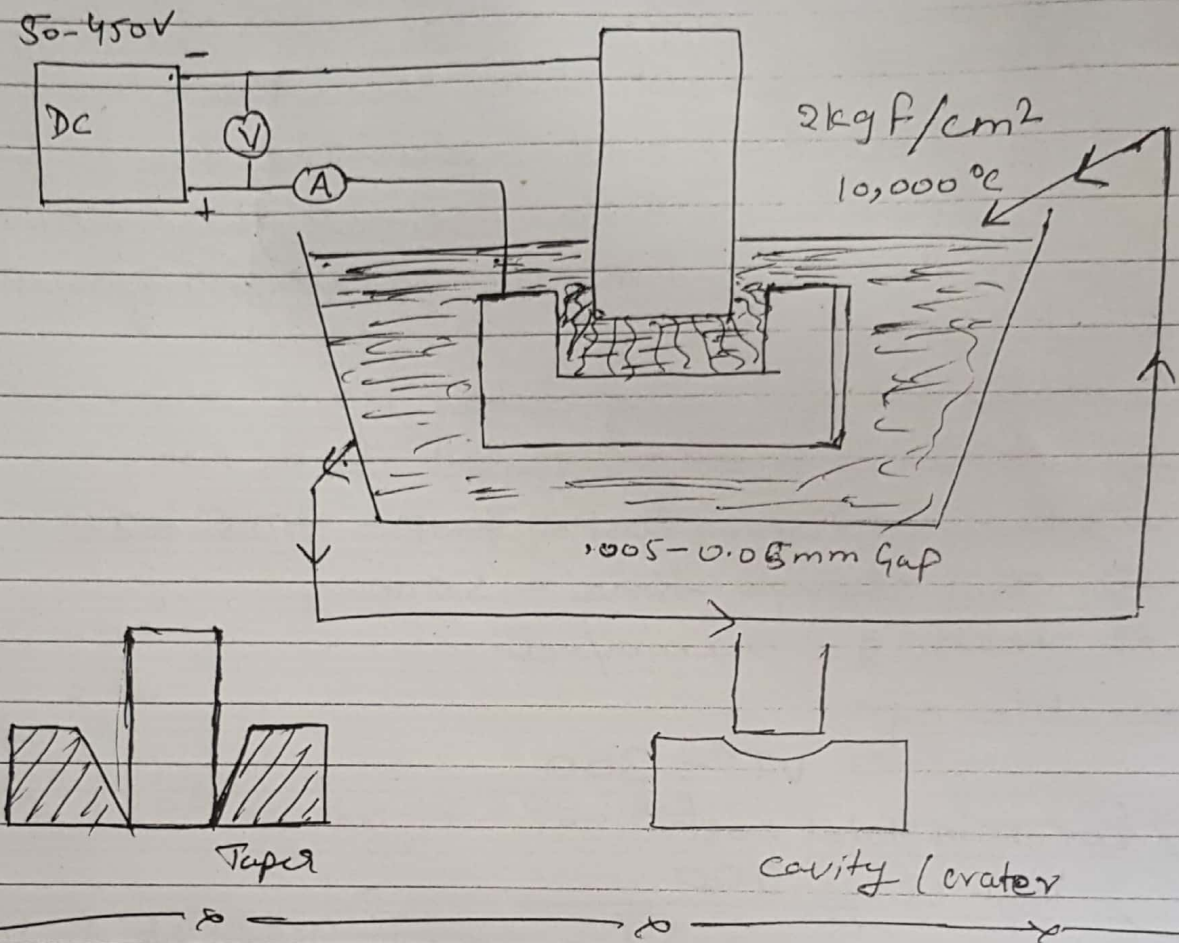
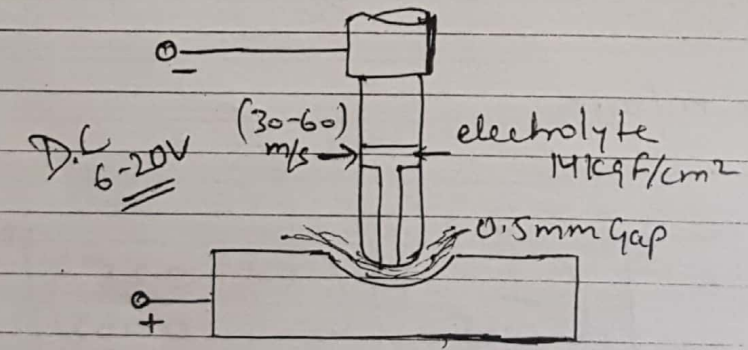
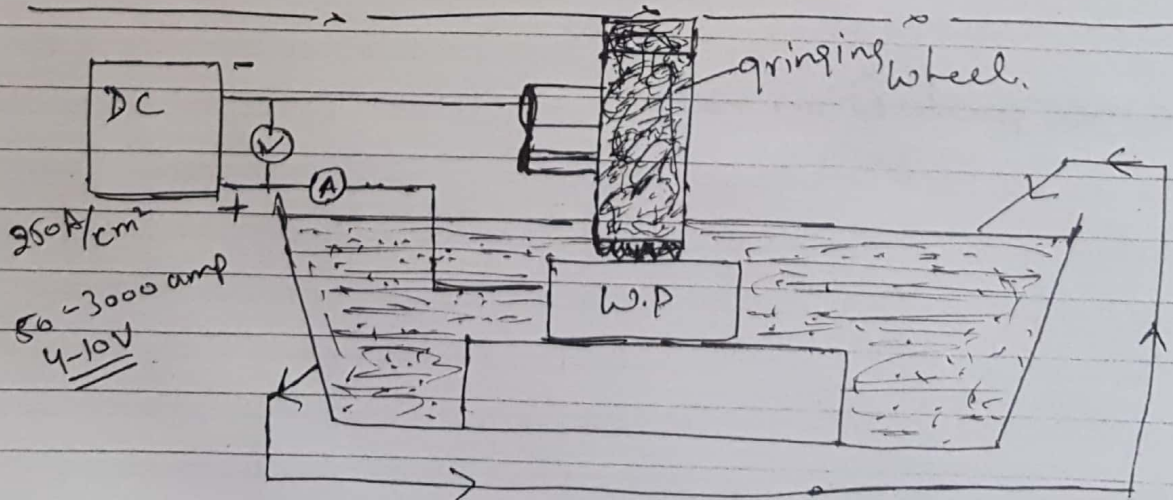
UNCONVENTIONAL MACHINING PROCESSES

EDM



ECM





⇒ non convention metal cutting process
⇒ tool is softer than w/p
⇒ In major of the process tool is not in contact with w/p
⇒ Sp. Energy consumption is nearly 100 to 1000 times more than convention metal cuttings.
⇒ Tool geometry in Unconventional metal cutting is not emphasised to much.
⇒ Tool uses some form of energy to remove material

EDM :- Electric discharge machining

The principle of the process relies upon the compressive shock wave created by sudden electric discharge from a dielectric medium

Dielectric fluids ⇒ Paraffin, transformer oil, kerosene, EDM oils.

Tool materials ⇒ Copper, Copper-tungsten alloys, brass, Graphite etc

Current parameters Current density in the discharge channel is 10000amp/cm², Power density = 500 MW/cm²

⇒ Work tool gap is maintained by electrohydraulic servo mechanism,

Wear ratio :- It is defined as the ratio of volume of w/p removed to the volume of the tool material removed

The value of wear ratio depends upon the tool material employed as given below.

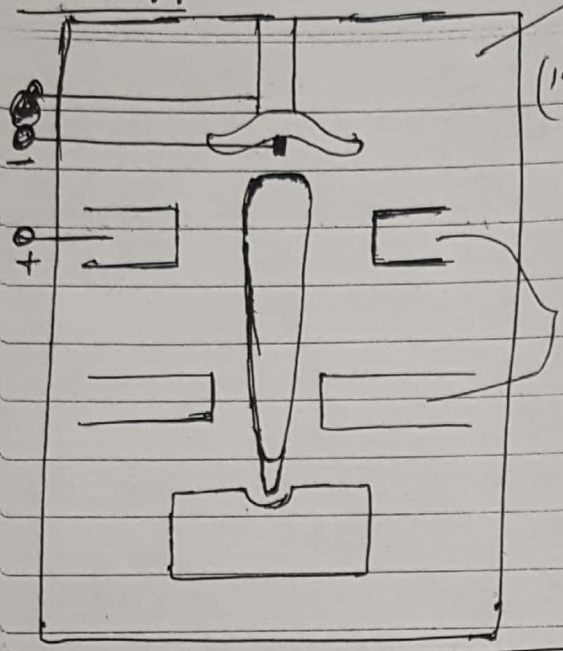
Graphite	100:1
Cu	2:1
Brass	1:1
Copper tungsten alloys	8:1

Over cut It is the distance the spark will penetrate the workpiece from the tool generally it is larger than the gap b/w the tool & w/p.

Sharp corners get rounded due to over cut radius of the corner is approximately equal to the amount of the over cut

Overcut increases with increase in current and decrease in frequency

EBM:



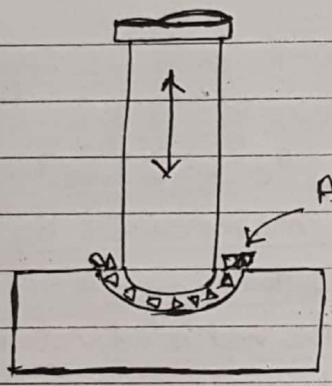
10^{-5}mm Hg (Vaccum Pressure)

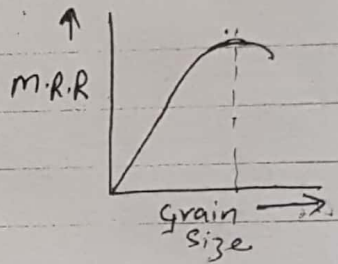
(1.5×10^{6} watt/cm^2) Power density is of the order billion watt/cm

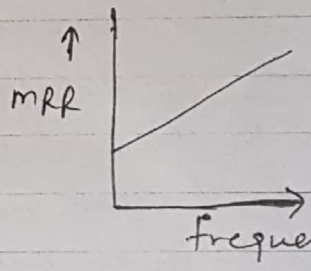
anodic m.field.

Heat energy $\approx 10000^{\circ}C$

USM:

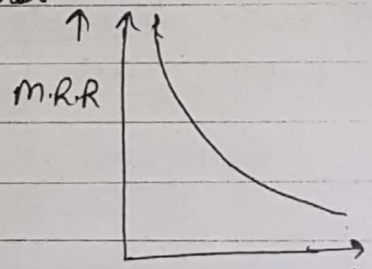




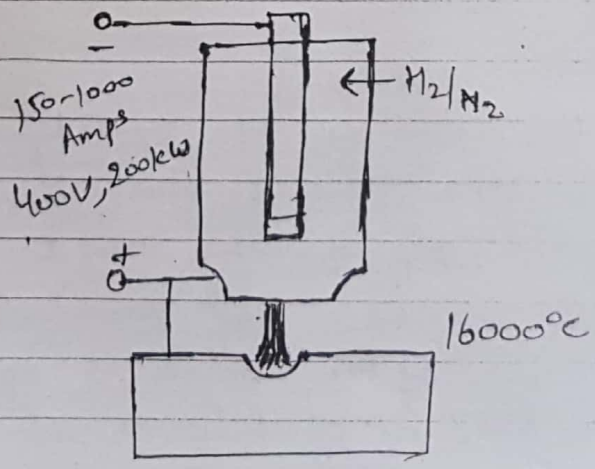


High frequency longitudinal vibrations are used.

Non-conducting materials can be machined.



PAM:-



Taper effect: In through hole drilling the presence of frontal spark accompanied by a side spark results in tapered holes. After a penetration of about 75 mm. Taper effect is found to be zero.

The quality of surfaces reduced by this process reveals the presence of microscopic craters. A surface roughness is inversely proportional to the frequency of cutting.

Applications ① Shaping of alloy steel and tungestun carbide dies used for moulding, forging, extrusion, wire drawing etc.

② Holes in injector Nozzle, embossing engraving oppn on harder materials.

(iv) Electro Chemical Machining

In this process a p w/p is made as anode and cathode is used as a tool the metal is removed by controlled dissolution of anode, ~~is~~ based on faraday's Laws of electrolysis.

Electrolytes used Sodium chloride, Sodium Nitrate Potasium chloride, Sodium Hydroxide Sodium floride. NaCl is mostly used because its conductivity remains fairly constant during the electrolysis. However corrosion and sludge formations are the major problems identified with Sodium chlorides. These problems can be overcome by increasing the velocity of electrolyte or by changing the electrolyte to Sodium Nitrate

Tool materials:

Copper, brass, S. steel, aluminium, Graphite, bronge, Platinum and Tungestun carbide

Advantages :-

① No tool wear
② Material removal rate is quite high
③ Very complex configurations can be machined
④ Distortion free machining can be achieved

Application

① Machining of hard heat resisting alloys for cutting cavities in forging dies.
② for drilling of holes for machining of turbine blade.
③ sharpening of tungestun carbide tooling
④ Machining of alloy steel nozzles

iii Electro chemicals Grinding ECG

It apply very little pressure on the work it is used to grind slotts, flats and thin walled w/p(s). The mechanism of material removal is the combined action of electrolysis and abrasion Conducting bond and non-conducting abrasives can be applied with a grid size of 100

Current Parameter (50 - 3000) amps. r (4 - 10) volts
250 amps/cm² current density.

Resharpening of milling cutters, drill bits and tungestun carbide tools are some of the other appliation.

IV EBM Electron Beam Machining.

1. The source of electron beam is the heated tungestun filament (25000°C)
2. The electron beam is focused with the help of electromagnetic lens system.
3. Under the operating conditions the velocity of electrons may reach 160,000km/sec
4. The impingement of electron beam results in a local rise of temperature so that the work piece material will be heated melted and evaporated. ~~This procers is us~~
5. This procers is used for aprature holes in electron microscopes, ie; very fine and smaller dia, drilling of holes in ruby and diamond crystals.

V (USM) Ultrasonic Machining:

1. High frequency ultrasonic waves of amplitude of 0.001mm are produced by piezoelectric effect or magnetostriction effect.
2. The tool used in USM is only a transducer it drives the abrasive particles against the workpiece
3. Maximum Material removal rate is obtained in this procers when the abrasive particle size is aproximately equal to the amplitude of tool vibration

Applications

Holes as small as 0.1mm can be produced by drilling.
Hard materials like S.steel, Glass ceramics, carbides, quartz and semi-conductors are machined by this procers.

VI PAM Plasma Arc Machining

① Material removal takes place due to the → radiant heat energy liberated by plasma medium
② M.R.R depends upon Gas flow rate
③ This is considered as a rough machining process with as accuracy of 1.5mm
④ The heat effected zone can be reduced by increasing the speed of cutting.
⑤ It is used for rough machining of high strength heat resisting alloys.

VII (LBM) Laser Beam :

① Lasers are produced from crypton crystal or from ruby rod.
② This process can result in development of 8000°k in 0.0005 seconds of time.
③ It is a rough maching operation with an accuracy of 0.6mm.
④ This process cannot be employed for metallic surfaces which posses High optical reflectivity and Good thermal conductivity like Al, Cu, Au alloys
⑤ The efficiency of this process is (10-20) %