface by attacking mould surface.

7. Sand erosion sand inclusions

Uncontrolled high pouring rate from ladle into mould leads to erosion of mould/core

PRECAUTIONS:

1. The furnace crucible should be clean and red hot for charging
2. Charge material should be free from oil, moisture etc.,
3. Melting must be done under steady condition to reduce gas pickup.

RESULT:

Melting practice is observed.

Applications:

- Transport : Automobile, aerospace, railways and shipping
- Heavy Equipment : Construction, farming and mining
- Machine Tools : Machining, casting, plastics molding, forging, extrusion and forming
- Plant Machinery : Chemical, petroleum, paper, sugar, textile, steel and thermal plants
- Defence : Vehicles, artillery, munitions, storage and supporting equipment
- Electrical Equipment Machines : Motors, generators, pumps and compressors
- Hardware : Plumbing industry pipes, joints, valves and fittings
- Household : Appliances, kitchen and gardening equipment, furniture and fittings
- Art Objects : Sculptures, idols, furniture, lamp stands and decorative items

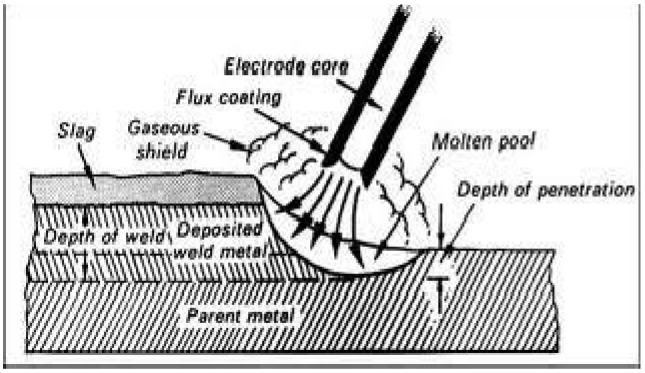
OBSERVATION

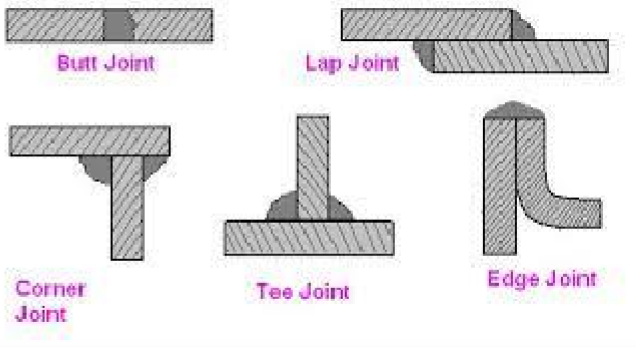
3. ARC WELDING

Aim: To prepare a butt joint with the specimens by Arc Welding.

Equipment and Material Required: D.C Welding machine, Bench vice, Tensile testing machine, M.S. Plates of 100x50x5(2), Metallurgical microscope.

Tools Required: Hack saw, Chipping hammer, wire brush, safety goggles, Hand gloves, Face shield, Files.





Procedure:

1. Given 2 M.S. plates are filled at an angle of 45^0 at 2 surfaces to be joined (V groove is formed)
2. Electrode is fixed to electrode holder.
3. Connections to be given such that electrode- negative and work piece positive.
4. Welding is to be done carefully for the half-length of the plates.
5. The work piece is to be cut into two halves by power hacksaw.
6. The beads are polished, etched with two percent natal solution and studied under the microscope whose magnification factors 10X for the heat effected zone.
7. By gripping the beads b/w the jaws pf Tensile testing machine and load is applied until the work piece breaks and the readings is to be noted.
8. The same procedure is repeated for the remaining half which is welded by reverse polarity and the results are to be compared

Precautions:

1. Edge preparation should be done very carefully.
2. Before welding ensure the surfaces are extremely clean.
3. While welding always use face shields or goggles.

Result: The effect of polarity on weld strength and heat effected zone in arc welding was studied.

APPLICATIONS OF WELDING:

Industries: Welding processes are a foundational aspect of all large-construction industries, ensuring strong, sustainable connections within buildings, bridges and other infrastructures.

Electrical:In the electrical and electronics industries, discharge capacitor (DC) welds are preferred for use with the thinner sheet metals associated with smaller, more delicate electronics systems. This welding option is used throughout the electrical system build-out process in numerous specialty applications, such as medical labs and small appliance fabrications. CD welding neatly bonds components like switchboards and switches in cabinets and on panels, fix fascia panels, add buttons and instruments, and attach printed circuit boards.

Mechanical:For more rugged applications that involve thicker metal dimensions, arc stud welding provides the control and effectiveness necessary to firmly bond heavier pieces together. In the automotive industry, arc welds bond heat shields, exhaust systems and hydraulic lines to the chassis. Metal furniture pieces like office desks, file cabinets and shelving units are often welded. Heating, ventilation and air conditioning units are usually constructed using welding processes.

Shipbuilding: Welding has been the traditional shipbuilding construction method used since the advent of the Industrial Age. Ensuring a water-tight surface is essential. Inside the ship, welding processes secure hatches, fluid lines, control panels and many other components critical to a safe and seaworthy vessel.

Equipment: Most, if not all, of today's industries rely on properly functioning equipment, and welding processes are vital to the success of those machines.

Farm equipment: In agriculture, farm machines that plow, plant, seed and harvest are fundamental to the country's food supply. Those machines are welded throughout their frames and processes. On the chassis, the cab frame, fenders and brackets are formed by welds. Motor structure and electrical functions are fused, as are the features of specialized tools such as threshers and spreaders.

Lawn and garden: Lawn mowers, trimmers, power saws and other garden equipment have long lives due to the strength of their welded frames. Other metal garden features enhance the enjoyment of outdoor life, such as barbecue grills, enclosures, seating and watering systems.

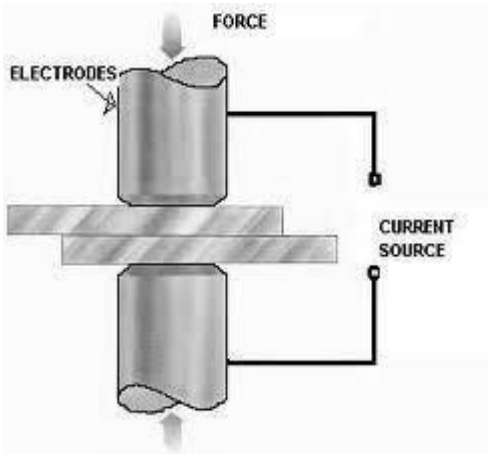
OBSERVATION

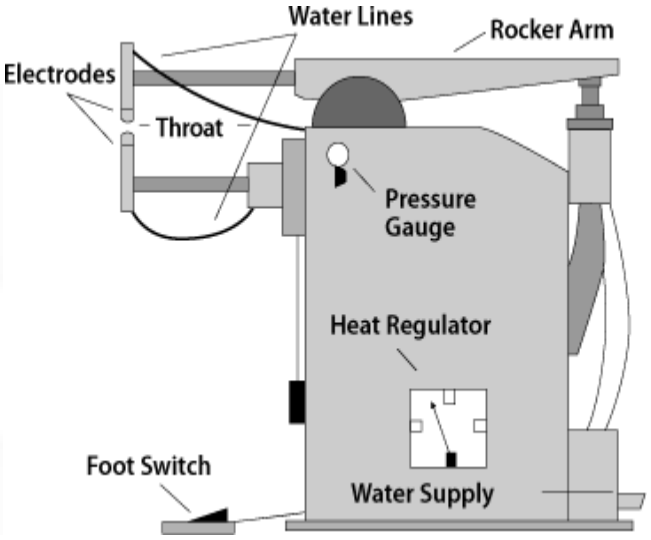
4. SPOT WELDING

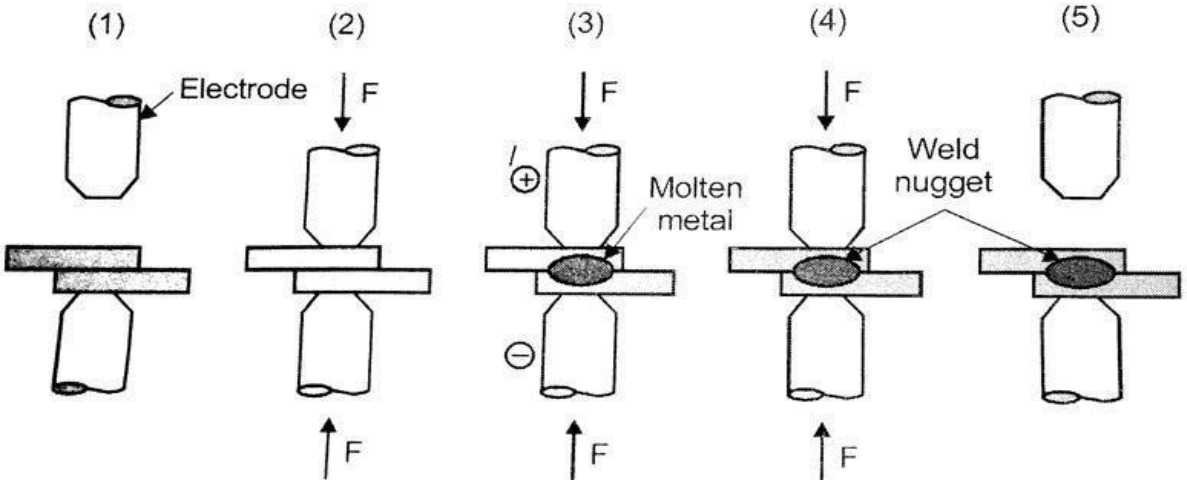
Aim: To prepare a job using spot welding process.

Equipment: Spot welding machine

Material required: Two metal pieces of size 4”x2”







Process of spot welding

Description of the Equipment:

A typical resistance spot welding machine essentially consists of two electrodes, out of which one is fixed. The other electrode is fixed to a rocker arm (to provide mechanical advantage) for transmitting mechanical force from a pneumatic cylinder. This is simplest type of arrangement. The other possibility is that of a pneumatic or hydraulic cylinder being directly connected to the electrode without any rocker arm.

For welding large assemblies such as car bodies, portable spot welding machines are used.

Here the electrode holder and the pneumatic pressurizing system is present in the form of a portable assembly which is taken to the place, where the spot is to be made. The electric current, compressed air and the cooling water needed for the electrodes is supplied through cable and hoses from the main welding machine to the portabe unit.

In spot welding, a satisfactory weld is obtained when a proper current density (A/Sq mm) is maintained. The current density depends on the contact area between the electrode and the work piece. With the continuous use, if the tip becomes upset and the contact area increases, the current density will be lowered and consequently the weld is obtained over a large area. This would not but able to melt the metal and hence there would be no proper fusion.

A resistance-welding schedule is the sequence of events that normally take place in each of the welds. The events are the squeeze time is the time required for the electrodes to align and clamp the two work pieces together under them and provides the necessary electrical contact.

The weld time is the time of the current flow through the work pieces till they are heated to the melting temperature.

The hold time is the time when the pressure is to be maintained on the molten metal without the electric current. During this time, the pieces are to be forge welded.

The off time is time during which, the pressure on the electrode is taken off so that the plates can be positioned for the next spot. The off time is not normally specified for simple spot welding, but only when a series of spots are to be made in a predetermined pitch.

PROCEDURE:

1. Switch on the machine and set the current in the machine to 2 Ampere
2. Set the timer to two seconds
3. Over lap the two metal pieces to the requires size and place them between the two electrodes.
4. Apply pressure by foot on the lever such that two electrodes come into contact if the over lapped metals.
5. After 2 seconds remove the pressure on the lever slowly.
6. Now the joint is ready for use.
7. Repeat the same procedure at various amperes
8. Test the strength of the joints using universal testing machine.

PRECAUTIONS:

1. Ensure that the electrodes should not be touched.
2. Don’t touch the welded potion by hand immediately after the welding is done.

Result: Effect of current on strength of spot weld is studied.

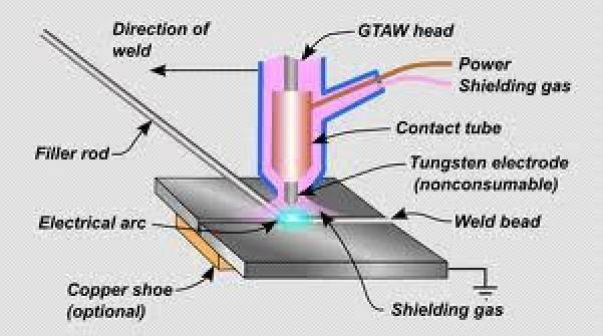
OBSERVATION

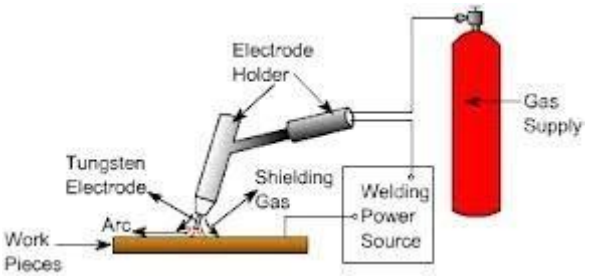
5. TIG WELDING

Aim: To prepare a job by using TIG welding equipment.

Equipment And Material Required:
Inert gas(helium,argon) welding outfit, MS Sheets 150x50x5mm (2No)

Tools Required: Wire brush, hand gloves, and chipping hammer, spark lighter.





Procedure:
1. Inert gas valve on the torch is opened slightly and lightened with the help of a spark lighter.
2. The torch tip is to be positioned above the plates so that white cone is at a distance of 1.5mm to 3mm
   from the plates.
3. Torch is to be held at an angle of 30^0 to 45^0 to the horizontal plane.
4. Now filler rod is to be held at a distance of 10mm from the flame and 1.5 mm to 3 mm from the surface of the weld pool.
5. As the backward welding allows better penetration, back ward welding is to be used.
6. After the completion of welding, slag is to be removed by means of chipping hammer, wire brush.

Precautions:
1. Ensure that torch movement is uniform.
2. See that the joints are extremely clean.

Result: A butt joint is prepared using gas welding process.

OBSERVATION

6.POWER PRESS

Aim: To prepare a washer using press

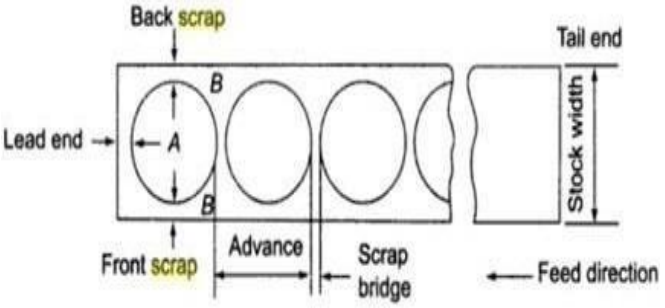
.

Equipment and tools required:

- Power press machine
- Punches
- Steel Rule

Material Required:

Specimen of mild steel 250 X 12 X 2mm



Procedure:

- Take a steel of strip of given dimension and punch the holes
- Place the strip is available slot in the machine
- Punch holes on each side by pressing the lever
- After completing on one side report the same on other side

Precautions:

- Care is taken while handling the rotating parts
- Check that lubrication is done properly

Result:

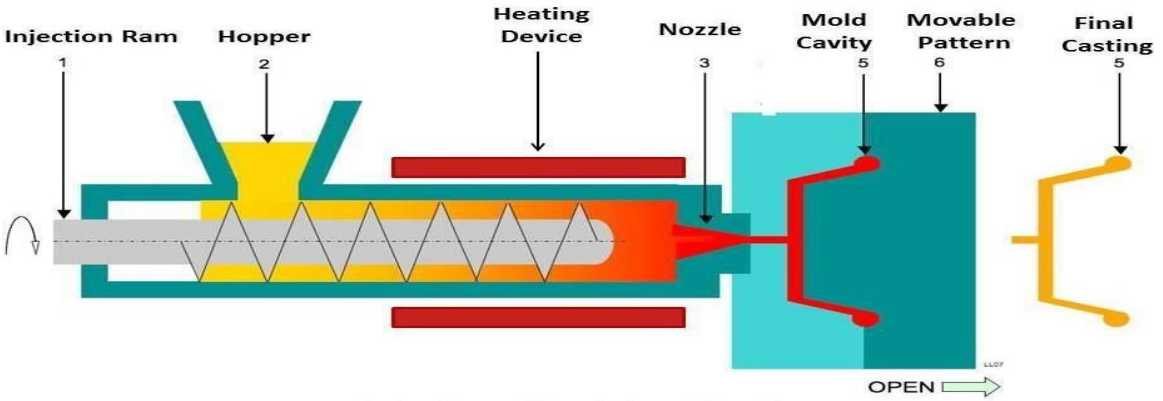
The object is made by power press by using die punch to required shape

OBSERVATION

7 INJECTION MOULDING MACHINE.

Aim: To Prepare a job using Injection Moulding machine

Equipment: Injection moulding machine.



Injection Moulding Machine

Material Required: High grade poly ethylene

Description of The Equipment:

Hydraulic Plastic Injection Moulding machine, Model JIM-1HD has been designed for moulding variety components up to 45 Gms capacity in polystyrene. The machine is robustly built to ensure consistent high quality and volume production of precision components. Operator fatigue due to injection process is completely eliminated by use of hydraulic power for both the injection and releases operations.

Locking Unit: This locking made by Hydraulic Cylinder.

Injection Unit: Injection Unit consists of two guide rods, nuts, top and bottom plates with injection cylinder and barrel. Injection cylinder is designed to develop 3 Tons load. Barrel diameter 30mm is attached with the machine as standard.

Hydraulics: Hydraulic pump is driven by 3 HP Induction motor for a rated delivery of 14 lp, at 1440 Rpm and at 80kg/cm^2. The maximum pressure in the hydraulic system is present in our works and is not to be altered. The oil tank capacity is 60 liters. All hydraulic system manufacturers safety precautions are provided to hydraulic system by using section strainer, which will prevent the contamination entering into the system.

Oil Cooler: Oil cooler provided to keep the oil temperatures below 50^0c which will gives more life to hydraulic oil in continuous use.

Electricals: Electrical control panel with automatic blind temperature controller is fixed on the right hand side of the machine for clear viewing of the temperature and for easy to operate the switches. Designed with safety measure, which will protect the motor from over load.

Working Procedure:

Injection moulding makes use of heat softening characteristics of thermo plastic materials. These materials soften when heated and re harden when cooled. No chemical change takes place when the material is heated or cool. For this reason the softening and re hardening cycle can be repeated any no. of times.

1. The granular moulding material is loaded hopper where it is metered out in a heating cylinder by a feeding device.
2. The exact amount of material is delivered to a cylinder, which is required to fill the mould completely.
3. Set the die in position Provide spacing plates if necessary. Clamping the Die using hydraulic operate ram.
4. Set the injection pressure by rotating (clockwise) the regulator knob to suit the requirement of moulding the container.
5. Switch on the heater. Set the required timings to the timers, for top and middle heater**.** Set the temperature by adjusting automatic temperature controller to control the bottom heater. Allow sufficient time to stabilizer. When temperature reached, operate the hand lever valve to inject the material.
6. Apply injection pressure on the heated material using plunger rod.
7. The injection ram pushes the material in to the heating cylinder and in doing so pushes a small amount of heated material out of the other end of the cylinder through the nozzle and screw bushing and into the cavity of closed mould.
8. The material is cooled in a rigid state in the mould.
9. Release the injection pressure. In clamp the Die using hydraulic operated ram.
10. The mould is then opened and piece I ejected out.

Result: Required product is made using injection moulding machine.

OBSERVATION

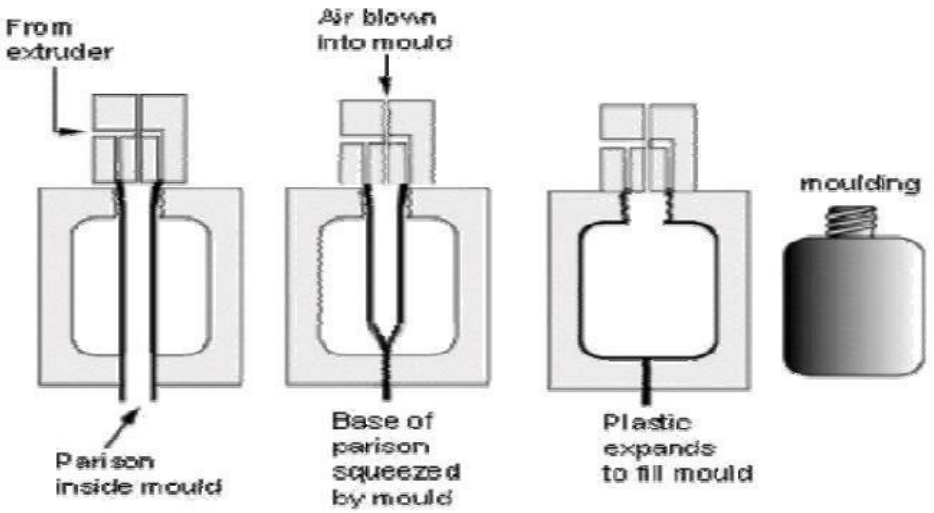
8. BLOW MOULDING MACHINE.

AIM: To prepare a job using blow moulding machine.

APPARATUS REQUIRED: Die, blow-moulding equipment, air compressor.

MATERIALS REQUIRED: Plastic pellets

TOOLS REQUIRED: Blow Molding machine, grained plastic, Die (bottle shaped)



PROCEDURE:

1. Set the die in position. Adjust the guide rod nuts to suit die height. Align the tapered face of the die for sealing the parison while blowing also checks for the face opening and closing of the die.

2. Ensure minimum die height is 80mm. provide spacing plates if necessary.

3. Set the injection, release and blow pressure by rotating (clockwise) the regulator knob to suit the requirement of moulding the container.

4. Feed correct quantity & quality of plastic material and switch on the power supply.

5. Switch on the heater.

6. Set the required timings controller to control the bottom heater.

7. Allow sufficient time tostabilizer.

8. When temperature reached, operate the hand lever valve.

9. Extrude the parison (Tubular form) to the required length and close the two die halves. Release the injection cylinder.

10. Operate the hand lever valve and blow the air so that the parison to form the shape of the container as designed in the die.

11. Allow the component to cool.

12. Open the die & take the product out of the die.

13. Now the machine is ready for nest cycle.

PRECAUTIOS:

1. The material should not be heated rapidly.
2. The die should be placed exactly below the nozzle.
3. Proper temperature should be maintained while heating the plastic.

RESULT: Required product is made using blow moulding process.

OBSERVATION