ARYAN SCHOOL OF ENGINEERING &TECHNOLOGY

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LECTURE NOTE

SUBJECT NAME-SURFACE MINING TECHNOLOGY

BRANCH-MINING ENGG.

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Surface mining

Mining :-

Mining is excavation process which is economica mineral extraction of metal and minerals.

(i) Survey (ii) Drilling (iii) clear (iv) Blasting (v) Transporting.

u/g = underground

o/c = open cast

Surface mining applies to extraction of mineral resources from water and sedimental of rivers, lakes, seas, and ocean; from solution circulating through broken rock and soil; and from rock and of soil excavated from the earth.

Surface mining is responsible of mineral production in the united states and a substatial portion of the wouds total production.

Surface mining is a form of mining in which the soil and the rock covering the mineral deposits are removal. It is the other way of underground mining In which the overlying rock is left behind, and the required Mineral deposits are removed through shafts or tunnels.

An open pit mine is an excavation or cut made at the surface of the ground for the purpose of extracting ore and which is open to the surface for the duration of the mine's life. To expose and to mine the ore., It is generally necessary to excavation and reco-cate large quantities of waste rock. The main objective in any commercial mining operation is the exploitation of the mineral deposits at the

lowest possible cost with a [illegible]
profits.

Although the basic concept of an open pit is quite simple, the planning required to develope a large deposite for surface mining is a very complex and costly undertaking.

At one mine, it may be desirable to plan for blending variation in the ore so as to maintain as nearly as possible, a uniform feed to the mill.

At another operation it may be desirable to completely separate two kinds of ore, as for example a low grade deposit where one kind of 'oxide' ore must be treated by acid leach, but a second kind of useful ore must be treated by different methods.

The grade and tonnage of material available will determine how much waste rock can be stripped and there is often an ultimate limit to the pit that is determine more by the economics of removing over burden than a sudden change in the ore deposit from mineral to non-mineral bearing material. Mining is usualy done by track-mounted electric shovels in the large operations and by rubber-tired diesel front-end loaders in the smaller operations. scrapers are sometimes used in special situations.

open cast mines means any mine other an under-ground excavation. It includes related expressio such as surface mines, open pit and strip mines. Mine means any excavation in the earth whether abandoned or worked, made for the purpose of searching or winning any mineral, and any place where a mineral deposit is being [illegible]

or more such places are being worked jointly, they may be deemed to constitute one mine.

→ Dip below 7'
→ Dip in betn 7' to 16'
→ Dip in betn 16' to 45'
→ Dip in more than 45'

exclusively flat deposits occured in a very shallow depth, on flat and outcropped deposite the best positions for surface mining. steeply dipping stratified deposite, veins or loads can be extracted with the open cast method that generally limits near the out crops and govern by the inclination.

Form of the deposits :—

+ stratified bedded deposits :—

These type of deposits are mostly sedimentary deposits having a high degree of continuity and regularity. although sometimes the bed is affected by various dis continuities like fold, faults and other disturbances coal seam, limestone deposites, iron ore deposits etc come under this catagory.

Leads or vein :—

The leads or veins which have the commercial value, regularity and continuity mineralization are rarely straight or consistent in width but distributed haphazardly. They may be lenticulare irregular, massibe or thin.

(3) Types of surface mining system and its applicability.

Surface mining systems can be categorized into 3 basic types which are as follows -

A. Removal of blocks of minerals over the surface
B. Mountain top removal by contour mining
C. Open-cast mining or quarrying.

A. Removal of blocks of minerals over the surface:-

In many occasion mineral deposits like limestone dolomite etc, are available over the relatively level plane beneath level to a gently rolling surface or in the fashion of a heap. The depth of the mineral body from the level ground may remain fairly constant over an extensive area, mining of these blocks is done first at the out crop and then proceeds to the limit of the quarry.

B. Mountain top removal by contour mining:-

Surface mining method in the hilly and mountainous terrain is generally done by the contour mining system in most of the iron ore and bauxite deposits occurs in the hilly terrain.

C. Open-cast Mining or Quarrying :-

It is basically a system of surface mining in which the excavation of minerals and overburden is done by digging the earth of an open cast mine may go beyond 400m.

Classification of surface Mining methods :-

Classification or subdivision of surface Mining methods into two parts :-

1- Mechanical excavation →

(a) open-pit (or open-cut or open cast) Mining.

(b) Terrace mining
(c) Strip (flat terrain) mining
(d) Contour strip (hilly terrain) mining
(e) Auger mining
(f) Glory mining
(g) Quarrying

Aqueous →
(a) Placer →
(i) panning
(ii) sluicing
(iii) Dredging
(iv) Hydraulic mining

b- Solution →
(i) Heap leaching
(ii) Rotor leaching

TNT =
RDX =

GSI = Geological survey of India
GIS = Geo Information system

Explosive :-
The mechanical mixture of substance of chemical compound that can be exploded by the application of fire or detonation strong shock such mixture of substance or chemical compounds is known as explosive as for India explosive in 1884.
Explosive is having two types —
(i) Low explosive
(ii) High explosive

(i) Low explosive :-

It is a mechanical mixture of substance ignited burns from grain to grain to produced large amount of gas that beald gradual pressure due to compliment and breaks the surrounding rock and hav heaving effect such mixture of substance is known as low explosive.

(2) High explosive :-

It is a chemical or chemical compound which is subjected to detonation or strong shocked that hae limmited chemical de-composition producing large amount of gases that beald suddenly pressure when will consinate and breaks the surrounding rocks in small peices and through than long distance due to sadering effect such chemical or chemical compound is known as high explosive.

(3) Blasting is divided into two types - (Blasting)

(1) primary Blasting

(2) secondary Blasting

(1) Primary Blasting :-

Primary Blasting is utilisation the purpose of daily production.

(2) Secondary Blasting :-

Secondary Blasting is after primary Blasting when a rock big Boulders due to reblasted to break big Boulder to handly material such this Blasting is called secondary Blasting.

Secondary Blasting, mainly 3 types —

(i) pope whole blasting
(ii) plaster blasting
(iii) snake blasting

Control blasting :—

(i) The secondary blasting by a small hole in a big boulder this process is called control.
(ii) when the explosive is charge coverdly with the secondary blasting is known as plaster Blasting
(iii) when the explosive charge explosive just below big boulders are coverdly possible size when the explosive is excapes through this is known as snake blastering.

Equipment of Blasting :—

(1) wire
(2) detonator
(3) safty shoes
(4) greenter
(5) exploded
(6) wodden sticks
(7) knife
(8) ometers
(9) Detonatic relay
(10) Rayded
(11) cut Relay
(12) crimper

Blasting assosories :—

various of assories are used in Blasting ingnation explosive are called

Explosive mixture containe :—

→ combustible material
→ oxidising agent
→ stabilizers agent
→ Antiseptting agent
→ sensitiser agent.

Combustible Material :-

wood mill, fiber, sulphur, charcoal etc.

Oxidising agent :-

Sodium nitrate, ammonium nitrate, carbon nitrate.

Stabilizers agent :-

Magnesium and calsium carbonate

Antiseptic agent :-

To prevent cacking of salts.

Sensitiser agent :-

Metalic powders

Blasting pattern in open cast :-

→ green pattern
→ starver pattern (Staggered pattern)
→ V pattern

control blasting :-

→ line drilling
→ splitting
→ cursive, blasting
→ valeve blasting
→ morpher blasting

Explosive used in open cast Mining :-

→ Gran powder
→ Blasting gelatin
→ liquid oxygen explosive
→ open cast
→ ammonium nitrate
→ ammonium nitrate fuel oil (ANFO)
→ Slurry explosive
→ Dynamite gelatin → plaster gelatin

* what are the Blasting accessories :-

Various types of devices used for initiating explosive are called Blasting accessories.

Ex:- safety fuse, detonating fuse, Nonel, Raydet, detonating relays, cord relays, circuit tester, crimper, shot firing cables, exploder.

* Safety fuse :-

→ Safety fuse looks like cord consist of a core of fine grained gun powder wrapped with layer of a tape and water proof coating.

→ Burning speed of safety fuse is 100 to 120 sec/meter

* Detonating fuse :-

→ such as . cordtex and Geocord detonating fuse.

→ The detonating fuse looks like a plastic cord, its external dia - is about 5mm and weight about 80 gm per meter length.

→ Its velocity of detonation 6500 m/s to 7000 m/s.

→ A large no. of shot-hole connected with detonating fuse can be blasted by a single detonate.

→ A detonating fuse is also used for demolition operation.

* Nonel (Non electric detonator) :-

→ Nonel is developed by Nonel AB of sweden.

→ Primers charge explosive with Nonel detonators inserted and charged the blast holes.

→ The shock wave at a rate of approx V.O.D is 2000 m/sec.

⇒ It prevents vibration, fly rock, air blast, noise and misfire.

⇒ Nonel made by two company :—

(i) IOL - Raydet
(ii) ICIL - Exicel

* Raydet :—

⇒ It consist of plastic tube carrying a very small quantity of EXPLOSIVE material on its innert surface.

⇒ It can be initiate by detonator or detonation fuse.

* Detonating Relays :—

⇒ In O/C workings detonating fuse for initiation provide a non-electric delay firing system.

⇒ The delay interval for each detonating relay veries from 15 to 45 ~~mm~~ m/s.

* Cord relays :—

⇒ cord relays are some as detonating relays.

⇒ A cord relays have a diameter 11.5 mm and length of 153 mm.

⇒ It is available with two delay periods 15 mm and 25 mm.

* Circuit tester :—

⇒ An instrument to test continuity of an electric circuit for blasting is blastometer.

⇒ It is available in two ranges.

(a) 0 to 100 Ω for u/g coal mines
(b) 0 to 100 Ω for other application.

crimper :—

A crimper is a pair of plyers to crimp or press end of a plain detonator on a safety fuse inserted into it, so that the fuse cannot come out of the detonator.

firing cables :—

The cables are twin-core and insulated to withstand at least 250 volt.

Exploder :— (বিস্ফোরক)

The portable apparatus which provides the current necessary for firing electric detonators is called an exploder. Those are following types.

(i) Magneto exploder or Dynamo exploder
(ii) Battery exploder
(iii) condenser pynamo exploder.

→ A low of tension magneto or Pynomo exploder gives a voltage about 15 volt and high tension exploder gives 125 V.

→ The magneto exploder fires only 1 or 2 shots at a time with single shot exploder and upto 6 shots in series with a 6-shot exploder.

→ Rhino exploder are permited to be used u/g only in degree I and degree II gassy mines or coal.

→ In Rhino no. 25 the firing current 1.5 amp. input volt 9v output 0.c-650 volt and firing current duration 3-4ms.

Magazine :—

In small magazine store the following explosive under license in form J which permits the magazine owner :—

Gunpowder - 45 Kg
other NG explosive - 5 Kg
Gunny explosive - 50 Kg
Detonator - 200 no. and any quantity of safety fuse.

Direct Ignition :—

In this explosive charge placed short primer cratigeon pushed last all and the business end of the detonator towards the end this method is called direct Ignition.

=> It proven is Ignition of time that, Bloomed short and give maximum coal having a privase.

Indirect Ignition :—

In this process the primary cratigeon the business end toward the

Magazine :—

A magazine is a building where explosives and detonators are stored. A magazine construction should be approved by the inspector of explosives.

During choosing the place for magazine following points are considered.

(a) It should be located in remote place like in a jungle or hilly area, so that if any accident occurs the damage of the public property is least.

(b) The magazine should be connected with well maintained approach road throughout the year.

(c) The magazine should be situated away from the over head power transmision lines at a minium distance of 90m.

(d) Magazine should be situated in a sloping ground where there is good drainage.

(e) It should be use ventilated strong or bullet proof and fire resistance construction schedule VII of the Implosive rule 1983 describes the specification of Magazine. According to this explosive magazine can be Mod A (large magazine) and mode B (portable magazine)

construction of mode 'A' magazine (large magazine)

Mode A or large magazine should be approved by chief controller of explosives, that should be issued in 9 form. It stores high explosives upto 25,000 kg and 3,00,000 detonators.

under the explosive rules following can be stored together in a magazine.

(1) Gun powder (class-1)
(2) Nitrate com pound (class-2)
(3) Nitro com pound (class-3)

(4) chlorate mixture (class-4)
(5) Safety fuse (class-6)
(6) plastic Ignition chord (class-6)
(7) Detonating fuse (class-6) (8)

(I) The wall of this Magazine should be rain-forced concrete at least 225 mm, thick or brick stone at least 450 mm thick, set in cement morter, concrete should have a minimum compressive strength of 2300 lb/sq.

(II) The roof is to be mode-leak proof and may be made of R.C.C Gloom of 100 mm thick line concrete with 25 mm cement plaster.

(III) The detonators store Gooms can Integrals part of this magazine. The doors should be open out wards and it shall separated from explosive.

Store by a 50 cm thick brick walls.

(IV) The magazine is to be provided with 2 type ventilators of size 228 mm x 114 mm.

(V) There should not be any electrical fittings in the magazine.

(VI) around each branch of explosive boxes a clear space of 600 mm is to be provided.

(VII) Number of stack of Explosives should be of more than 3 meter in hight.

(VIII) The Internal volume no less than 0.4 cubic meter for each kgs explosives.

Mode (B) of small magazines :- (small magazines)

small magazine in the mine permits are according to licence given such a lincence permits the magazine owner to store up to -

(a) 45 kg of gun powder

(b) 5 kg of other NG based explosive

(c) 200 detonators.

(d) 50 kg slurry explosive

(e) Any quantity of safety fuse.

This magazine having :-

(1) walls of steel plate at least 5mm thick.

(2) A roof of steel plate at least 5mm thick.

(3) Internal lining at least 10mm thick woodenboard core jointed so that no iron or steel in explosive to the interior side.

(4) An Internal volume not less than 0.6 cubic meters each 100 kg of explosive. The maximum Internal volume shall not be more than 2- cubic meters.

(5) ventilation by means of vents which should be adequately protected.

(6) A lock of dead lock type for external use.

(7) A coating of anti corrosive paint.

(8) while fitting the portable magazine It has to be on raised ground and maintaing a minimum safety distance 95mm from

All factories, building, huts, houses etc, 48 meters from all roads, rivers walls market etc 91 meters from overhead high tension electric lines.

Detonation :—

It is a process of giving sufficiently violent shocked to the explosive to bring about at almost instantaneous are re arrengement of atom.

Detonators are mainly following type -

(i) Plane detonator or ordinary detonator
(ii) ordinary electric detonator
(iii) delay detonator

(i) Plane detonator or ordinary detonator :—

It is non electric consists of aleminium tube 6mm dia 37 - 50mm long and fit 1/3 As & and PETN

As as a prime charge (
PETN as a best charge (Pentaerythritol tetranitrate (PETN)

⇒ plane detonator is fire by safety fuse or sparks.

(ii) Ordinary electric detonators :—

- These are two types
(1) low tension detonators
(2) high tension detonators (Not use for mine)

⇒ ordinary detonators are instantaneous type that is without only delay elements.

⇒ The priming charge and best charge are same as plane detonator that is As as prime charge PETN as best charge.

⇒ there are not fire by ignitation or safety fuse can cut by passing electric current through a fuse head.

⇒ The resistance of a low tension detonator with a long supharing table is about 7Ω.

the current of network of ignation and fuse head is 0.5 ampers and single detonator can be blasted with minimum voltage of 3.5 V.

→ continuate of circuit of low-tension of detonation. It is tested by galvano meters.

delay detonator :—

This are sub-divided by two types -

(i) half second or long detonatoin

(ii) Milli second or short detonator

→ delay detonatoin having a delay, electric and provided fuse head and primary charge.

→ delay elements consist of cupper or branch silk and bridd with antimonic and potasium permanuate in case of long delay element and red lead and silicon in case of short delay element.

→ fuse head consists of blacking material lead monomited. resences.

Operation in open cast working :—

Open cast working is provides wining minerals depositing following steps.

(i) cleaning and brush :—

Small vegitation and breassed are clean and cupputred by dozzen and tractors --- etc.

(ii) Grubbing :—

In this process whole area is clearly clean and table by scraper, road grader, dozzen etc.

(3) Scarification :-

The top sub soil are removed by ripping ripperbul dozzers, scrapers etc.

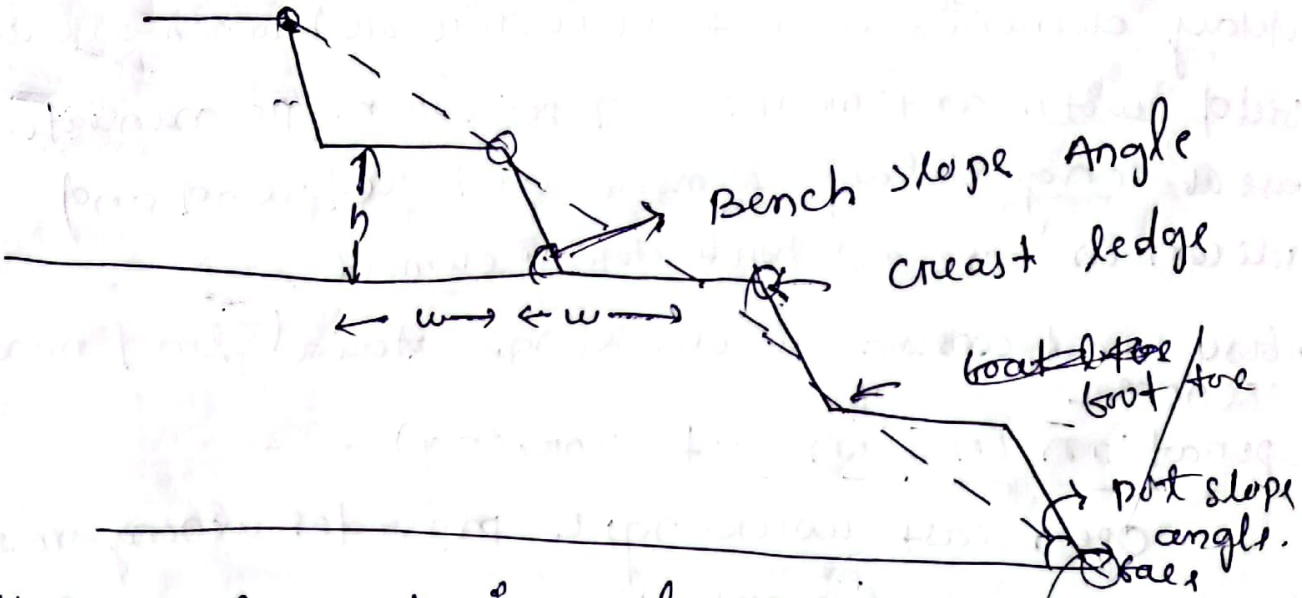
(4) Formation of trenches or box cut to open the deposites.

Preparation of minerals deposites :-

(i) Drilling (ii) Blasting (iii) Loading

Loading is mineral deposites.

~~Various~~ parameters of benches :-



width :- It is the horizontal distance betn creast point and toe.

Height :-

It is the vertical distance betn the Goaf and creast.

Face :- It is the surface area along the height of the bench Gom its full length is called face.

Crest :-

The upper side of a face of a bench is known as crest line and the various point on this line is known as crest point of that bench.

Toe / Foot :-

The lower side of a face of bench along its length is known as toe line and the various points on this line is known as toe.

Bench slope angle :-

This is the angle which the face of particular bench marckes with the horizontal is known as bench slope angle.

pit slope angle :-

This is the angle which an imaginary line makes with the horizontal and lower point of this line this are the back of lower bench and the other bench it is called pit slope angle.

* Factor effecting the hight of bench :-

(i) Method of working
(ii) Thickness of ore deposite
(iii) length of drill rod
(iv) Requirement of regulation
(v) length of the benches.
(vi) Nature of the rock
(vii) wetness of the strata
(viii) depth of the diposit
(ix) presence of plane of weakness
(x) variation of ore grade.

Factor affecting the width of bench :—

(i) Height of bench
(ii) loading Gability
(iii) Track laying
(iv) Free movement of Machine
(v) change in time
(vi) shovel loading
(vii) Separation of ore
(viii) slope stability
(ix) Manner of blasting

End

Slope stability :—

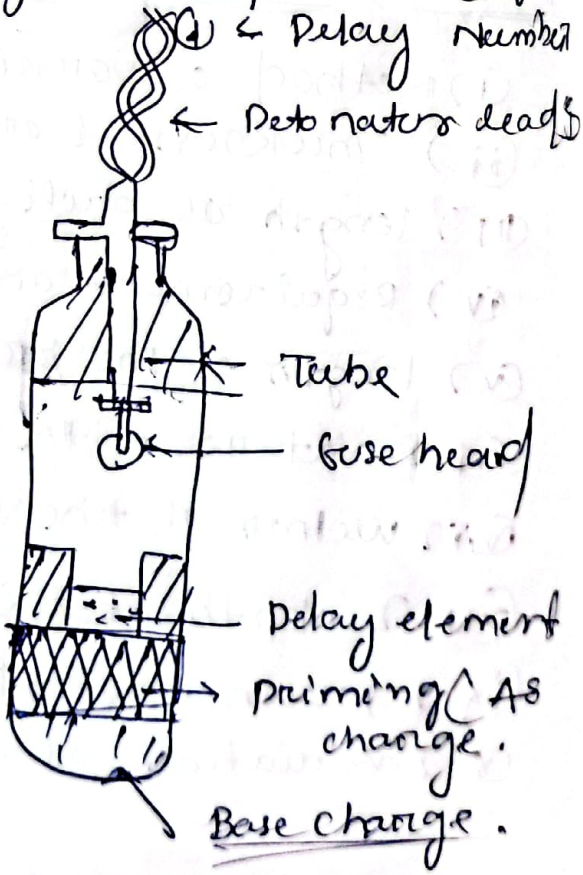
It is the slope of the excavation at which the bank of the

~~Detona~~

(Detonator)

Detonator is a small Aluminium or capper tube which containing small amount of special type of high explosive and ignited by the help of fuse or electric current.

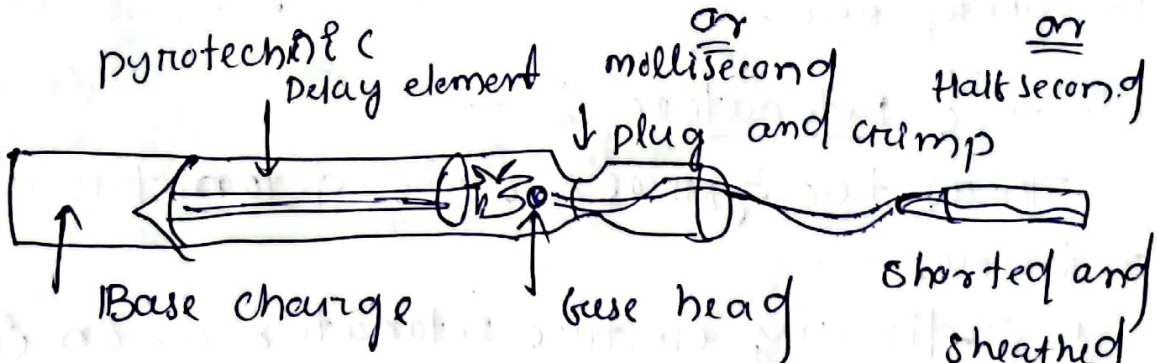
The diameter of Detonator is 6mm and length verry from 32mm to 52mm.



(In Indda, Indian detonator company manufactured 8 number delay Detonator with diameter 6.5 mm and 38 mm in length)

Detonator

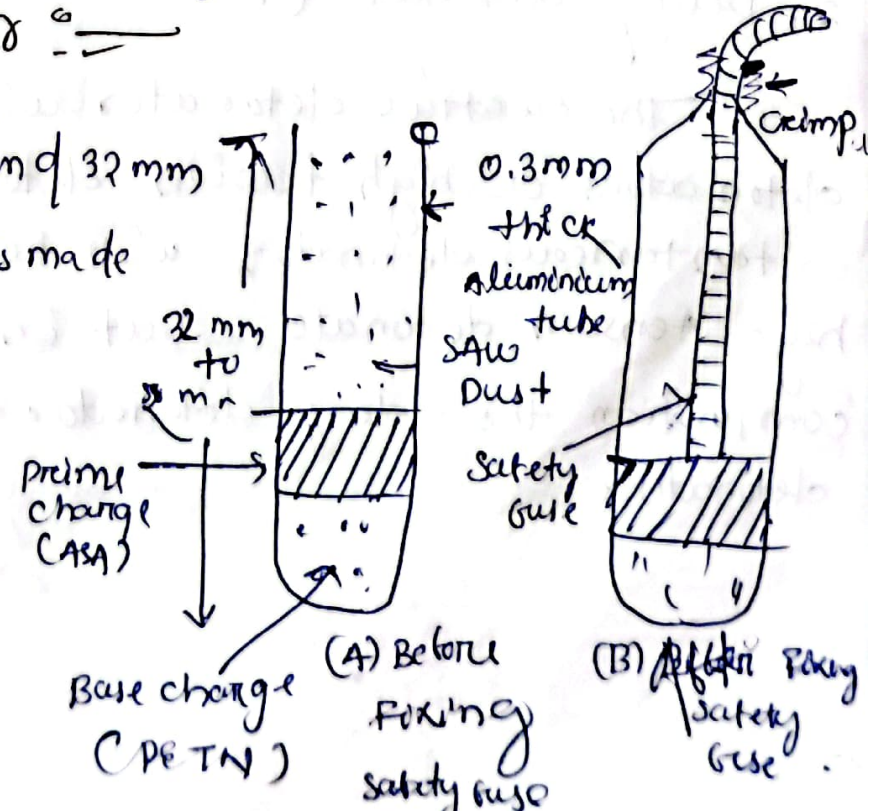
- Plane detonator (fired by safety fuse)
- Electric Detonator (fired by electric current)
  - ordinary Electric detonator
    - low tension
    - High tension
  - Delay detonator
    - Short delay detonator (or millisecond)
    - Long Delay Detonator (or Half second)



(Electric pyro delay detonator)

Plane detonator :—

It is a Aluminium tube having diameter 6mm and 32mm to 52mm in length It is made out of a 0.3 mm thin section aluminium plate closed at one end



The tube is filled with two types of explosive. I.e Base charge (PETN - (Penta - erythritol - tetra - nitrate) and prime charge A-S-A composition (The A-S-A composition consist a mixture of lead azide, lead styphnate and small quantity of aluminium powder.

The 1/3 portion of the tube is filled with A-S-A composition (0.35 gm) and PETN (0.25 gm)

The Base charge PETN present at the bottom of the tube and above the base charge there is a primedy charge (A-S-A) and the top portion of the tube is filled with saw dust., during the use of detonator the saw dust is remove by tapping before inserting the safety fuse.

Electric Detonators :—

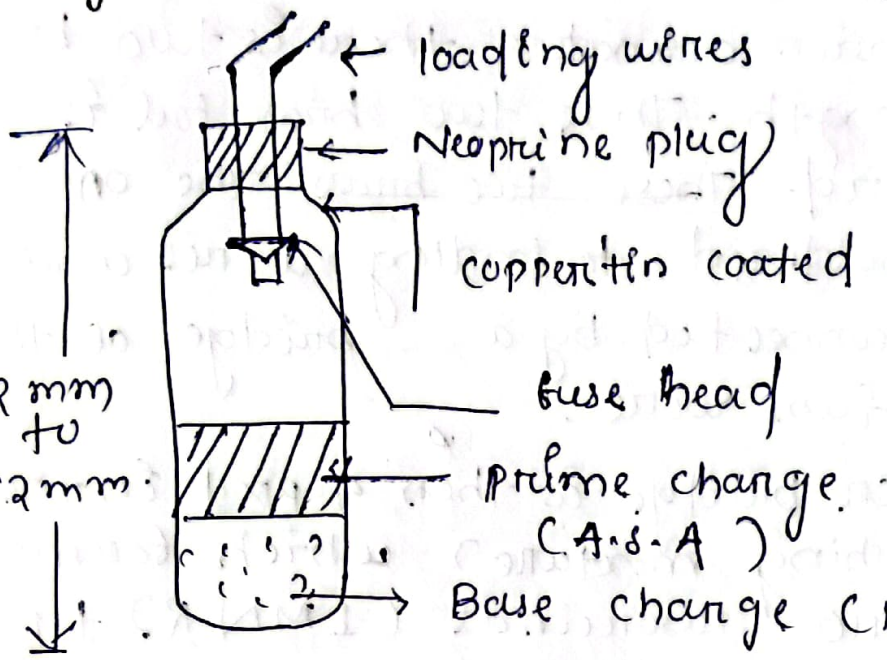
There two types of electric detonator which are as follows —

1- Ordinary electric detonator or an instantaneous detonator.

2. Delay detonator.

The electric detonator will be either low tension detonators or high tension detonator. The ordinary or instantaneous detonators will be low tension or high tension detonators. But in appearance and composition the delay detonators is like low tension detonators.

Ordinary Electric Detonator :—



In India IOL company manufactured No. 6 and No. 8 instantaneous detonator. And No-6 contain 0.30 gm of PETN while No. 8 contain 0.60 gm of PETN and the length of the loading wires is 2.3 cm 4 meter long.

The mouth of the detonator is sealed with neoprene plug (polymerised dichlor buta diene). This is a water sealing synthetic rubber with low inflammability. This neoprene plug carries two loading wires (copper) or tin coated iron wire of length 1.8 mt or more outside the detonator.

On the basis of the composition of the flashing mixture and the electric circuit used in the flashing mixture (fuse head) the electric detonator classified into two types.

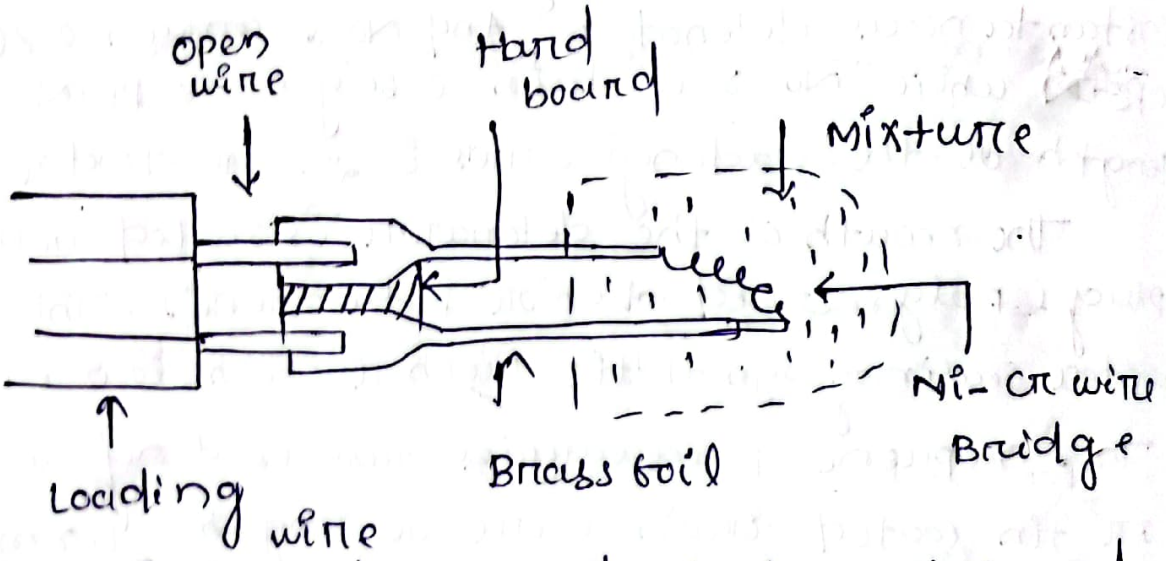
(1) Low tension electric detonator
(2) High tension electric detonator.

while the priming charge and base charge of the both detonator is same (uncharged).

Low tension Electric Detonator :—

In low tension detonator there is two brass foil of unequal length. These two brass foil is separated by hard board. ~~These two brass~~ The one end of the brass foil is soldered to loading wires and the other end is connected by a bridge of thin Nickel-chromium wire.

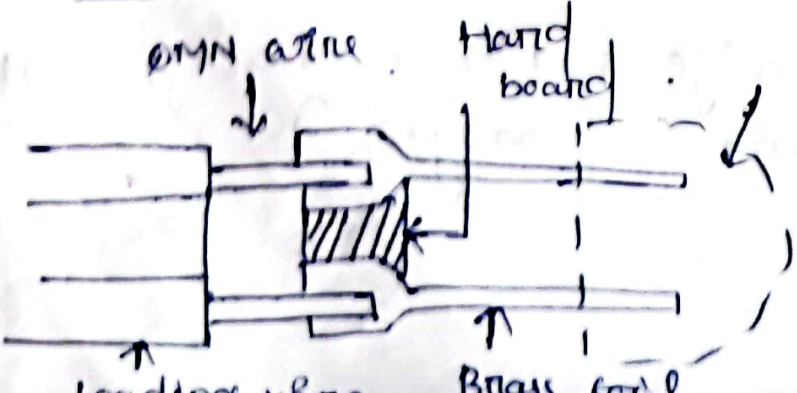
The Ni-Cr bridge is then dipped in the adhesive mixture (Flashing mixture) which formed of lead-mononitro resorcinol (LMNR) + potassium chlorate + charcoal + colloidal cotton.



The globule is formed around the brass foil and the bridge.

The internal resistance of the circuit including internal resistance of the loading wire is less than 1 ohm and the current required for the blasting is 0.5 amp.

High tension Detonator :—



In high tension electric detonator there is two brass foil of equal length, the one end of these brass foil are soldered to leading wires end, and another end of the brass foil is open.

There foil is separated by hard card board, The open end of the brass foil are dipped in the flashing mixture

In this case the flashing mixture contains lead mono-nitro-resocinol (LMNR) + potassium chlorate + charcoal + Nitro cellulose + graphite powder and cupper acetylide.

The graiphite powder used in the Flashing mixture act as a semi-conducting medium or chemical bridge betn the ends of the two brass foil in the flashing mixture.

(Imp)

The different betn high explosive and low explosive

High explosive :—

⇒ The chemical explosive compound are used high explosive and there are mechanical Mixed.

⇒ The detonators are required for blasting as blasting to Impact or shocked wave.

⇒ There is very high speed of de-composition of chemical compound.

⇒ There suddenly rise of temp. due to Elem of detonation and its propagation through to explosive

⇒ pressure blst sudden as the gases from due to de-coroposition are large in volume and sudden.

⇒ Due to sudden rising pressure the explosive has the shattering effect (60 to 80)
→ The velocity of detonation is few km/s.
↳ It is fire by detonator.
⇒ In the fragmentation and the dust formation is more.

Low explosive :- (MP)
→ It is a Mechanical mixture but each ~~compound~~ component not explosive in self.
→ The blasting is carried by firing the fused by ignition.
⇒ There is slope decomposition of reaction of component.
⇒ There is gradual rised temp as burning contaneous from to grain to grain.
⇒ The pressure belt of slow as gasses are form to the grain to grain burning.
⇒ Due to gradual rising in pressure as having action
→ The velocity of propagration flem for few m/s
⇒ It is fire Seatty fuse.
↳ More lumps are formed and dust production less.

Comparison of L.T and H.T Detonators :-

L.T Detonators
⇒ It is used for blasting of high explosive.
⇒ The detonator tube may be either aluminium or copper.

H.T Detonators
⇒ It is used for blasting of high explosive.
⇒ The detonator tube may be either aluminium or copper.

⇒ It has base charge of PETN or tertryl.

⇒ It has prime charge of ASA.

⇒ It is electric detonator.

⇒ It has base charge of PETN or tetryl.

⇒ It has prime base charge of ASA.

⇒ It is electric detonator.

Contrast:-

Brass coils used are of unequal length.

⇒ Ni-cr wire bridge is used.

⇒ The blasting mixture used in this case contains LMNR, potassium chlorate, charcoal and nitro cellulose.

⇒ The internal resistance of detonators is equal.

⇒ The internal resistance is 1.25 ohms and including 30m blasting cable the resistance.

⇒ The voltage required for blasting is minimum 3.5 volt but generally 5 volt is used.

⇒ The current required for blasting is 0.25 amp.

⇒ The continuity of the circuit can be tested safely.

⇒ Both the loading wires are white.

⇒ Brass coils used are of equal length.

⇒ Graphite poweler act as semi conductor.

⇒ The blasting mixture used contains LMNR, potassium chlorate, charcoal, nitro cellulose with copper acetylide and graphite powder.

⇒ The internal resistance of detonators is not equal.

⇒ The Internal resistance is 1500 to 3000 ohms. The resistance of the blasting cable comparatively negligible.

⇒ The voltage required for blasting is 50 volts.

⇒ The current required for blasting is 0.025 amp.

⇒ The continuity of the circuit can be tested.

⇒ One the loading wire is white and the other loading wire can be red.

Permited explosive :—

The permited explosive is the explosive manufactured such Grm and of such type which the Director general of mine safety specifies in the official gazette Grom time to time.

Two tests are carried of the explosive for notifying the explosive as permited explosive. The normal charge of the explosive used in test 794 gm of high density, high explosive or 510 of low density high explosive.

(1) Coal dust test :—

A normal charge of explosive is placed in shot hole. The shot hole is stemmed and it is fired in coal dust having the specification that volatite matter content in coal dust as 36% and 80% of coal dust pass through 200 mesh sieve. when shot is fired there is no ignition of coal dust.

(2) Gas test :—

A normal charge of explosive is placed in the shot hole. A stemmed and an unstemmed shot hole is fired in the air containing 9.8% of methane gas (CH_4). The charge of explosive is not capable to ignite methane gas air mixture.

The explosive is notified as permitted explosive when the standard charge of explosive is not capable to ignite coal dust and CH_4 air mixture under the above two tests. This explosive is written as I.P.I The permitted explosive has very short duration of flame. The duration of flame is less than 1/1000 second.

secondarily the temp of detonation of these explosive is has been considerable reduced. The product of temp of detonation and duration of flame is always kept very small. Due to this small product, the ignition temp of coal dust or city air mixture is not reached. the shot is fired without and danger of ignition. ~~the shot is fired or~~ The product of temp x time is kept low by addition of cooling agent. The instimate mix of cooling agent. is made in the explosive cooling agent absorbs heat during its de composition and the temp of detonation is lowered.

The excess of cooling agent mixture in high explosive is avoided as it makes the explosive insensitive to detonation. Any one of the cooling agent is mixed in high explosive. The lag on ignition is the diff. in time betn time required to ignite the mixture and the actual time of duration of flame. Thos lag on ignition is kept as maximum as possible to make the use of explosive more safe in gassy or dusty mines.

Uses of permitted explosive :—

(1) In gassy mines :— under regulation all mines of coal are declared as gassy only permitted explosive is required to be used in all coal mines.

(2) when any part of mine or section is on fire, the fire may be sealed or not.

(3) In all dry and dusty mines.

(4) and all places where there is possibility of liberation of gas due to blasting as in case of ~~faulted~~ fault planes.

The following types of permitted explosive are used in mines as per the classification by D.G.M.S

(1) permitted explosive - P_1 type
(2) sheathed explosive - P_2 type
(3) equivalent sheathed explosive - P_3 type
(4) extra safe explosive - P_4 type
(5) Explosive of solid blasting - P_5 type

The P_1 explosive are recommended for the use in degree of gassy mine. The explosive recomended are monodyne godyne, Endo coal-1, Ajax-G, vikeng-6, permatio-1, praehand-L etc.

Sheathed explosive :— (cartridge- ... coat - ...)
The sheeathed explosive are catagorised as P2 Explosive in D.G.M.S notification - These are high Explosive. The explosive cartridge is surrounded by sodium bi-carbonate ($NaHCO_3$). An adhesive coat of sodium bicarbonate is prepared. A coat of 3mm thickness is given around high explosive cartroyge except ends care is taken that there is uniform and continous coat without any gap or crack. when such cartridge is formed, it is wrapped in waxed paper, for the use. It's detonator is always more than normal cartridge. $NaHCO_3$ liberates $2NaHCO_3 = Na_2CO_3 + CO_2 + H_2O$ Cendo-thermic reaction CO_2 and H_2O as the temp. decomposition at 70°C to 120°C It absorbs heat during decomposition. Due to liberation of the there is further lowering of temp. of detonation. while CO_2 formed during decomposition covers the flame of explosive CO_2 gas is incombustible. This gas does not allow the flame of Explosion to come in direct contact of surrounding air.

incombustible -

Hence this explosive is more safe. It can be used in mines of any degree of gassiness. This explosive is not manufactured in India.

Advantages :—

(1) This explosive is very safe.
(2) It is safe even in blasting of hole where gas is coming through crack.
(3) It is safe even the hole is blown out.
(4) $NaHCO_3$ absorbs heat during decomposition.
(5) The sheathing material has cooling effect on flame (आग)
(6) CO_2 formed due to decomposition form a blanketing cover around the flame of blasting.
(7) Sensitivity of explosive is not affected as sheathing is around the cartridge of explosive.
(8) Efficiency of explosive is unchanged.
(9) less noxious gases are formed. (noxious = हानिकारक)
(10) Percentage of dumpy coal is more and dust formation is less.
(11) The weight of sheathing is not included in the explosive.

Disadvantages :—

(1) Diameter of cartridge is more so special drilling is required.
(2) cost of explosive is more.
(3) sheathing may cause in complete detonation.
(4) The sheathing effect is lost of the sheathing is ~~cracked~~ cracked.

precaution observed from the use of this explosives are:

(1) Do not roll the explosive cartridge.

(2) Do not open the end cartridge to insert the detonator. Always use pricker.

(3) Do not bump or drop the explosive from height any crack developed in the sheathing will be the flame to come indirect contact of atmosphere surrounding it without blanketing and the purpose of sheating is lost.

Equivalent sheathed explosive :—

These are P3 type of permitted explosive. In this type of explosive inert material is direct mixed with high explosive. In this explosive the explosive NaCl and Ammonium nitrate NH_4NO_3 or $NH_4Cl + NaNO_3$ are intimately mixed. These explosive are as safe as sheathed explosive.

The permitted charge of explosive is 1020 gm. The heat produced by explosive is partially consumed by the cooling agents from their decomposition. Thus the temp developed by explosive is lowered by cooling agents. The explosive is thus safe for use in gassy mine.

permitted explosive	equivalent sheathed explosive
⇒ polar Ajax, polar viking hydrobes, dinitrex are gelatinized N.G. type of permitted Explosive.	⇒ Equivalent sheathed are unigel, pentagex, deperex or gelatinise nitro glycerine type.

(4) while unisark unigex, penex are equivalent sheated explosive of powder nitro glycerine type.

(5) The explosive unirend, Tolumite are powdery non NG type of equivalent sheathed explosives. These explosives have ammonium nitrate and TNT base the

P3 type of explosives are permadyne, Indocoal-3, unisaal G, unigrout G, permomatle-3, Prrogal ph No. 1. These explosives are suitable for degree-I and II gassy seam while some of them are suitable to all degrees.

(4) Ultra Safe Explosive :-

These explosives are P4 type of explosive. These explosives are safer than sheathed explosives, These explosives contain more of cooling agents, and combustible matter. In this type of explosive fine powder of NaCl and fine powder of nitre chalk are used in nobbel no. 1235. This is not produced in India. It can be used in highly gassy mines for a long period the machine out was made necessary for the use of permited types of explosives. Now new series of explosive of P3 type are developed and manufactured. These explosive can be used in coal mining for solid blasting. The explosives of this type are pensadyne, safegex, solimex and prachar No. 5 These explosives can be used in any degree of gasiness of mine These are safe series of explosive.

Properties of explosives considered areas below :-

① Density :-

The density of the explosive is the important property which is considered for the selection of explosive. The energy of the explosive is concentrated at back of the hole as the high explosive is concentrated energy is prepared for break the hard rock such as in tunnelling and rock drives and mining in metal mines. while a low density explosive

will occupy the longer length of shot hole. The energy is distributed along the length. This reaction in giving the pump coal which is always required in coal mining.

② Strength :—

It is the measure of amount of energy given by or any explosive on detonation to do the useful work. The weight strength of any explosive is the ration of weight of blasting gelatine required to the weight of the given explosive to produce the same strength or energy. The bulk strength denotes the strength compaired with an equal volume of blasting gelatine, Blasting gelatine is taken as base.

③ velocity of detonation :—

It is the rate at which the detonation wave passes through the column of Explosive. It is important as the energy of detonation increases rapidly with the velocity of detonation. The shock energy does the useful work when the explosive is not confined such as in case of plaster shooting.

④ water resistance :—

Some of the explosives are affected largely due to contact of water and they fail to explode when detonated. But other Explosives are not affected by direct contact of water. They stand for long time still they are unaffected by water presence and are selected for blasting in wet condition. But ammonia based explosives are hydroscopic hence they are used in dry condition.

(6) Sensitivity :—

The explosive are required to stand rough handling friction and shock during handling and transport they are required to be insensitive to friction and rough handling. But at the same time they are required to be very sensitive to detonation. The detonation wave must travel from cartidge to cartridge even through there remain a short gap betn them.

(8) Oxygen ballance :—

The explosive will be combined to shot hole It will be out of contact of air. The explosive used must be capable to supply sufficient fress oxygen so that there is complete combustion of the combustible compound used on the explosive on complete combustion, the strong explosive wave will be developed to do the useful work, the amount of harmful gases given by the explosive will be minimum of the detonation is complete.

PMS - (Plant mixed slurry)

SMS (Size mixed slurry)

Bulk Explosive :—

Direct Deliver the blast hole through mechanise or mobile deliver system supply to large open cast mining and civil construction.

⇒ Annual explosive consumption 2000 ton.

~~ANFO~~

Bulk watergen

Bulk emulsion

HANSF (Heavy ammontum nitrate sulphide Hard)

Bulk slurry

Advantages :-

=> less hand power
=> It having safty wise good
=> Explosive product
=> Heighly production
=> Blasting efficiency is very good.
=> speed operation.

Condition to use Bulk Explosive :-

=> changing and firing by technical export.
=> Minimum no. of persons.
=> No spllage explosive wide conteing
=> proper requads of changing and firing.
=> Drilling should be complete taking up changing.
=> observed the generals briquation and relavan to the size.
=> No smoking with 3 meter of side
=> Area of charge hole marked by red flag or red light.
=> stend Imidealty after the changing.
=> collar area of hole should be covered the soft material.

permitted explossive :-

The explosive is capable of igniting fire dame or cool dust explosive and can be used under ground mine is known as permitted explosive.

Name of the explosive	type of explosive	Brand or company
P1	permited or un sweathed explosive	~~ASKRR~~ Agast-G, vitoking-G, inodyne
P2	non-permited in under ground (sheathed explosive)	non manufacturing in india
P3	permitted or (equivalent sheathed explosive)	~~unisdeag~~ (unisal-G) Permodyne

Py	For special purpose	non manufacture in India
P5	solid blasting Explosive	solized > Permadyn (slurry explosive)

Characteristics of Explosive :—

The characteristics of various type of commercial explosive with respect to velocity of detonation (VOD) composition burn size.

Drilling :—

Drilling pattern for blasting of coal or rock depends the hardness of coal/rock and the type of blasting. so

Pyramide cut :— (The short holds are inclined towards the centre as to appere to melt point create blasted pyramide.

Wedge cut :—

→ Fan cut
→ burn cut
→ Drage cut
→ coarm cut
→ Ring drilling.

Drilling method and there rock cutting principle

→ Diamond drilling (rotary)
→ Percussive Drilling (Impact action)
→ Rotary roller drilling (cutting and ploughing)
→ Jet piersing (Thermal spaling)

Types of drill	Size of Drill hole	economic depth	Application
Percussive	52 to 75 mm	800 meter	soft & hot medium hardness of work
churan cable dreiling	75 to 300mm	300 to 600mm	Pressure Deposit
Diamond	80 to 200mm	100 to 2000m	Any rock formation & coast Pusher.
caliyx or Child shot	75 to 1800 m	more than 45000mm	any rock drilling hard place

Standard below the Diameter

Standard	Drill rod out side diameter	hole Diameter	Core diameter
NX/NW	67	75	54
BX/BW	54	60	40
AX/AW	44	47	28
EX/EW	35	38	21

Stripping PMS - (Plant Mixed Slurry)
SMS - (Site Mixed slurry)

Stripping ratio :-
Given the Idea how much quantity how much waste will be remove in order to get 1 unit of ore & coal.

The removal of OB is cubic meter

The removal of mineral in tons

Types of stripping ratio :—

1) volumetric stripping ratio
2) Thickness stripping ratio
3) Instantanious stripping ratio
4) Avarage stripping ratio
5) overal stripping ratio
6) Breakeven stripping ratio
7) limiting stripping ratio
8) Incrimental striping ratio

Problem :-

In an open cast mines OB handling during a year 50,000 tone and coal extracted 200,000 tone if specific gravity of over burden and coal is 2.5 & 1.5 respectively, determine stripping ratio.

⇒ Stripping ratio = $\frac{\text{Ore}}{\text{Waste}}$

OB = 50,000 tons

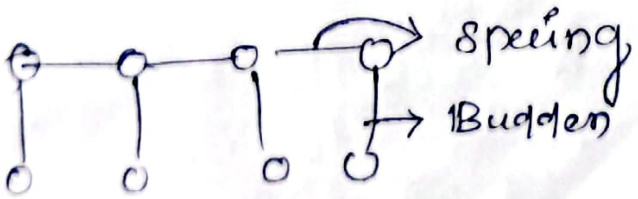
Coal = 2,00,000

Weight = volume × specific gravity

50,000 = volume × 2.5

= volume × 2.5 × 50000

SR = volume $\frac{200,000}{200000}$ (1 : 1 : SR : 1 : 1)



Blasting process :—

(1) Cleaning
(2) Drilling
(3) Primming
(4) staming
(5) charging
(6) Firing

Factor affecting designed and working of open cast mine slope angle :—

(1) Geological condition
(2) Assay value of the deposite
(3) Surface photography (open cast)
(4) Mining Equipment
(5) Economic factors of operating cost
(6) progt Margin
(7) Type of ore
(8) cut of grade
(9) Stripping ratio
(10) Hydro-Geological condition

Factor of slope stability from open cast Mines :— (slope stability)

(1) Geology of the place
(2) Hydro geology
(3) Rain fall
(4) Discontive in rock Mass and their Relative orientation
(5) Identification of continuable dis-continuities
(6) Shear testing of dis continuities.

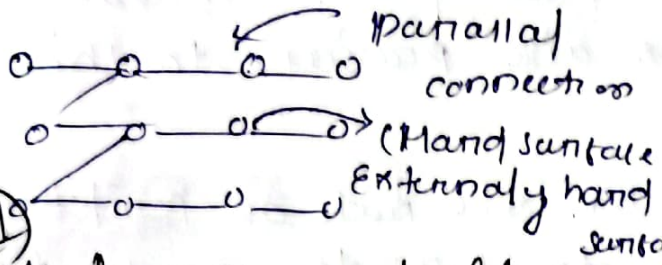
HEMM = Heavy Earth Moving Machine

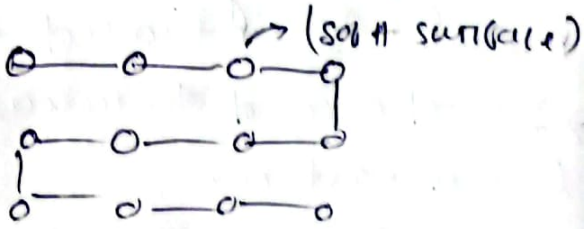
Mines are two types
(i) Spiral
(ii) Zigzack

under ground mine 2 types
(i) Shaft
(ii) Incline

Connection of Blasting

(i) Series
(ii) Parallel





(Series connection)

Jack hammer drill :- (underground) (Drilling)

=> It is normaly handhild drill used for vertically downword drilling upto depth of 8 meter.

=> Hole diameter is generally 25 to 37 mm and rarely 50 mm.

=> In a few cases Jack hammer may be mounted on air leg.

=> It is meanly used for dry drilling. also it can be adopted for wet drilling.

=> It is havier than the Jack hammer and its used extremely for metal mines and for tunnel drilling.

Stopper :-

=> A stoper is drill form drilling upword and drive its names formed its wild spread used in mine stop.

=> It is used in normaly wet drilling.

=> A driter and a stoper work on the same prinicipl as a jack hammer.

Air leg :-

=> Air leg drill is compressed air motive power drill machine.

=> An air leg essentialy a long cylinder in whicha pistol is actuated by compressed air controlled valv

=> It also used to release the air pressure to the lower piston.

=> The air leg doesn't increase the rate of penitstration or feed and its used form drift up to 2meter in height.

=> In under ground mines drilling rings or jumbo drill have to be used form high speed traverse of large size drifth.

(Drilling)

Digging or hole which in economically in the earth surface is known as Drilling.

+ Exploratory drilling :-

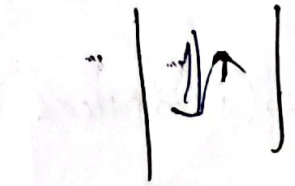
The drilling operation which the carried out to know the details of mineral depo site such as extension, quality, quantity and Geological str. is known as Exploratory drilling.

Define Core :—

The cylindrical shape of a rock cut by the drill bit known as core.

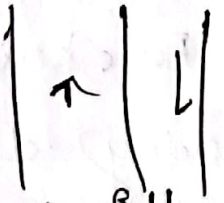
(CMPDIL) :- (central mine planning and designed Institute Limited)

Single line width :—



= 2x width of largest vehicle + 4 meter.

Double line width :—



2x width of largest vehicle + 3 meter

Types of Drill :—

There are two types of drilling

(1) Rotary drilling

(2) percussive drilling

* pattern of Blasting → Staggered pattern
→ Green pattern
→ V pattern.

* connection of Blasting → Series
→ parallel

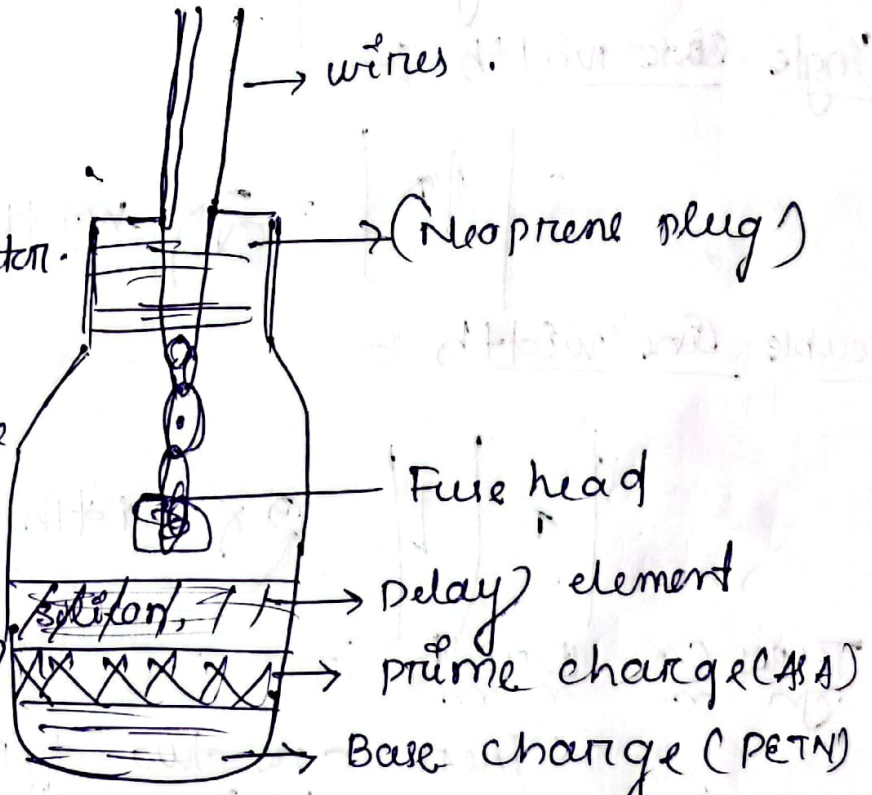
* DTH → Down The hole (250 mm)

TLD - Trunk line Delay detonator (two connection wire ft, 12, 52 ms)

Powder Factor :-

One kg of explosive produced How much of tone of coal or mineral is called powder factor.

Delay Detonators :-



⇒ Delay detonator is essentialy a low tension electric detonator.

⇒ Delay element like silicon, Bericum sulphate and Lead is inserted are placed betn the fuse head and priming charge.

Advantages of delay detonator :-

⇒ Saving of time

⇒ Availability of free face. Due to these -
- Good fragmentation
- less consumption of explosive (cost of explosive will be less)

⇒ less ground vibration.

Assosories of Blasting :-

Controlled Blasting technique as per statutory provision :—

controlled blasting :—

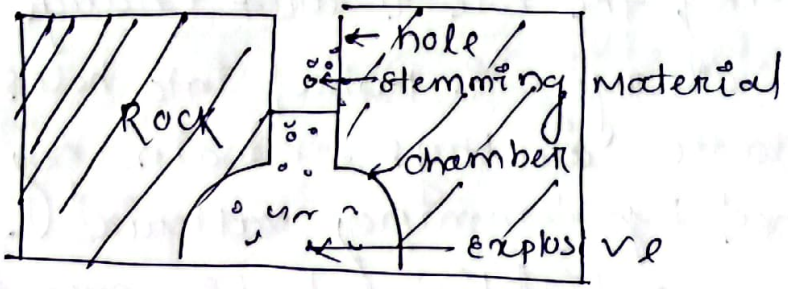
There are following types of controlled Blasting.

(i) Line drilling
(ii) Pre-splitting
(iii) Cushion-blasting
(iv) Model.

chamber blasting :—

In the normal case of blasting in high bench of o/c mining the explosive charge occupies the large length of hole & a small length of hole re-main for stemming. Resulting blow out the hole with out performing any useful work. Thus to avoid this, chamber blasting is practiced.

(8)

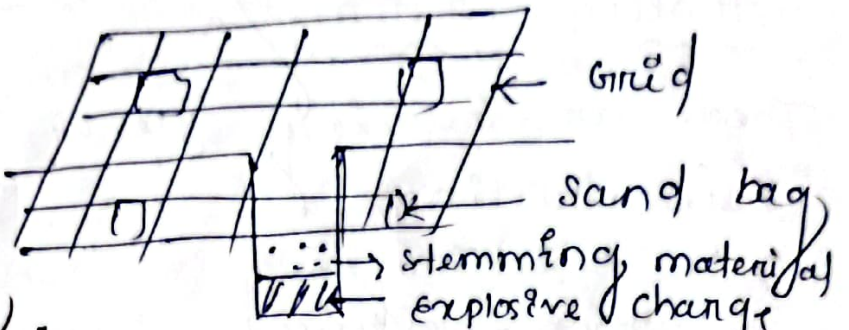


(9) Muffled blasting :—

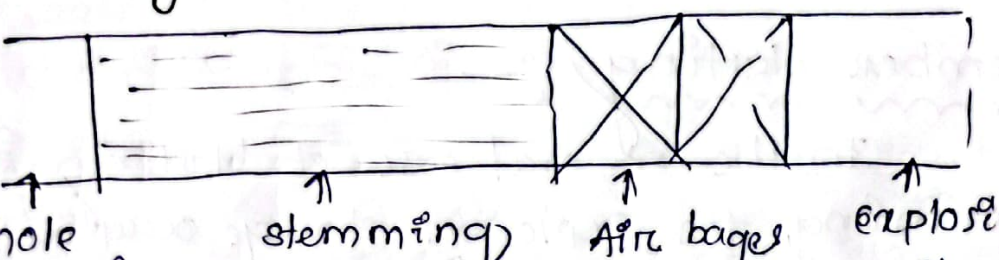
When the heavy blasting in o/c Mining is to be performed apopulated there is a chance of hitting of person by flying pieces of blasted rock. The over come this accident muffled blasting is carried out.

In this system the hole is charged and stemmed in general way. The holes are covered by the grid of steel rod. the rod is 2cm to 2.5 cm. in diameter and the distance bet^n the rod is 15 to 25 cm. The bag filled with sand is placed above the grid in sufficient number.

After blasting the grid with sand bag will not allow the fly the rock pieces.



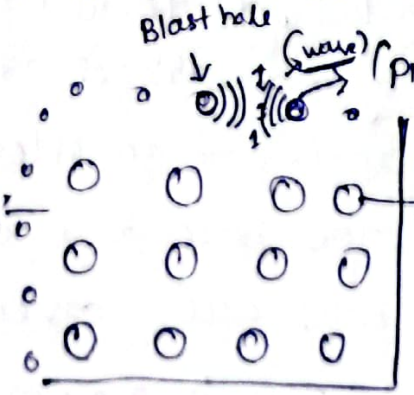
③ Cushion Blasting :—



When the aim of blasting is to get dumpy coal or to minimise the formation of coal dust, then this blasting is done. In this blasting low density high explosives are used.

⇒ In this blasting the hole is first charge with explosives. The explosive charge is pushed into holes followed by one or two plastic air bags. Remaining length of hole is stemmed by stemming Matterial. At first stemming is done lightly but in case it is done very tightly. In it air bags work as cushion blasting. Such blasting with air gas is known as cushion blasting.

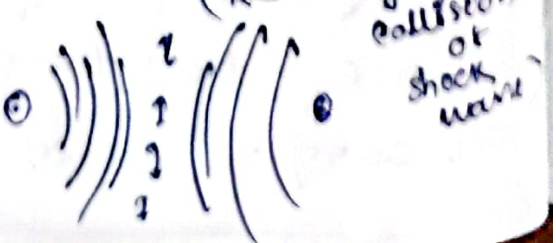
Pre-splitting :—



* A Fracture line (split) :—

⇒ Drilling of a single row of closely spaced holes dia of holes 50-100mm.

Spacing = 1 of Dia of holes.



~~Fired simultaneously~~ using
⇒ A fracture line (split) is developed along the final excavation.
⇒ The pre-split holes are fired simultaneously before main blasting using decoupled charges or low strength & low energy explosive.
⇒ Decoupled charges are available in the shape of pipes.

Theory of pre-splitting :—
⇒ when two closely spaced shot holes are fired simultaneously a fracture line is developed due to collision of shock wave.

Purpose :—
⇒ To reduce overbreak
⇒ To minimise ground vibration.

Explain PMS and SMS :—

PMS :- (Plant Mixed slurry)

The component required for ANFO and slurry explosives may be mixed at a plant away from a blasting site. In this case of plant mixed slurry. The explosives is loaded into a special tankers and from these tankers the slurry is pumped directly to the blast hole.

SMS :- (site Mixed slurry)

⇒ This explosive is not the cartridge form. The components of the explosive in liquid form in different compartments of the pump truck from suppliers plant to the mine.

⇒ It is directly through to the blast hole.

SLURRY EXPLOSIVE :—

⇒ It is a composition of TNT, AN and water in the ratio of 20 : 65 : 15

Ingredient of slurry explosive are :-

(i) oxidisers :- Ammonium, sodium, or calcium nitrate

(ii) Cross - linking agent - potasium or sodium or Sodium dichromates, antimony or boron compounds.

(iii) Gelling agent :- starch

(iv) Fuel sensitiser :- TNT, PETN, Pelolite - (All explosive) Aluminium, sugar, urea, paraffin wood pulp, (all non-explosive)

⇒ It's s.p gravity is more than 1.

⇒ It is highly water resistant and can be used directly into water holes.

⇒ The holes of dia - 62mm and above are economical from use of slurry.

⇒ The SMS (site Mixed slurry) is 15% more effective than the bulk explosive produced.

⇒ In SMS of the slurry explosive one pump - truck charge need 25000 kg of m in one shift.

⇒ Life of slurry explosive is 1 year but it is use within 4 month from the manufacture.

⇒ Standard safety tests for slurry explosive,

(i) Burning test,
(ii) Friction and impact test.
(iii) Impact sensitivity
(iv) Rifle bullet test
(v) sensitivity of flame head test.

⇒ Also available in the form of cartridge & can be used in UG Mines.

⇒ The slurry explosive is highly water resistant.

⇒ The slurry remains in intimate contact with the walls of blast holes and this results in effective utilization of the explosive.

⇒ They have low non-toxic fumes and do not cause headache.

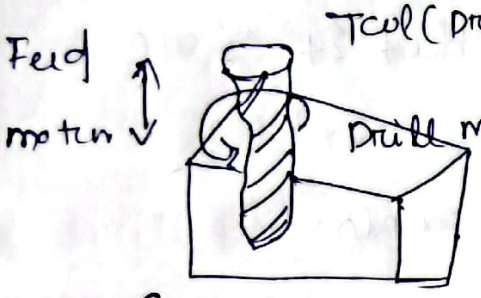
⇒ The best performance of slurry explosive manufactured by most of the companies is four months from date of manufacture.

DRILLING :—

Digging in the hole which is economically in earth surface is called Drilling.

Principle of Drilling :—

It is a process of producing holes with the help of a multiteeth tool known as drill.



⇒ The basic principle of a drilling Machine shows that a rotary as well as reciprocating tools as drill removes excess material of produce hole in a stationary workpiece.

⇒ Drilling by downward thrust :—

⇒ It is mainly used in rotary drilling. The weight of drill creates the hole by shear force, breaking the tensile strength of rock.

⇒ the energy is transmitted by rotational torque in the drill rod.

⇒ Material of drill bit :- Tungsten carbide or carbon steel.

Drilling by hammering impact :—

⇒ This type is applicable in percussive drill.

⇒ Energy is generated by pneumatic or hydraullic rock drill.

Exploratory drilling :—

The drilling operation which is carried out to know the details of of Mineral deposite such as extension, quality, quantity and geological etc. is known as exploratory drilling.

Types of drills

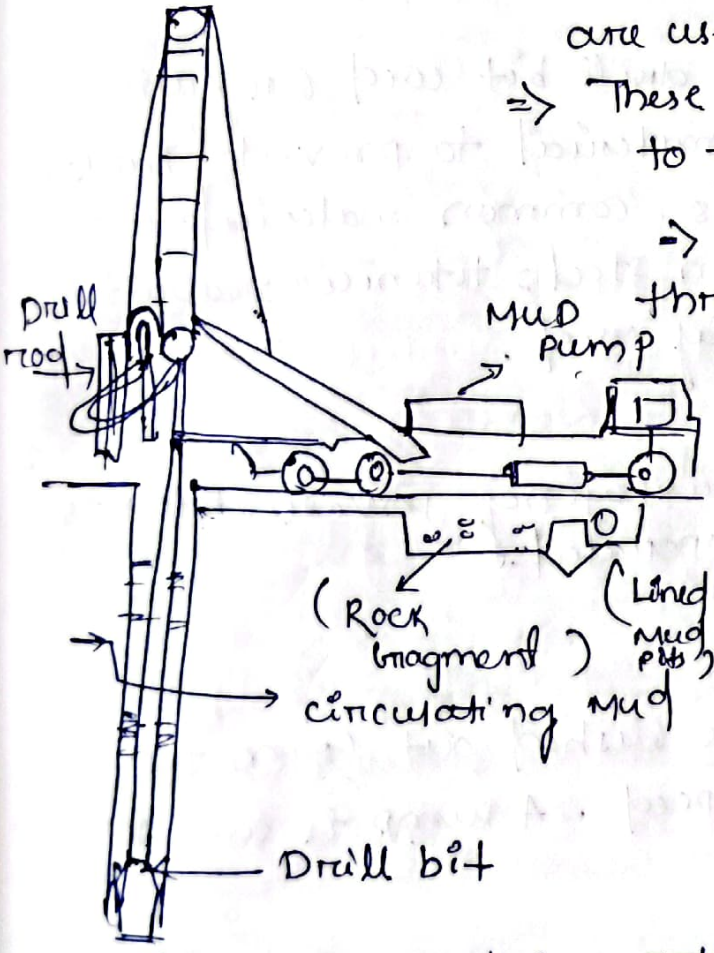
1. Rotary drilling
2. percussive drilling.

① Rotary drilling :—

⇒ Hollow drill rods of steel or aluminium are used.

⇒ These rods are connected and feed pressure to the drilling bit.

⇒ Rotation of the drill rods is through gearing driven by a prime mover at the surface. (engine)



⇒ As the rods rotate, the drilling bit abrades the rock & the cuttings are cleared by pumping water under pressure or compressed air down the hole through the hollow rods.

⇒ It is mostly used for getting the core of rock to find its property such as streangth, load bearing capacity, porocity etc.

ARRANGEMENT OF ROTARY DRILLING :—

In rotary drilling following equipment are used :—

* Drill Rod :—

It is a hollow rod and made of steel or aluminium. Aluminium rods offer numerous advantages, such as increased machine capacity, easier handling, more rapid and simple recovery of the drill rod and faster rotation. Drill rods are found in pieces which may be connected by coupling or thread. It transmit torque and feed pressure to the drilling bit.

* Drill Bit :—

⇒ There are various types of drill bit used for cutting rock. It is made of different material to provide hardness according to the requirements. common materials used to make drill bit are carbon steel, titanium, cobalt steel etc. Diamond bits is mostly used.

* prime mover :—

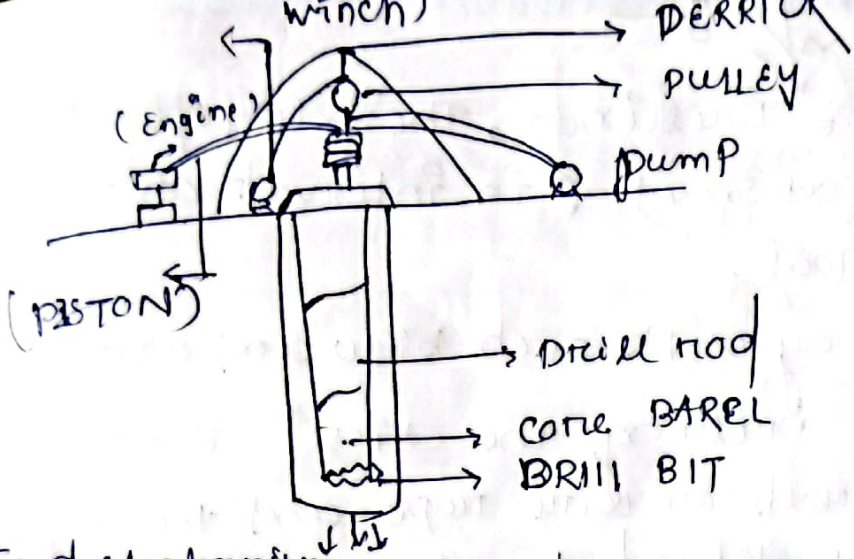
An engine is used for supplying power which is diesel operated or electric operated.

* pump :—

⇒ The cutting of the rock are flushed out from the hole by water entering at high speed. A pump is used for supply of water.

* Derrick :—

⇒ It is a iron frame work consisting tripods which holds the drilling machine including drill rod & other attachments.



Feed Mechanism :—

It is a mechanism which controls the speed of drill rod and rate of advancement into the rock. There are two types of feed mechanism.

1. Screw feed mechanism
2. Hydraulic feed mechanism.

* Core Barrel :—

It is a device used for collecting the core of the rock drilled. The length of core barrel varies from 0.5m to 3m.

Types of core Barrel.

① Single tube core barrel :—

A single core tube barrel is suitable for homogenous formation where core is not eroded by flushing water and solid core can be taken without risk of blockage of barrel.

② Double tube core barrel :—

It consist of two tube known as outer & inner tube. Inner tube holds the core & doesn't rotate during operation. water doesn't flow through the inner tube but it passes through the space bet^n inner & outer tube.

③ Percussive Drilling :—

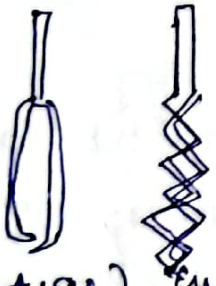
⇒ It is the oldest one of Drilling, the hole is Drilled by striking A Number of short in intervals on the Rock by a chiesel-Type Tool.

⇒ The Rock is chipped Away with each blow and a circular hole is formed. During Drilling the chiesel is suspended from the Surface by rods or wire rope and the weight of the chisel, Rods, etc, It utilised to give striking force.

Drilling by Rigid Rod :—

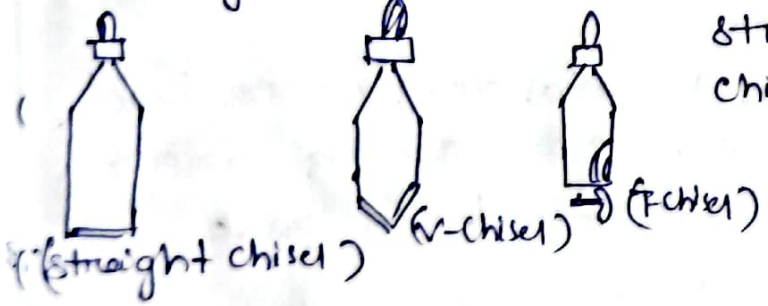
The rods are Ni-cr carbon steel. Each rod has a male crew at one end and female screw at the other. steel rods are usually lengths of 3m with nearly 38mm x 38mm square cross section.

⇒ The drilling tool used various greatly in shape and cutting edge according to the type of ground penetrate.



(clay Auger) (worm auger)

⇒ For soft Surface Deposits which consist of Alluvium, clay Auger and worm Auger may be used. These are given a rotary rather than a percussive motion. The straight chiesel commonly used for hard strata and the 'V' chisel and 'T' chiesel For very hard strata.



(straight chisel) (V-chisel) (T-chisel)

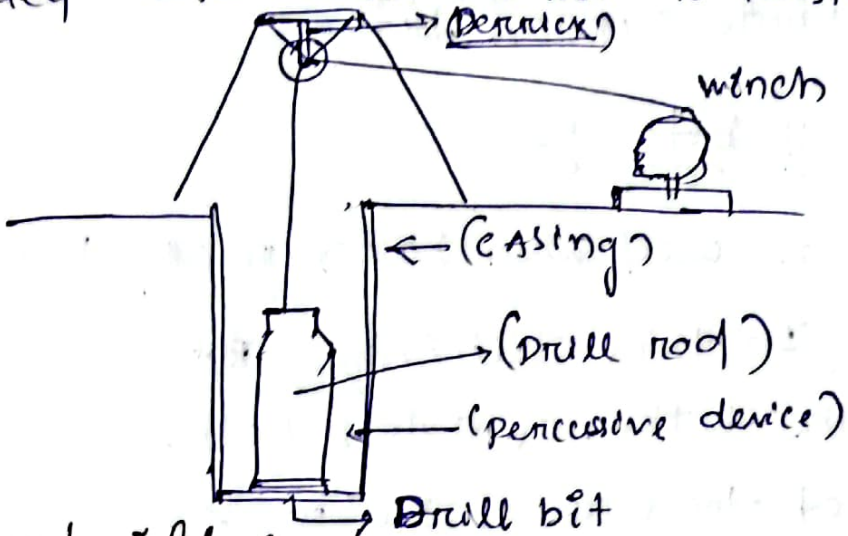
⇒ Every type of Drilling Require a Derrick which may consist of three or four legs And may be of wood or Tubular steel. It is used for Lifting the Rods from the hole with the AID of Drilling A winch.

Rope or Cable Drilling :-

The percussive Method of Drilling is employed cable drilling is commonly Adopted for holes Deeper than 30m. In this system the Rigid rods are replaced by a steel wire rope to which the Drilling tool is attached. The surface arrangement is practically the same as for drilling with rods.

Cable Drilling is also called Churn drilling.

During Rope drilling no device is Necessary to give a twist to the drilling tool b.tn successive Blows as the lay of stranded rope causes the tool to twist slightly.



Churndrill :-

The churn drill is a large drilling machine that bores large diameter holes in the ground.

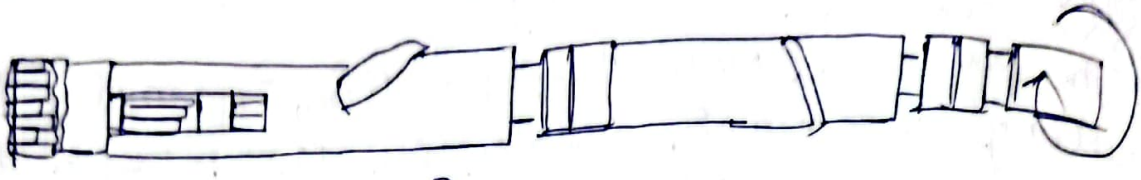
In mining, they were used to drill into the soft carbonate rocks of lead and zinc.

Churn drill is depth in 10 to 90m.

Churn drill is slow process.

DTH (Down the hole drilling) :-

Basically a mini jack hammer screwed on the bottom of drill string. The DTH hammer is one of the fastest ways to drill hard rock



(DTH)

Types of Drill bits :—

1. Diamond drill bits
2. Saw toothed drill bits
3. Rock Roller drill bits
4. Chilled steel shots
5. Tungsten carbide Tipped bits.

(1) Diamond Drill bits :—

=> These drill bit is used when hard rock to be faced during boring. In this drilling diamond pieces are placed at the bottom of a steel shell.

=> It is used to collect the core of the rock.

~~Tungsten carbide Tip~~

Tungsten carbide Tipped Bit

=> These bit is used for drilling a hole of dia 3mm to 25mm.

=> In this bit, the steel tooth is coated with tungsten carbide.

Saw-Toothed drill bit :—

=> The drill bits are suitable only for drilling through rocks of medium hardness only holes of diameter not less than 150 mm are possible.

give necessary clearance.

⇒ The speed of rotation is only 5 to 10 rpm.

ROCK Roller drill bit :—

⇒ These are suitable for hole diameter bet^n 75mm to 200mm.

⇒ In mining areas these are commonly used for drilling large diameter holes in mechanised quarries.

⇒ Flushing of the hole with compressed air instead of by water under pressure is the common practice with this type of bit.

⇒ Rock roller bits can be used for deep hole drilling with speed and suitable for mostly vertical downward holes.

CHILLED SHOTS DRILL BITS :—

⇒ These shots are prepared by very finely divided steel particles to a very high temp. and then suddenly cooling them in ice.

⇒ These bit is used for semi hard rock.

⇒ These bit is not favored these days as diamond drill bits have gained wide popularity.

(SLOPE STABILITY)

It is the slope of the excavation at which the bank of the ~~excation~~ excavated area will extent safety through it life till the mineral body fully extracted. It is the factor of safety of the slope angle. slop angle is the main factor of the slope stability.

The slope stability is depend upon the following factor.

(i) Height of Bench
(ii) width of Bench.

Factor affecting slope stability :—

1. Geology of the place
2. Hydro geology
3. Rain fall
4. Discontive in rock Mass and their relative orientation.
5. Identification of unfavorable dis-continuities
6. Shear testing of dis continuities.

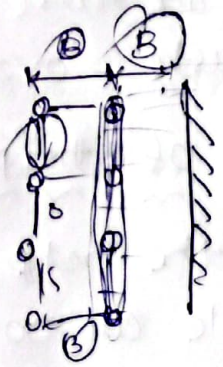
ANFO :—

=> Ammonium nitrate + Fuel oil (Diesel)
(NH4NO3)
=> used in large scale.
=> specific gravity 0.8 to 1.0
=> wt. strength - 75 - 80
=> VOD = 3500m/sec
=>

SLURRY EXPLOSIVE :—

=> with jelly like substance and water gels.
=> water gel - mixture of an oxidiser & fuel sensitizer in aqueous medium, thickened with a gum and gelled with cross liking agent.
=> In permitted explosive - coolent is added to reduce insensitivity (less sensitivity)

Burden(B) and Spacing(S) :—



Burden (B) :—

Burden is the minimum distance from the axis of the blast hole in free face.

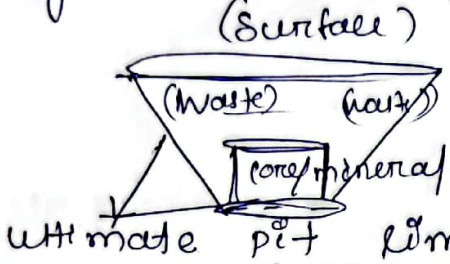
Spacing (S) :— Distance bet^n 2 adjacent holes in a same line or row,

Fragmented Rock volume :— (Burden x Spacing x Bench height)

Stripping Ratio :— (1m)

→ Stripping ratio can be defined as, "It is the ratio betn waste & ore/minerals.

$$\text{Stripping ratio} = \frac{\text{waste } (m^3)}{\text{ore/mineral } (m^3)}$$



→ Stripping ratio indicates that "how much of OB to be removed for 1 tonne of ore/mineral.

Over burden (OB)

→ Over burden is the natural soil and rock that lives above the ore/mineral deposits.

Inter burden :—

→ Inter burden is the natural soil and rock that lies betn two or more ore/mineral zone.

[waste - overburden + Inter burden]

Benefits of stripping ratio :—

→ With the help of SR we can find whether it is profitable or not to do surface mining method

→ SR is basic parameter to define the economic limit of surface mining.

Types of stripping ratio :—

1. Volumetric stripping ratio.
2. Thickness of stripping ratio.
3. Instantaneous stripping ratio.
4. Average stripping ratio.
5. Overall stripping ratio.