PREPARATION AND STUDY OF MICROSTRUCTURES OF PURE METALS LIKE IRON, COPPER AND ALUMINUM

AIM:

To mount the given pure metals like Iron, Cu, and Al specimen in a thermosetting material by using a mounting press and to draw their microstructure.

APPARATUS:

- Mounting press
- Thermosetting powder
- Specimen
- Belt, plate and disc polishing machines.
- Microscope

DESCRIPTION:

The mounting press consists of top plate and bottom plate with movable centre stage plate which is moving up and down along the guide ways. The middle part is raised and lowered by hydraulic jack. The mould part is the space between the guide ways. Its temperature is controlled by a knob. A digital timer is also provided on the panel to maintain the constant temperature of the mould for a certain period of time.

In belt polishing machine, an endless belt rotates between two shafts. In plate polishing machine different grades of emery papers are placed on the stand. In disc polishing machine emery cloth is placed over the two rotating plates.

PROCEDURE:

The given specimen is placed in the desired position preferably at the centre of the mould .Bakelite powder is poured up to the required level. The spindle is tightened. Set 400 sec in the digital timer. Switch ON the power supply. When 0 sec is reached in the digital timer, press the reset button, so that it again shows 400 seconds. Then for every 100 sec apply the pressure through hydraulic jack. When the digital timer shows 0 sec switch OFF the power. After three to five minutes take out the mounted specimen. Finally the specimen is mounted in the thermosetting material.

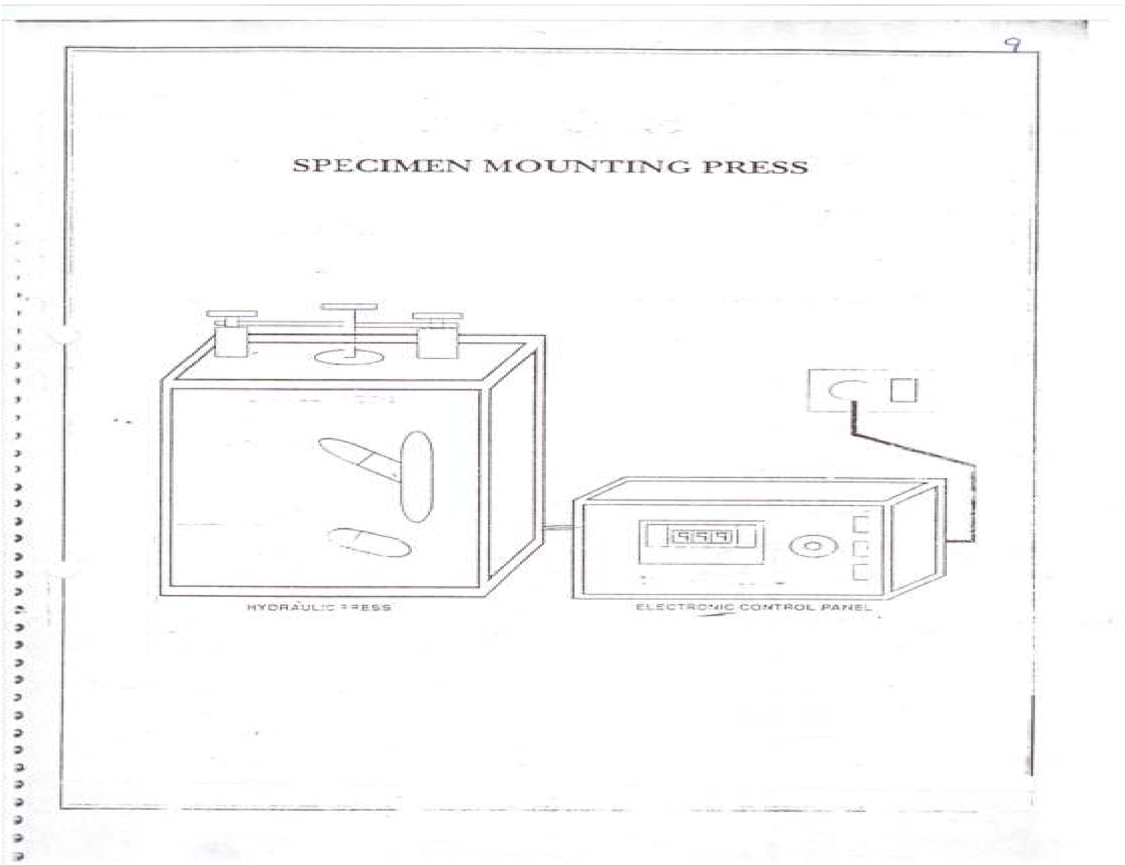
The mounted specimen is polished successively on belt, plate and disc polishing machines to obtain the fine surface finish. Place the specimen under the microstructure ad draw the microstructure of the same.

PRECAUTIONS:

- Pressure should be applied uniformly
- The specimen should be placed at the centre of the mould
- Heat the specimen uniformly

RESULT:

CONCLUSION: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SPECIMEN MOUNTING PRESS
HYDRAULIC PRESS
ELECTRONIC CONTROL PANEL

PREPARATION AND STUDY OF MICROSTRUCTURES OF MILD STEELS, LOW CARBON STEELS AND HIGH CARBON STEELS

AIM:

To prepare the specimens of pure metals like mild steels, low carbon steel and High carbon steels and observes the microstructure of the same

APPARATUS:

- Given specimen
- Specially designed files
- Belt grinder
- Emery papers (80,120,240,400,600)
- Disc polishing machine
- Microscope

THEORY

Plain carbon steels are steels having carbon as the predominant alloying element and the other alloying elements are either Nil or negligible though some amount of sulphur and phosphorous are present. Normally the amounts are less than 0.05 percent and hence they are not considered. The plain carbon steels are broadly classified in to low carbon steels with carbon content less than 0.3 percent and medium carbon steels contain Carbon between 0.3 to 0.7. The high carbon steels contain carbon from 0.7 to 1.5 percent.

PROCEDURE:

The specimens of pure metals like Mild steel, Low carbon steel and high carbon steels are mounted in a thermosetting material as explained in the experiment no. 1. Polish the specimen by using (80,120,240,400and 600) grade emery papers. Subject the given specimen to mirror like finish by using disc polishing machine and with suitable abrasive. Clean the specimen with alcohol and wash it under the stream of flowing water. After washing the specimen is dried. After drying apply the suitable etching agent for 30 to 60 sec. After etching wash the specimen under the stream of flowing water. Dry the specimen with the help of air blower. Place the specimen under the microscope for metallurgical studies. Draw the micro structure and identify the material for the given specimen.

LOW CARBON STEEL:

As the microstructure shows the structure of the mild steel, it contains 25% pearlite and 75% ferrite. The dark region defines the pearlite and bright portion is of ferrite. The properties of low carbon steels are

The material is soft and ductile
It is easily weldable
It is cold workable
The tensile strength varies between 390 to 550 N/ mm^2
The Brinell hardness number varies from115 to 140.
The application includes making steel wire, sheets, rivets, screws, pipe chain and structural parts.

MEDIUM CARBON STEEL:

The microstructure reveals two phases are to be about 50% each. Hence the carbon content can be accessed to be equal to it. The properties of medium carbon steels are invariably between low and high carbon steels. The tensile strength varies between 75 to 800 N/ mm^2

The medium carbon steels are used in manufacture of drop forging dies, die block plates, punches, screws and valve springs etc.

HIGH CARBON STEEL:

Microstructure of high carbon steels consists of continuous network of cementite in matrix to pearlite. This cementite structure is hard and brittle and hence has poor machinability. As carbon content increases weldability and cold working decreases. They have high strength and hardness. Its Tensile strength is up to 1400 N/mm^2 hardness varies from 450 to 500 BHW.

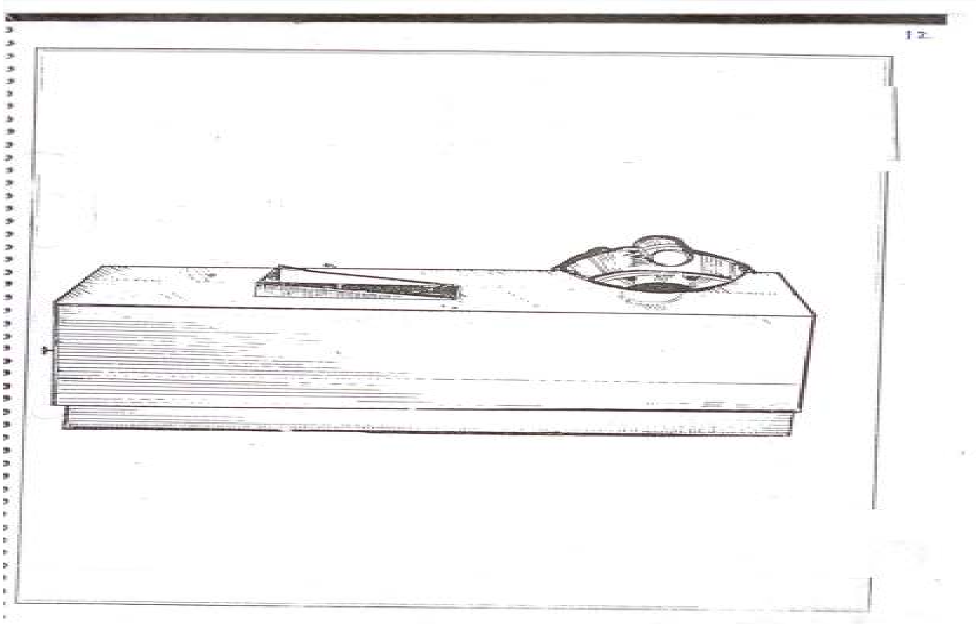
High carbon steels are used in cutting machine tools, manufacturing cold dies and wheels for railways.

PRECAUTIONS:

1) Polishing should be slow, sooth and flat.
2) Uniform pressure is applied through out the polishing.

RESULT:

CONCLUSION:



BELT GRINDING MACHINE

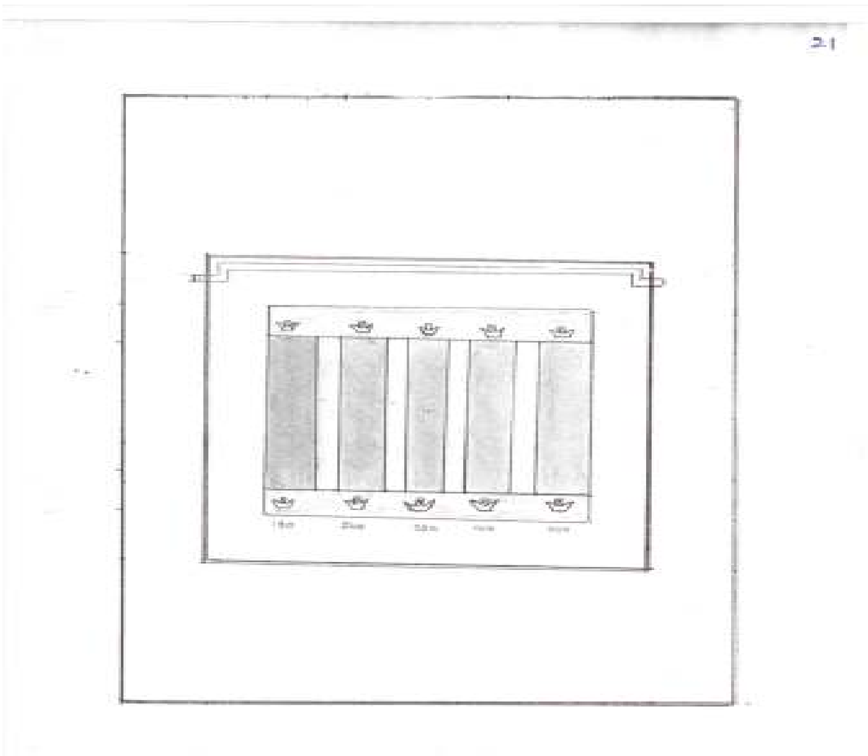
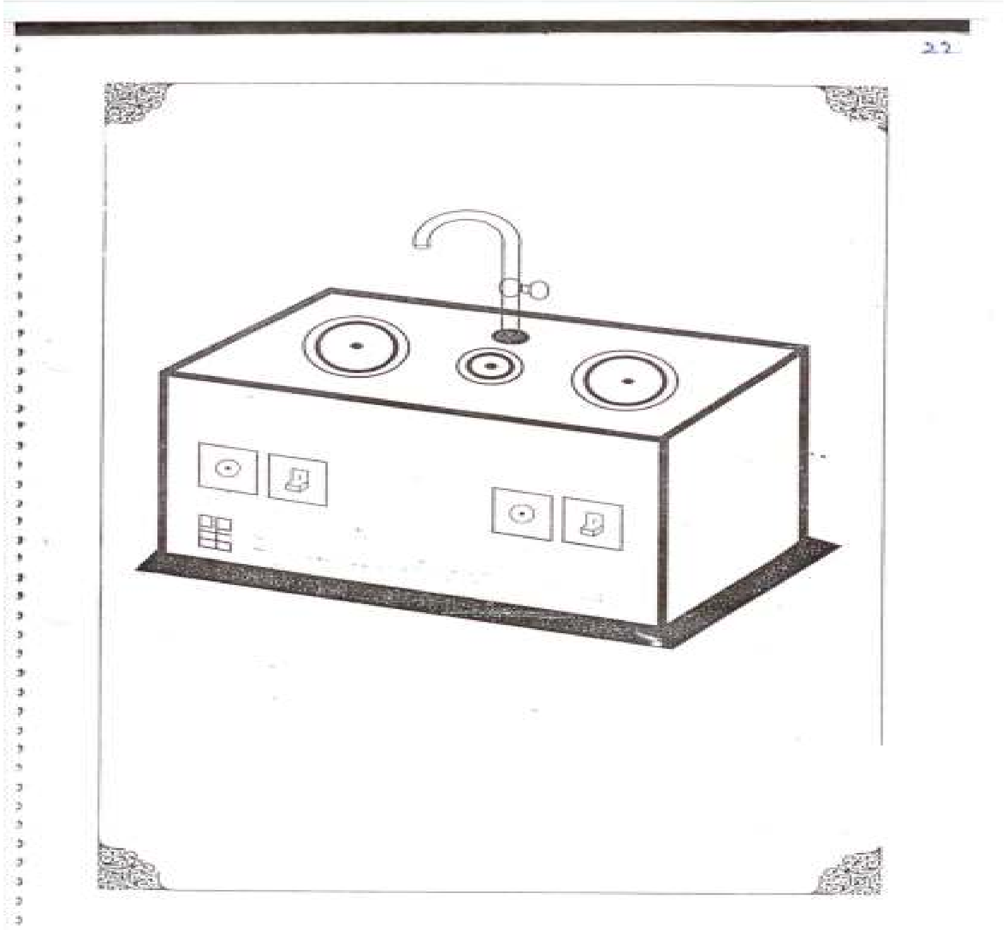


PLATE POLISHING MACHINE



DISC POLISHING MACHINE

STUDY OF MICROSTRUCTURES OF THE CAST IRONS

AIM:

To identify and draw the microstructures of Cast Iron specimens like Grey Cast Iron, White Cast Iron, Malleable Cast iron, and S.G. Cast iron etc.

APPARATUS:

- Given specimen
- Specially designed files
- Belt grinder
- Emery papers (80,120,240,400,600)
- Disc polishing machine
- Microscope

THEORY:

Cast irons contain 2 to 6.67 % of carbon. Since high carbon content tends to make the Cast iron very brittle, most commercially manufactured types are in the range of2.5 to 4% of carbon. The ductility of Carbon is very low and it cannot be rolled, drawn or worked at room temperature. However they melt readily and can be cast to complicated shapes which are usually machined to final dimensions. Since the casting is only the suitable process applied to these alloys, they are known as cast irons.

Although the common cast irons are brittle and have lower strength properties than most steels, they are cheap, can cast more readily than steel and have other useful properties. In addition by proper alloying good foundry control and appropriate heat treatment is possible. The properties of any cast iron can be varied over a wide range.

PROCEDURE:

- Polish the specimen by using (80,120,240,400,600) grade emery papers. Subject the given specimen to mirror like finish by using disc polishing machine and with suitable abrasive. clean the specimen with alcohol and wash it under the stream of flowing water
- After washing the specimen is dried. After drying supply the suitable etching agent for 30 to 50 sec.
- After etching wash the specimen under stream of flowing water.
- Dry the specimen with the help air drier.
- Place the specimen for metallurgical studies.
- Draw the microstructure and analyze the properties

WHITE CAST IRON:

In white cast iron most of the carbon is present in the combed forms as cementite.This is obtained by rapid cooling of the iron. White cast irons contains large amount of cementite as continuous inter dendritic network. It makes the cast iron hard, wear resistance but extremely brittle and difficult to machine.

White cast irons are limited in engineering applications because of brittleness and lack of mach inability. They are used where resistant to wear is important and service does not require, such as cement mixer, ball mills certain types of drawing dies and extrusion nozzle. A large tonnage of white cast iron is used as a raw material for manufacture of malleable cast iron.

The composition of typical malleable cast iron is as follows

Carbon: 2.9%

Silicon: 1.15%

Manganese: 0.6%

Phosphorous: 0.15%

Sulphur: 0.5%

MALLEBLE CAST IRON:

In which most of the carbon is uncombined form of irregular particles known as tempered carbon. This is obtained by heating the white cast iron to 920 to 1000 degree centigrade for about 50 hours followed by slow cooling to room temperature. While on heating, the cementite structure tends to decompose in to ferrite plus tempered carbon (Graphite). The lubrication action of the graphite imports high machinability to malleable cast iron and lower the melting point makes it much easier to cast than steel. Malleable cast irons are tough, strong and shock resistant. The addition of copper and molybdenum in combination produces malleable cast iron of superior corrosion resistance and mechanical properties. The malleable cast iron is used for wide applications such as agricultural implements, automobile parts, man hole covers, rail road equipment gears, cams and pipe fittings etc.

GREY CAST IRON:

In which most or all of the carbon is uncombined form of graphite flakes. The tendency of carbon to form as graphite flakes is due to increased silicon and carbon content and there by decreasing the cooling rate.

It is a low melting alloy, having good cast ability and machanibility. It has low tensile strength, high compression strength and very low ductility. Grey cast iron has excellent damping capacity and is often used as base for machinery or any equipment subject to vibration. It is also used for machine tool bodies, pipes and agricultural implements. The presence of graphite flakes provides lubricating effect to sliding bodies.

The composition of typical grey cast iron is as follows

Carbon: 2.8 to 3.6%

Silicon: 1 to 2.75%

Manganese: 0.4 to 1%

Phosphorous: 0.1 to 1%

Sulphur: 0.06 to 0.12%

NODULAR CAST IRON: (SPHEROIDAL GREY CAST IRON)

Nodular cast iron is also known as ductile iron. Spheroidal graphite iron is a cast iron in which graphite is present as tiny balls or spheroids. The compact spheroids interrupt the continuity of the matrix much less than graphite flakes. This result in higher strength and toughness compared with a similar structure of grey cast iron. Nodular cast iron differs from malleable cast iron in that it is usually obtained as a result of solidification and does not require heat treatment. The spheroids are more rounded than irregular aggregates of temper carbon found in malleable cast iron. The formation of spherical graphite is due to addition of magnesium to the molten grey iron.

The composition of typical S.G.cast iron is as follows

Carbon: 3 to 3.5%

Silicon: 2 to 2.5%

Manganese: 0.15 to 0.6%

Phosphorous: 0.025 to 0.4%

Sulphur: 0.015 to 0.04 %

APPLICATIONS:

Agricultural tractor and implement parts, automotive and diesel crank shafts, piston and cylinder heads, electrical fittings, motor frames, hoist drums, flywheels and elevator buckets, steel mill, furnace doors and bearings wrenches levers and handles.

STUDY OF MICROSTRUCTURES OF NON-FERROUS ALLOYS

AIM:

To study the microstructures of Non ferrous specimen alloy specimens like Cu, Al, alloys and bearing metal

APPARATUS:

- Given Al, Cu alloy specimens
- Metallurgical microscope
- Suitable etchants

THEORY:

Non ferrous metals ad alloys contain other than iron as a main constituent. They exhibit different properties compared to ferrous metals and alloys.
Hence their application also differs from ferrous metals. We shall study the microstructures of Al, Cu, and alloys.

PROCEDURE:

- Polish the specimen by using (1/0, 2/0,3/0,4/0,) grade emery papers. Subject the given specimen to mirror like finish by using disc polishing machine and with suitable abrasive. clean the specimen with alcohol and wash it under the stream of flowing water
- After washing the specimen is dried. After drying supply the suitable etching agent for 30 to 50 sec.
- After etching wash the specimen under stream of flowing water.
- Dry the specimen with the help air drier.
- Place the specimen for metallurgical studies.
- Draw the microstructure and analyze the properties

CU- ALLOYS

BRASS:

Brasses are the copper alloys containing zinc up to 30% they possess relatively good corrosion resistance and good working propewrties. They also posses high ductility hence they are suitable for drastic cold working. In common to relieve the stresses annealing is done. Most normally used brass contains 30% zinc and 70% copper which is known as cartridge brass. This shows higher ductility and malleability. The microstructure shows a typical equi axied grain structure with twins in annealed structure. This brass is used for making cartridge cases. Other applications include4s radiator cases, head light reflectors, hardware, and plumbing accessories.

AL-ALLOYS:

Aluminum alloy contains silicon up to 12 %. Aluminum- silicon is also called as silumin. There are two types of aluminum silicon alloys are there.

LM-6:

It contains above 12% silicon due to its higher corrosion resistance and fluidity. It is used in water cooled marine tools for pump parts

LM-13

It contains silicon up to 12.5%, Ni 2.5%, ca 1% and Mg 12%. This shows good forgability and low coefficient of thermal expansion. It is used in automobile pistons.

BEARING METAL:

Bearing metal has high compressive strength and high wear r resistance, high fatigue strength and better thermal conductivity for heat dissipation, corrosion resistance and good machinability. They have hard and soft phases. Most widely used bearing metal is a Babbitt metal. They are called as low melting bearing alloy. Lead based ad tin based Babbitt contain Antimony as most popular this group.

PRECAUTIONS:

Polishing should be slow, smooth and flat

Uniform pressure is applied through out the polishing

RESULT

STUDY OF MICROSTRUCTURES OF HEAT TREATED STEELS

AIM:

To identify, draw and to analyze the microstructures of heat treated specimens like Grey Cast Iron, White Cast Iron, Malleable Cast iron, and S.G. Cast iron etc.

APPARATUS:

- Given specimen
- Specially designed files
- Belt grinder
- Emery papers (80,120,240,400,600)
- Disc polishing machine
- Microscope

THEORY:

Heat treatment is a process of heating the metal below its melting point and holding it at that temperature for sufficient time and cooling at the desired rate to obtain the required Properties. The various heat treatment processes are annealing, normalizing, tempering, hardening, mar tempering, austempering.

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The final mechanical properties depend on the microstructure formed due to various heat treatment processes (due to various cooling rates). An annealed specimen was cooled in the furnace or any good heat insulating material; it obtains the coarse grain structure of ferrite and pearlite in case of hypo eutectoid steels and coarse grain structure of ferrite and cementite in case of hyper eutectoid steel. It possesses high ductility.

A normalized specimen was cooled in the presence of air so cooling rate increases, it obtains the fine grain structure of ferrite and pearlite in case of hypo eutectoid steels and fine grain structure of ferrite and cementite in case of hyper eutectoid steel. It possesses high ductility.

A hardened specimen was quenched in oil (incase of alloy steels) or in water (in case of carbon steel).due to faster cooling rate martensite (hard steel) structure was formed.

PROCEDURE:

- Take the given treated (annealed, normalized, hardened) specimens.
- Polish the specimen by using (80,120,240,400,600) grade emery papers. Subject the given specimen to mirror like finish by using disc polishing machine and with suitable abrasive. clean the specimen with alcohol and wash it under the stream of flowing water
- After washing the specimen is dried. After drying supply the suitable etching agent for 30 to 50 sec.
- After etching wash the specimen under stream of flowing water.
- Dry the specimen with the help air drier.
- Place the specimen for metallurgical studies.
- Draw the microstructure and analyze the properties

PRECAUTIONS:

1).Polishing should be slow, smooth and flat.
2).Uniform pressure is applied through out the polishing.

RESULT:

CONCLUSION:

JOMNY END QUENCH TEST

AIM:

To evaluate the hardenability of the low carbon steel or medium carbon steel by Jomny end quench test Method.

APPARATUS:

Heat treatment furnace

Jomny end quench apparatus,

Test specimen,

Rockwell test setup

PROCEDURE:

The various steps involved in evaluating the hardenability test for a given specimen are

- Determination of hardness no. by Rockwell hardness test
- Heat treatment in the furnace
- Quenching the specimen in Jomny end quench apparatus

DETERMINATION OF HARDNESS NO.BY ROCKWELL HARDNESS TEST

The method of determining the hardness consists of measuring the depth of a diamond cone penetrant that was forced into a metal by applying primary and secondary loads. This method of measuring hardness significant because errors due to mechanical defects on the system such as backlash are eliminated ad as well as errors resulting fro slight surface imperfections.

The specimen is placed on a suitable anvil on the upper end of the elevation screw. A minor load of 10 kg is applied by raising the anvil by using elevation screw. Then apply the major load by using the leaver. After applying the load for a period of 20 sec, remove the load by turning the lever. Note down the reading on the Rockwell scale.

- HEAT TREATMENT IN THE FURNACE

Heat treatment is a combination of heating and cooled operations timed and applied to a metal or alloy so as to produce the desired properties. Heat treated steels amount to about 5 percent of total steel production, but it is indispensable for tools, dies, ad a variety of special purpose steels.

SPECIMEN: Medium carbon (plain Carbon) steel. The percentage of composition is

Carbon	0.35% to 0.45%
Silicon	0.35 %(max)
Manganese	0.60% to 0.8%
Sulphur	0.05 %(max)
Phosphorus	0.05 %(max

Take the specimen, place it I the furnace and supply the power. Wait till the temperature reaches to the austenising temperature. Heat the specimen at the austenising temperature until it is completely transformed in to Austenite. Remove the specimen from the furnace with the help of tongs and gloves and place it in the Jomny end quench apparatus and allow the jet of water to strike one end of the specimen. When the specimen reaches to the room temperature remove it fro the apparatus and find the Rockwell hardness at 0.5cms along the length of the specimen. Plot the graph between the hardness and distance from the quenched end.

PRECAUTIONS:

1. Don’t use the hard water as it leads to formation of scales in nozzles and copper conduits.

RESULT:

CONCLUSION:

FIND THE HARDNESS OF THE VARIOUS TREATED AND UNTREATED STEELS.

AIM:

To find the hardness of the given treated and untreated steel specimens by conducting the hardness test.

APPARATUS:

- The given specimens
- Hardness tester
- Diamond penetrant

THEORY:

The method of testing introduced by J.A.Brinell in 1900 consisting of indenting the metal with a "d" mm diameter and tempered steel ball subjected to a definite load. ball of 10 mm , 5 mm , ad 2.5 mm are generally used. The load is maintained for a definite period (usually 10 or 15 sec) after which the load is removed and the diameter of the impression or indentation is measured. The hardness of the material expressed as number and represented by the symbol "HB".

h= depth of indentation

$$(D- \sqrt{(D^2 - d^2})/ 2$$

Brinnel's hardness number HB = Total load / surface area of indentation

$$\frac{2F}{\Pi D (D- \sqrt{(D^2 - d^2)}}$$

PROCDEDURE

- The face of the specimen is lightly grind and rubbed with fine emery paper if required.
- Select the proper test table based o the size and shape of the specimen and place it on main screw or elevating screw
- Select the diameter of the indenter as 10mm or 5 mm based on the thickness of the specimen and place it I the corresponding ball holder and fix the ball holder.
- Place the required weights on the weight hanger based on the type of material of the specimen and diameter of the indenter
- Check and keep the operating level in horizontal position
- Place the specimen securely on testing table
- Turn the hand wheel in clock wise direction so that the specimen touches the ball indenter
- Lift the operating lever fro the horizontal position upwards slightly, after which it rotates automatically.
- Wait for 10 to 15 sec after lever becomes stand still.
- Bring the lever back to horizontal position
- Turn back the hand wheel and remove the specimen
- Measure the diameter of impression of indentation by Brinnel microscope and find the Brinnel hardness number.
- Repeat the above procedure for three to four times

PRECAUTIONS:

1. Apply the load slowly and gradually on the sample
2. Distance between old impression and location for new impression should be 3D (three times the ball diameter)
3. After applying the specified load wait for 15 sec then remove the load
4. The thickness of the test piece must not be less than 8 times the depth of impression

5. The surface o which the brinnel impression is to be made should be sufficiently smooth and clean.

RESULT:

The Brinnel hardness number of the give material is -------

CONCLUSION:

OBSERVATION AND TABULAR COLUMN

Room temperature –

material	P/D^2	Dia. of indenter D mm	Applied load Kgf	Diameter of indentation (d)					Brinell Hardness number
				1	2	3	4	5	

P/D^2 Ratio for different metals

	Ferrous material	Non ferrous material		
	Steel & Iron	Brass	Aluminum	Soft bearing material
P/D^2	30	10	5	2.5

MAGNA FLUX TEST

AIM:

To find the surface and sub surface defects in a given ferromagnetic material by using Magna flux test.

APPARATUS:

- Magna flux testing machine,
- Fine Ferro magnetic powder
- and the given test specimen

THEORY:

MAGNAFLUX TEST METHOD:

This is a continuity test and is particularly useful in a Ferro magnetic material. It is a non destructive test which is to be conducted on the finished product instead of representative specimen.

PRINCIPLE OF OPERATION:

The principle of this test consists of inducing a magnetic field in the specimen of interest either by passing an electric current or by the influence of internal magnetic field yoke coil surrounding the specimen.

Load flux leakage field, which may be detected by the application of finely, divided particles or Ferro magnetic powder to the surface of the specimen. The Ferro magnetic powder of fine size will offer paths of low reluctance to the leakage fields and as a consequence of the particles will tend to out line the effective boundaries of the discontinues which disrupted by initially induced magnetic flux.

The Ferro magnetic powder used here is fine iron powder of 250 mesh size. The specimen is to be magnetized using direct current (D.C) or alternative current (AC) the detections to only the discontinuities that is open to the surface. This is due to the phenomenon of skin effect. The use of A.C limits only to small sizes. However, D.C magnetization makes possible the direction of large and small sub surface discontinuities as well as located directly on the test surface.

PROCEDURE:

1. The surface of the Ferro magnetic specimen to be tested is cleaned
2. The fine Ferromagnetic powder is sprayed uniformly over the surface of the specimen.
3. Switch ON the power
4. The specimen is magnetized by using the prods.
5. The prod is operated with the help of a button provided on one of the prods.

Place the prods at a minimum distance of one inch. During the magnetization of the specimen poles are formed at the defects and the Ferro magnetic powder gets accumulated at the flaw or crack if present on the specimen. If there is no defect there will not be accumulation of powder.

By this the defect on the specimen can be clearly seen due to the accumulation of fine Ferro magnetic particles at the flaw.

PRECAUTIONS:

The prods should not be brought in contact with each other
The spreading of Ferro magnetic powder should be uniform.

LIMITATION:

This method cannot be applied for non-ferrous metals.

RESULT:

CONCLUSION :