GEOLOGICAL FIELD TRAINING

AROUND

KORBA (GEVRA OPEN CAST MINES) C.G.

Submitted By

Ku. Kiran kanwar

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PROFESSOR IN CHARGE
S.K. CHANDRAKER

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CHAPTERS

3. GEVRA COAL FIELD (OPEN CAST)

1. INTRODUCTION

1.1 Aim – our aim are learning how to work in open cast coal mine like mining, chemical analysis and environmental management at SECL. Gevra (Korba).

The training was conducted to acquaint with practical aspect in a field. Under training we learnt about preparation of mining plan, ore reserve, grade estimation, drilling and collection of coal samples.

2.0 KORBA COAL FIELD

2.1 INTRODUCTION

Coal, the black diamond is the back bone of industries. Out of the several reliable resource's for producing energy such as petroleum, natural gas, solar energy and atomic energy, coal is considered as one of the most important resource of energy as it is outstanding amongst all other known resource due to its abundance and easily availability for human use.

In Indian economically exploitable coal resources occur in two stratigraphic horizons.

1) The Lower Gondwana Coals.

2) The Tertiary Coal.

Korba coal fields belongs to lower Gondwana Coals, It is the belt located in the South Central part of the vast stretch of lower Gondwana Sedimentary basin of Son-Mahanadi Valley. It occupies a transitional position between the drainage areas of the Son and Mahanadi rivers. The Barakar Coal measures of the Korba Coal Field are continuous with that of the Mand River basin to the east through the intervening area covered by Kamthi beds. Northward, an extensive stretch of Talchir sediments link this Coal-field with the Hasdeo Arand Basin. A narrow strip of Barakar, rocks also connects the Korba Coalfields with Hasdeo, Ahiran towards east. Thus the Korba, Hasdeo, Ahiran and Mand, Raigarh Gondwana areas form a master basin in the upper reaches of Mahanadi Valley, and have more or less similar tectonic sedimentological history. Nevertheless the Korba basin has gained greater importance because of the large reverses of coal of both superior and inferior quality in comparison to the adjacent basins

KORBA	
--- City ---	
Location of Korba in Chhattisgarh and India	
Coordinates	22°21'N 82°41' E 22.35°N 82.68°E °20
Country	India
State	Chhattisgarh
District(s)	Korba
Population	12,06,640 (2011)
Time zone	IST (UTC+5:30)
Area	
• Elevation	• 252 meters (826ft)

2.2 GEOGRAPHY

Korba is located at $22^0 21'$N $82^0 41'$ E 22.35^{0}N 82.68^{0}E. It has an average elevation of 252 meters (826 feet).

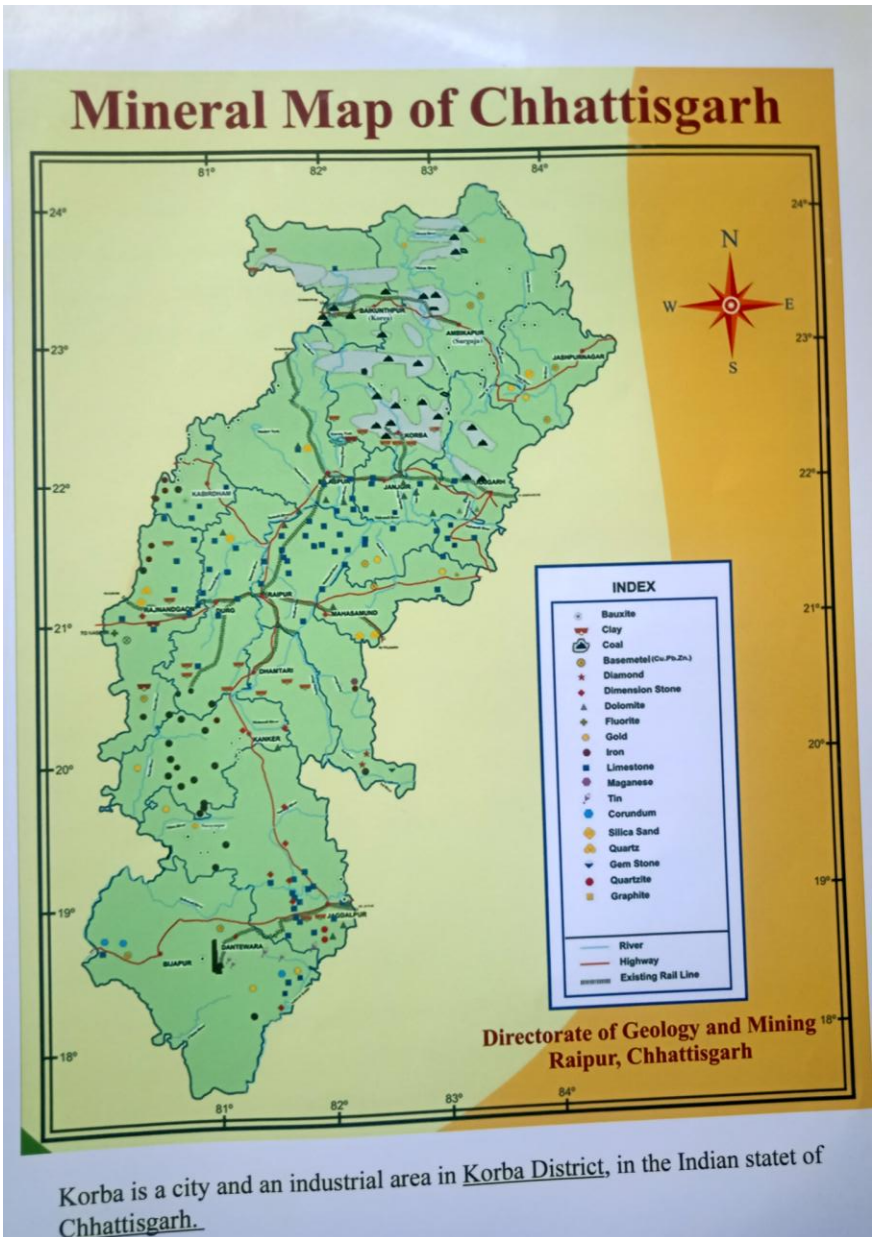
Korba (population 501568) is a center of Korba District in the newly formed state of Chhattisgarh, India (Nov. 1, 2000). It is situated at the confluence of the Hasdeo and Ahiran rivers. Located at $22^0 20'$ North Latitude and $82^0 42'$ East longitude, with a height of 304.8 meter, above sea level. It is the major source of electricity in Chhattisgarh. It is Also Famous for BALCO, (Bharat Aluminum Corporation) which is one of the Asia's largest aluminum production industries.

Korba city enjoys varied climates and weathers. Korba and Champa are well known for "Kosa", a special variety of silk used for producing one of the best qualities of cloth in the world. Being light in weight and having shiny glaze, it is used to make Kurtas, Sarees, Shirts, Salwar-Suits and other garments for party as well as casual wears. Korba is also famous for "Korva tribes.

Other large towns in Korba district are Kartala, Katghora, Pali and Chhuri.

2.3 LOCATION AND APPROACHABILITY

The Korba Coal-fields are situated entirely within the Korba Dist. of C.G. It is 250km from Raipur in the North east direction. It is connected through Bombay Howrah route of South Eastern railway. It is bounded by $22^0 15'$N and $22^0 30'$ N latitude and $82^0 15'$E and $82^0 55'$E longitude



Korba is a city and an industrial area in Korba District, in the Indian statet of Chhattisgarh.

2.4 TOPOGRAPHY AND DRAINAGE

The topography of the coalfield is gently undulating with a general elevation ranging from 275-335mt. above MSL. The field is bordered on the north east and west hills rising up to 915mt. above MSL. These hills contain two peneplained surfaces approximately of 900mt. and 600mt. elevations. It is elongated in the east west direction having a length of 64 kms and width varying from 4.8-16kms covering an area of over 530sq. kms.,

In the south, Hasdeo River is flowing dividing the coal fields into two unequal parts is the main drainage channel. It originates in the hills of the Surguja District. After traversing through coal field it joins Mahanadi at a point about 50km to the south. The width of the river bed within the coal field ranges from 400-1200m.

The river is at its peak in monsoon but acquires a normal flow in dry season. The tributaries of the Hasdeo may be broadly subdivided into two categories, one originating from the coal fields and other apart from the coal fields. The major tributaries comprises of westerly flowing Ahiran and Kholarnalas. While the Dhengar and phulakadi debouch into Hasdeo River from the east.

2.5 CLIMATE AND VEGETATION

The climate of the area is hot and humid. The temperature is as low as 3^0 to 4^0 C in winter but rises to 42^0C in June. The total annual rainfall from July to September is around 150cm. The K.C.F. has a thick forest covering higher elevations to the north and east, all around it the paddy fields occupy the low lands over a major part. The forestry includes Sal, Palas, Kusum, Haritaki, Bahara, Tendu and Bamboo.

2.6 GENERAL GEOLOGY

The K.C.F. is trending in E-W direction conforming the regional strike of the basement rocks Precambrian. The coal bearing strata covers an area of about 500sq. kms. Out of which 150sq.kms. Lies to the east of Hasdeo river and the larger part of it lies to west. A narrow strip of Barakar Sediments continues up to Ahiran Valley, in the North-West. To the east, coal measures pass under Kamthi formation under watershed between Hasdeo and Mandriver. A thin strip of Barakar strata also connects the coal measures of Mand river Valley. In the North, granitic and metamorphic rocks appear to have a dominant control in shaping the northern outline of the basin.

NON-CONFORMITY

Precambrian

Graintes, Gneiss, Migmatites

Quartzites, Phyllite, micaschists

2.6.1 PRECAMBRIAN ROCKS

The metamorphites comprising gneisses, schist's, amphibolites and quartzite's outcrop along northern and southern boundaries of coal field. The deposition of Precambrian rocks extremely of undulating nature of the basement rock particularly towards the western part of the basin.

2.6.2 TALCHIR FORMATION

The Talchir sediments are well exposed in the northern periphery of the Korba Coal fields and over a large tract between Korba and Hadsdeo – Ahiran Coal Field the base of the formation is classified by the presence of tillite comprising of clast of a wide spectrum of rock types including those of granite, gneisses, amphibolites and quartzites. The tillite is characterized by the presence of huge boulders, measuring 7mt. long. The fabric study of the embedded clast in tillite lies to northern direction of ice transport.

Green shales, clays and siltstones constitute a dominant proportion of the lithic fill. In the north- western part of the basin near Lalmatia about 107mt. thick black shale sequence intersected in the lower pat of the Talchir sequence. The development of the black shale points to its Euxinic condition of deposition and may indicate marine influence as well during its formation.

Medium grained greenish grey sandstones define the upper unit of the formation and attain a thickness of 70-80mt. Varved rhythmites with dark and light layers are another charactersticfacies in Talchir sequence of Korba basin. The thickness of the Talchir formation is 250-300m. The sandstones in the upper part of the Talchir formation grade upward imperceptibly into lower Barakar Sandstones and no stratigraphic break between the two has been reported.

2.6.3 BARAKAR FORMATION

The Barakar formation covers the major part of the Korba under Gondwana basin and broadly has similar lithological constitution and thickness as those of the adjacent Mand Raigarh basin. It comprises of medium to coarse grained sandstones, a few pebble beds, conglomerates, shales, and coal seams. The sandstone, are usually feldspathic and the feldspar are generally kaolinised to a high degree and the sandstones are ferruginous. Based on vertical variation of gross lithofacies, the Barakar formation can arbitrarily be subdivided into lower, middle and upper members.

2.6.3.1 LOWER MEMBER

The lower member is very well exposed in the phulakdi, Dengur, Saur and Ahiran nalas in the field and Kholarnala and its tributaries in the western part.

The base of the lower members is defined by massive thick bedded of grayish white, compact sandstone with conglomerate beds and pebbly lenses. The unit varies in thickness between 30-76m. The lower barakar occupies a large area in north extending from Dilwadih in the north- west through, Banki-Surakachhar in the central part and Rajgamar-kesla in the east.

Thin superior grade coal seams are confined to Lower Barakar formation. In this tract thick inferior quality coal seams i.e. Kusmunda / Jatraj group of seams are preserved. This unit is usually devoid of any carbonaceous interbands.

The basal barren zone is succeeded by 130-150mt. Thick sequence of coarse to fine grained sandstones, grey shales and coal seams. The repetition of this unit is observed fining upward in cycle, which at places, contain a coal seams towards the upper part. This lithic assemblage contains the Ghordewa group of seams, which are well exposed in the phulakadinala and Ahiran river near Rajgamar and Ghordewa villages. The lower member as a whole shows a predominance of sandstones and sandstones / shales ratio usually ranges between 10:1 to 32:1. There is a general thickening of the shales as well as coal to the west.

2.6.3.2 MIDDLE MEMBER

The middle member of the Barkar formation is defined as thick sandstone unit which separate the Jatraj group of seams of upper Barakar sequence from the Ghordewa group of the lower member. This unit comprises of coarse grained quartz and chert. The middle member attains a maximum thickness of 300mt.

2.6.3.3 UPPER MEMBER

The upper member comprises of fine grained sediments including flag, fine to medium grained sandstones, grey shales and several thick coal seams. The total thickness of the upper member is 350m. It is confined to the southern part of K.C.F. from Dipka in the west to Manikpur in the East. Thick inferior grade coal seams are confined to upper Barakar formation. Some of them are D to E grade.

2.6.4 KAMTHI FORMATION

The Kamthi formation forms prominent ridges in the east and this separates K.C.F. from that of the Mand-Raigarh.

The geological mapping shows a disconformable and overlapping contact between the Kati and Barakar formations. The kamthi formation comprises coarse ferruginous sandstones, pebble sand stones and conglomerates. **The Kamthi sandstones differ from that of Barakar being more porous and calcareous and having a lesser amount of clayey matrix.** Presence of at least two coal seams, each of 2-3mt. thick is reported from Kamthi formation occurring on hills in the north east of Rajgamar.

2.7 STRUCTURE

The korba basin forms the northern member of the linear Gondwana belt extending from the IB River in Orissa in south-east to Korba in the North-West. This basin shows a broad similarity in its structural setup having a well-defined east-west trending of southern boundary fault, while the northern margins a normal sedimentary contact. In other words, Korba basin corresponds to a half Graben configuration. The boundary fault defines a prominent lineament and shear zone of antiquity . This stretches farther south east & defines the southern boundary of the Mand, Raigarh and IB river basin.

Periodic activation along this zone of crustal dislocation resulted in the accumulation of thick pile of sediments all along this linear basin. In response to the subsidence along the boundary fault, the rock formations have attained a regional southern dip. The olders units are disposed normally in the north, while the successive younger units are seen towards the southern part of the basin. As a result, the younger sections of the Barakar formation lie against the metamorphisms along the southern boundary fault.

In the north eastern part of K.C.F., the beds forms a south-east plunging shallow anticlines and show a remarkable swing in strike from NNE-SSE and even north-south with eastern dips in the north, to east-west with southern dips in the south. Further north-west in the Surakachhar area, the basin tapers and forma a synclinal structure with axis plunging towards south-east. In Gevra block, south of surakachhar, the strike swings from ENE through north-east to east-west.

Most of the major faults are strike faults aligned in either east-west or NW-SE directions. These faults usually headed towards north resulting in the repetition of coal seams. A major east-west strike fault headed northward with throw over 200m runs through centre of the coal field. This resulted in the up throw of the Kusmunda group of seams. In Korba sector to the east of the Hasdeor river, a major strike faults delineates the southern-boundary of the lower Barakar member. In addition, there is another major strike fault to the north of Korba, which also extends further west across the Hasdeo River. The down throw of the fault is southward.

In the area west of the Hasdeo river, around Banki and Surakachhar, five major strike faults are recorded which are arranged almost in Enechelon. These strike faults are caused partial/ total repetition of outcrops of some of the seams.

In addition, several well defined oblique faults are also recorded. One such fault stretches over NW-SE along Ahiran River.

2.8 COAL STRATIGRAPHY

The coal seams are restricted to the Lower Upper member of the Barakar formation and are separated by a barren zone.

The lower member is characterized by the presence of thin seams of superior quality. There are altogether eight coal horizons in the lower member, which rarely exceed 5mt. in thickness. The upper member contain not only the thick Jatraj-Kusmunda seam, but also other seams of inferior quality and a total 21 coal horizons have been recognized in the Manikpur area.

It is remarkable that about 30% of the Upper Barakar sequence is made up of carboniferous horizons, while the coal seams approximately contribute about 10% of the total Barakar sequence.

BARAKAR FORMATION

Age	Formation	Thickness (mt.)
Upper Gevra	Upper Kusmunda seam	13 to 20
Barakar	Parting	45 to 8
Member	Lower Kusmunda seam Parting with minor seam	80 to 85
Middle Barakar Member	Sandstone	300 (approx)
Lower	Ghordewa/Rajgamar Group of seams	
Barakar	G-III seam	1 to 4
Member	Parting	30 (approx.)
	G-II seam	1.2
	Parting	1.5 to 20
	G-I seam	1 to 4
	Parting	30 to 40

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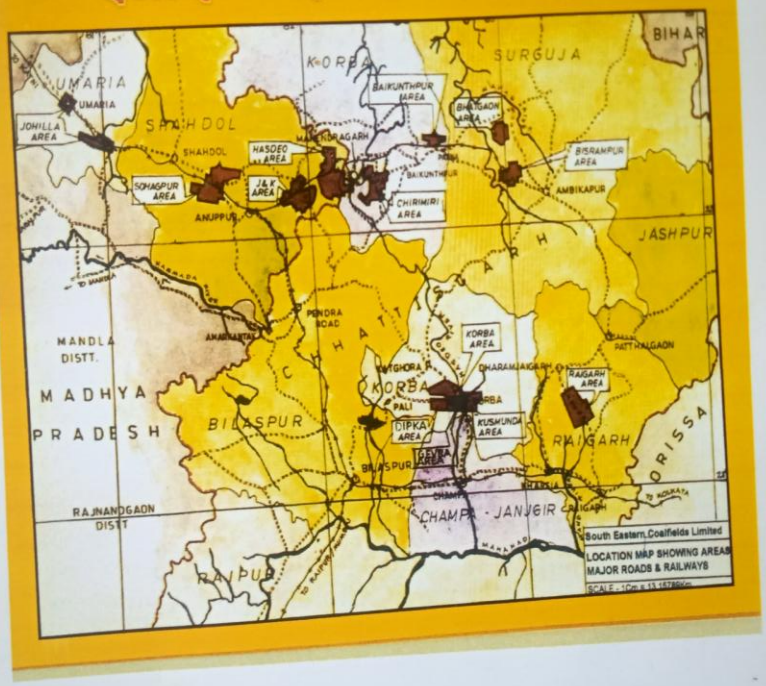
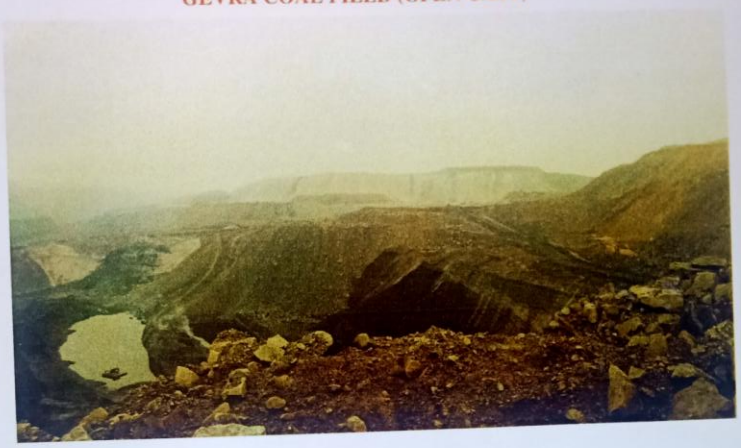
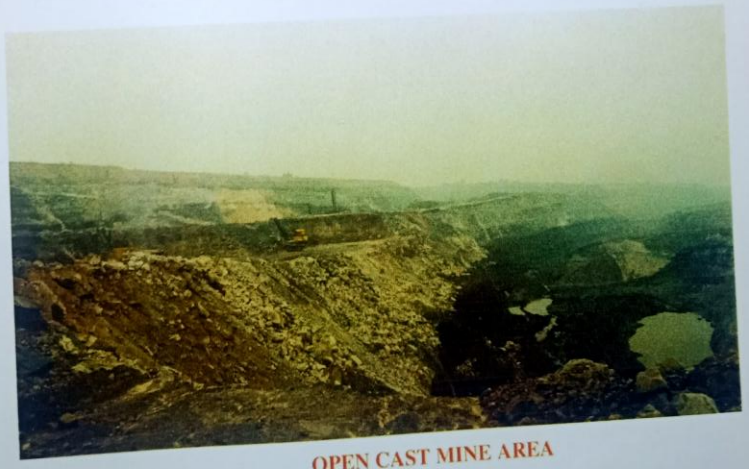


GEVRA COAL FIELD (OPEN CAST)



GEVRA OPEN CAST MINE AREA



OPEN CAST MINE AREA

GEVRA OPEN CAST MINE

3.1 INTRODUCTION

Gevra mine is an open cast mine complex at the town Gevra that has been described as the largest open cast mine in India and Asia, as well as the world's second largest.

As of 2016, it has a capacity of 35-41 million tones per annum. It was opened in 1981, during 1999-2000 it has produced 18 million tones of coal and removed 12 million tones of overburden. In 2000, Gevra mine had a plan to expand from 12 million tones per annum.

Actual production was raised from 18 million tones to 26 million tones annually in three and half years. SECL reported that on 18 march 2007, Gevra open cast mine produced 100,000 tones of coal. The highest quantity of coal ever produced by any mine or coalfield in India on a single day.

Expansion of capacity of Gevra mine from 35 million tones annually to 43.75million tones annually has been awaiting environmental clearance since2009.

Dumpers in Gevra mines

GENERALISED STRATIGRAPHIC SUCCESSION IN KORBA COALFIELD-

AGE	AGE	THICKNESS(M)	LITHOLOGY
RECENT	ALLUVIUM	UPTO 20M	SOIL AND SUB-SOIL
LOWER TRIASSIC UPPER PERMIAN	KAMTHI	MORE THAN 200M	COARSE FEERUGINOUS SANDSTONE PEBBLY SANDSTONE AND CONGLOMERATE
UN-CONFORMITY			
LOWER PERMIAN	UPPER BARAKAR	MORE THAN 300M	SANDSTONE SHALE CARBONACIOUS
	MIDDILE BARAKAR	MORE THAN 200M	SHALE AND COAL SEEMS xx TO xx ||| MANIKPUR SANDSTONE OF VARIED GRAIN SIZES SHALES AND CARBONACEOUS SHALES WITH THICK COAL SEAMS(LOWER&UPPER KUSMUDA SEEMS)
	LOWER BARAKAR	MORE THAN 300M	COARSE GRAINED TO PEBBLY SANDSTONE WITH THIN INFERIOR COAL
	KARHARBARI	MORE THAN 150M.	COARSE GRAINED TO PEBBLY SANDSTONE WITH THIN GOOD QUALITY COAL SEEMS (GHORDEVA GROUP OF SEAMS)
BASAL PERMIAN	TALCHIR UPEER CARBONIFEROUS	MORE THAN 251M	FINE GRAINED COMPACT TILLITE AND GREENISH SHALE
NON-CONFORMITY			
ARCHAEAN			GRANITE GNEISSES ETC

4. COAL TYPES-

Coal is mixture of various hydrocarbons. The value of coal depends on the concentration of carbon in its composition.

The verities of coal that are generally found in India are Anthracite, Bituminous, Lignite & peat.

1. ANTHRACITE COAL- this coal ranks highest amongst the coals unlike bituminous coal anthracite ignites slowly and has a high heating value.
2. BITUMINOUS COAL - this is commercial coal. It is used as steam coal, house hold coal, cooking coal, gas coal etc. peat is to be washed in washers in order to reduce the sulfur and ash contains.
3. LIGNITE COAL- it is also inferior in calorific value 1 tonne of gondwana coal is equivalent to about two tones of lignite.
4. PEAT COAL- peat has got no fuel value practically it has the least combustible matter. It is the 1st stage in the development of coal.

There are 110000 ton coal is transported by this Gevra mine daily and 50000 ton coal all of these is transported only by road through truck.

8. Sampling and sample preparation – :

For the purpose of sampling, coal should be divided into following three size group.

Name	size (cm)
Run of mine	23 to 0
Coal large	15 to 5
Coal small	5 to 0

Sampling from conveyers -:

For the purpose of sampling , a lot , while it is being discharge over a conveyer, shall be divided into a number of sub-lot of approximately equal weight as given in table 1

Weight of the lot (tones)	No. of sublots
Up to 500	2
500 to 1000	3
1001 to 2000	4
2001 to 3000	5
	6

Sampling from wagons -:

For the purpose of sampling , all wagon in a lot shall be divided into a suitable number of sublots of approximately equal weight in accordance of table 1 . The wagons shall be selected at random from the sublots and to ensure the randomness of selection the procedure are given in table 2.

RANDOM SELECTION OF WAGONS – Two set of random number are given in table 2. The first set of random number shall be used ,if the number of wagons in the sublots is less than or equal to 100, whereas the second set shall be used if the number of wagon in sublots is more than 100 but less than 1000.Having selected the set , any one numeral shall be chosen from it at random, starting from the selected numeral and counting on with the numerals in any direction , right or left ,up or down, the succeeding numerals shall be copied out one by one till the number of numerals copied out is equal to the number of wagon to be chosen.

Example – suppose there are 60 wagons in a lot of approximately 1200 tonnes . according to table 1. This would require the division of the lot into 4 sublots, each consisting of 15 wagons of approximately 300 tonnes , it imply that 4 wagons have to be selected out of 15 in the sub lot.

Taking the first set of random numbers as given table 2.suppose further that numeral 07 occurring in third row under second column is chosen at random. Proceeding further in any direction ,say right and omitting the numeral which are greater than 15, The numeral encountered are 07, 04 ,08, 14 .It then follow that the 4^{th} ,7^{th},8^{th}, and 14^{th} wagon counted from beginning of sublot shal be selected for drawing the gross sample.

Sample preparation:

1. Run of mine coal – The gross sample shall be crushed to 5cm, preferably by mechanical means, mixed thoroughly and quartered. Two opposite quarters shall be retained and the rest rejected. the retained material shall be further mixed together, halved and one half retained. Thus ultimately one quarter of original gross sample is retained and the rest rejected, The material so obtained shall be crushed to 12.5 mm by a jaw crusher and then to 3.35 mm by a palmac type of reduction mill. The crushed material shall be reduced e by coning and quartering till 2 kg of sample is obtained.

2. Large coal – The gross sample shall be crushed to 5 mm , preferably by mechanical means , mixed thoroughly and then quartered. Two quarters shall be retained and the rest rejected . the material so obtained shall be crushed to 12.5 mm by a jaw crusher and then to 3.35 mm by a palmac type of reduction mill. The crushed material shall be reduced by coning quartering till 2 kg of sample is obtained.

3. Small coal – The gross sample shall be crushed to 3.35 mm in two steps, namely through 12.5 mm by a jaw crusher and finally through 3.35 mm by a palmac type of reduction mill.

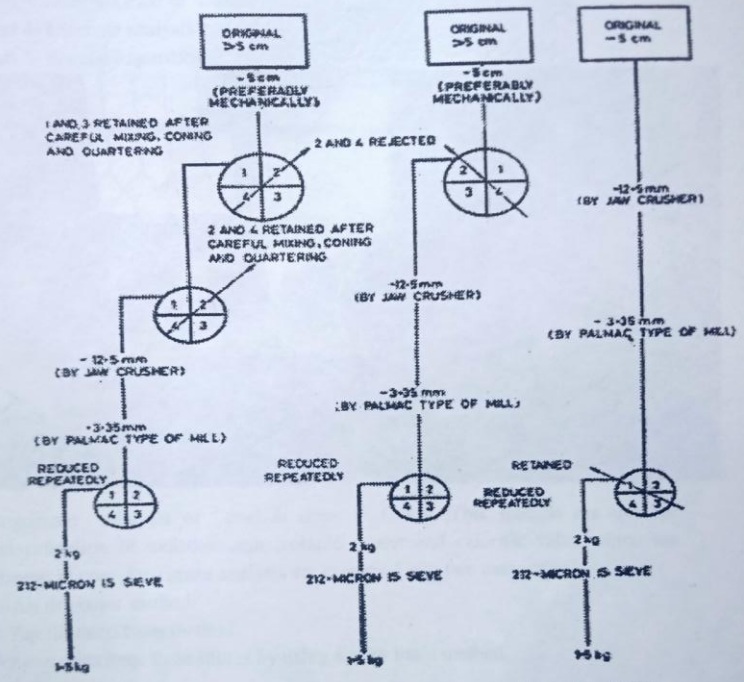


FIG. 3 RUN-OF-MINE COAL

FIG. 4 LARGE COAL

FIG. 5 SMALL COAL

9. COAL RESERVE AND GRADE ESTIMATION

The method of test for coal is covered in the following parts.

Part 1- Proximate analysis

Part 2-Determination of calorific value

Part 3- determination of sulphur

Part 4- Ultimate analysis

Part 5- Special impurities

Proximate analysis of coal is done in Gevra .This method are use for determination of moisture ,ash ,volatile matter and calorific value which are present in coal .Proximate analysis are classified into two categories.

1. Air dry basis method
2. Equilibrated basis method

We can determine three things by using air dry basis method.

1. Ash

2. Moisture

3. Gross calorific value

Sample is received in the laboratory if already ground to pass 212 micron IS sieve shale be re-sieved to verify that all material pass through this sieve and then air dried for 24 hour.

Coal especially those of low rank, are hygroscopic to various degrees ,and absorb or lose moisture according to their humidity and temperature to which they are exposed .A separate determination of moisture in air dried material shall be made at the same time as ash and volatile matter are determined .

The result of proximate analysis are generally recorded as a percentage of air dried material .The ash may be expressed on dry basis , dry ash free basis or dry mineral free basis.

1. Determination of moisture (Air dry basis)

1.1. Form and conditions of moisture – The moisture present in laboratory sample of coal is of importance in proximate analysis and in calculating other analysis results. Moisture and free water may be defined as follow.

(a) Total moisture – The coal has been exposed to contact with water in seam or in a washery or coal wetted by rain may carry free or visible water .This water plus the moisture within the material ,is referred to as **total moisture**.

(b) Free water or visible water –Free water or visible water is that quantity of water which is physically adhering to coal .In essence this is that quantity of water which is in excess of the moisture holding capacity of coal.

1.2 Method – Following method are used for determination of moisture.

(a) Indirect method – A known mass of the coal is dried and the loss of mass calculated as moisture .The moisture may be determined either by drying in one stage at 108° ± 2°C or by a two stage process in which the coal is first air dried under atmospheric condition and the remaining moisture removed by drying in an oven at 108° ± 2°C temperature .In the latter case the total moisture is calculated from the loss during air drying and that during oven drying .

- **Drying in air (one stage) – It is divided in two methods**
  Method 1-It is not applicable for coal
  Method 2
- Drying in air (two stage) – Air drying is followed by oven drying

(b) Direct method – A known mass of coal is heated in glass tube .This method applicable when free water is absent.

1.2.1. Drying in air (ONE STAGE) method two

- Applicability – This method applies to laboratory sample of coal crushed to pass 212 micron IS sieve.
- Apparatus

I. Air oven – Ventilated drying oven in which a constant and uniform temperature at 108° ± 2°C can be maintained.

II. Weighing vessel – Shallow vessel,approximately 10 cm3 in area , man made silica or glass with ground edges and fitted with ground cover or of stainless steel.

- **Procedure**

  Heat the empty vessel at 108° ± 2°C and weigh after cooling for 20 minute in a desiccators. Uniformly spread about 1.5 g of coal ,passing 212 micron sieve , in the weighing vessel , so that there is not more than 0.15g of the material per cm3 area and weigh again . Uncover the vessel in drying oven and heat at a temperature of 108° ± 2°C degree until there is no further loss in mass .This normally takes 1 to 1.5 hours. Replace the cover ,coal in desiccator for 20 minute and weigh.

- **Calculation and reporting of result**

  Express the loss in mass due to drying as a percentage of total mass of the sample and report the result as the percentage moisture sample

FORMULA :-

m2- m3/ m2-m1 x 100

1.2.2. **Drying in air (TWO STAGE) – air drying followed by oven drying.**

I. Stage one (oven drying)

- **Applicability**

This method applies to a special moisture sample of 1kg of coal crushed to pass a square mass of screen conforming to designation 12.5 mm and delivered in a sealed non corrodible container.

- **Apparatus**

Non corrodible trays approximately 1000 cm3 in area and large enough to hold the entire sample.

- **Procedure**

Accurately weigh the sample and container to the nearest 0.5g .transfer the sample from the container to the weighed metal tray and spread the material evenly on the tray, dry the container in air and transfer to the tray any coal that was left behind adhering to the sides .weigh the dry empty container . allow the material in the tray to air dry at atmospheric temperature in a well ventilated place free from dust .Take the drying to be completed when the change in mass during an hour is less than 0.1 percent of sample .Record this mass.

II. Stage two (oven drying)

- **Apparatus**
  a) Ventilated drying oven – In which a constant and uniform temperature of 108° ± 2°C degree can be maintained.
  b) Weighing vessel - shallow, approximately 40 cm3 in area, made of silica, glass or stainless steel , with ground edges and fitted with ground cover.
- **Procedure :-**

Heat the empty vessel at 108° ± 2°C degree and weigh after cooling for 20 minute .Crush the air dried material to pass 2.90mm IS Sieve . Spread uniformly in the weighing vessel about 10gm of the crushed material and weigh . Heat the uncovered vessel in the drying oven at a temperature of 108° ± 2°C degree until there is no further loss in mass .This normally take 1.5 hour to 3 hour .Replace the cover , cool in a desiccator for 20 minute and weigh.

m2 - m3/m1-m2 x 100

- Calculation and reporting of result
  a) Air drying - Express the loss in mass during air drying as a percentage of the original mass of the material. Represent this as (x).
  b) Oven drying – Express the loss in mass during on oven drying the sample ,as a percentage of total mass of sample placed in the oven . In this case the figure obtained (y).

Formula= $X + Y (1 - x/100)$

2. **Determination of moisture (equilibrated basis)**

1. Take about 5gm of laboratory sample of coal, ground to pass 212 micron Is sieve ,in a beaker or conical flask of 100ml capacity.
2. Pour about 20ml of hot water on the sample and wet the coal by gently swirling the beaker or flask .
3. Put the beaker or flask on an asbestos centered wire gauze and apply a small flame , underneath and allow the contents to boil very slowly for about 15 minute.
4. Filter off the water using a qualitative filter paper and then remove the visible water as far as possible by pressing the wet coal between folds of blotting or filter paper.
5. The coal which are present in between the filter paper , take this in Petri dish and placed this Petri dish with coal in humidity chamber for 24 hours.
6. After 24 hour remove this Petri-dish with coal from humidity chamber and crush this coal.
7. Keep this Petri-dish with crushed coal again in humidity chamber for 48 hours.
8. After 48 hours place this Petri-dish with coal in oven , heat, and weight this Petri-dish with crush coal and calculate the loss in mass of coal.

Weight of empty Petri-dish- a1
Weight of Petri-dish with coal – a2
Weight of lab sample coal- 5gm
Mass of coal – a3

9. After this transfer the coal from Petri-dish to silica crucible and keep the crucible with coal in desiccators for some time with cover the crucible.
10. Weight the crucible with coal (m2).
11. Place this crucible with coal in oven again for 1:30 hours and weight this (m3).
12. Weight the empty crucible (m1).

FORMULA = (M1 – M2/M2-M3)×100

3. **Determination of volatile matter (air dry basis)**

- General – The volatile matter of coal is of particular importance is assessing the use for which the coal is suitable .By itself or in conjunction with other characteristic the volatile matter on a dry mineral free basis is used for coal classification. The volatile matter is the loss in mass less that due to moisture ,when coal is heated under standard condition. The test is empirical and ,in order to ensure accurate result, it is essential that the rate of heating ,the final temperature and the overall duration of test should be carefully controlled .it is also essential to exclude air from the crucible during heating to prevent oxidation and therefore the fit of the lid of the crucible is critical. The moisture content of sample should be determined at the same time as the volatile matter so that the appropriate correction could be made.

- **Method** – The method consist of heating out of contact with air a weighed quantity of air dried sample of coal at the temperature 900+10 for a period of 7 minute.

- **Apparatus**

  a) Crucible and lid

  b) Stand

  c) Muffle furnace

- **Procedure**

1. Use air dried material passing through 212 micron IS sieve.
2. Depending on the furnace available , heat at 900+10 for 7 minute either one crucible with lid or requisite number of crucibles with lids to fill the stand , remove from the coal crucible from the furnace and cool the crucible with coal first on metal plate for 5 min. and then in desiccator for 10 min. Weigh each empty crucible 1.00 to 1.01gm of sample replace the lid and tap the crucible on a clean hard surface until the sample from a layer of even thickness .

FORMULA= (M2-M3/M2-M1)×100

Determination of ASH

- **Apparatus - :**

a) Muffle furnance – Capable of giving a substantially uniform zone of 500c in 30 minute from cold , of being raised to 815 + 10 c in a further 30 to 60 minutes and of maintaining this temperature up to the end of the run up period . the furnance

b) should also be capable of being raised to a temperature of 850 +10 ,if necessary . The ventilation shall be such as to give about five air changes per minute.

c) Dish – of silica, porcelain , 10 to 15 mm deep , of such a size that, with the amount of sample used , the spread does not exceed 0.15 g /cm.

- **Procedure - :**

Thoroughly mix for one minute the air dried material, ground to pass through 212 micron is sieve preferably with a laboratory mechanical mixer .Weigh a clean dry empty dish and lid. Into the dish weigh accurately about one to two grams of the material according to the size of the dish. distribute the material so that the spread does not exceed 0.15 g per cm. insert the uncovered dish into the muffle furnace at room temperature, raise the temperature to 500 c in 30 minute and to 815 +10 c in a further 30 to 60 minute and maintain at this temperature for 60 minutes.

Cover the dish with its lid if the ash is light and fluffy, remove from the muffle furnace and allow to cool, first on a cold metal slab for ten minutes and finally in a desiccators placed at the side of balance .Weigh after the dish has been in desiccators for 15 minute. Re ignite at the same temperature until the change in mass of ash and reweigh the empty dish .Obtain the mass of ash by difference.

- Calculation -:

Ash percentage = $100 \times (M3 - M4 / M2 - M1)$

M1= mass in gm. Of dish

M2= mass in gm. Of dish and sample

M3= mass in gm. of dish and ash

M4= mass in gm. of dish after brushing out the ash & on reweighing.

Fig 1- Coal sample from ROM.

Fig 2- 5gm. Coal dilute with water

Fig 3 – Dilute coal on hot plate

Fig 4- Oven

Fig5- Blast furnace

Fig 6- Calorimeter

SALIENT FEATURE AT YOUR FINGER TIPS
SECL,GEVRA EXPN. PROJECT (35-40Mty)

Situation of the mine : **Latitude 22*18'35" to 22*22'07"**
: **Longitude 82*32'33" to 82*38'54"**

Sn.	Particulars	Coal	OB	Striping Ratio
1.	Reserve for Gevra Block (as per12 MT PR)	: 622.59 MT	624.00M Cum	1.002
2.	Transfer to Dipka Project	: 30.50 MT	15.18 M Cum	0.497
3.	Transfer to Laxman Project	: 32.66 MT	32.85 M Cum	1.005
4.	Net reserve of Gevra project (as on 01.01.81)	: **559.43 MT**	575.97M Cum	1.029
5.	Addl. reserve of 25 MT –PR	: 428.16 MT	561.38 M Cum	1.311
6.	Addl. reserve of 35 MT –PR	: 309.87 MT	339.60MCum	1.139
7.	**Extracted/Removed up to 31.03.2016**	: 671.54MT	475.04MCum	0.71
8.	**Balance reserve as on 01.04.16** (4+5+ 6-7)	: 625.92MT	1001.92MCum	1.60

9. Total All Right area of (Kusmunda & Pondi block) under CBA(A&D). : 4184.486 hectare

10 Mine Boundary area of Gevra project(10.05.2016) (including Dipka unit & Laxman) : 2177.498hectare

11. Quarry limit as per 35-40MT.P/R : 2037.250 Hectare

12. Excavated area as on 1.04.2016 : 1374.000Hectare

13.External OB Dump area up to 01.04.16

Dump No	Dump Area/TR	B/R
: Dump No.1	5.250 hact.	5.25 hact
: Dump No.2,3&4	109.260 hact.	97.25 hact.
: Dump No.5	61.700 hact.	61.70 hact.
: Dump No.6&7	156.716 hact.	58.00 hact.
: Dump No 1 (DU)	8.909 hact.	08.00 hact.
: Dump No 2 & 3 (DU)	32.496 hect.	32.00 hact.
: Total	374.331 hect.	262.2200 hect.

14. Internal OB Dump area up to 01.04.16

Dump No	Dump Area/TR	B/R
: Dump No.1	15.260 hact.	13.00 hact.
: Dump No.2&3	123.940 hact.	68.85hact.
: Dump No.4	154.437 hact.	16.75 hact.
: Dump No.5,6&7	241.426 hact.	24.00hact.
: Dump No 8	80.072 hact.	0.00 hact.
: Total	615.135Hact	122.600 hact.

15. **Total de-coaled area as on 01.04.16** : **869.21 hectare**

16. **Balance de-coaled area as on 01.04.16** : **254.075 hectare**

17. General lithology of the area :

10. ENVIRONMENT MANAGEMENT PLAN -

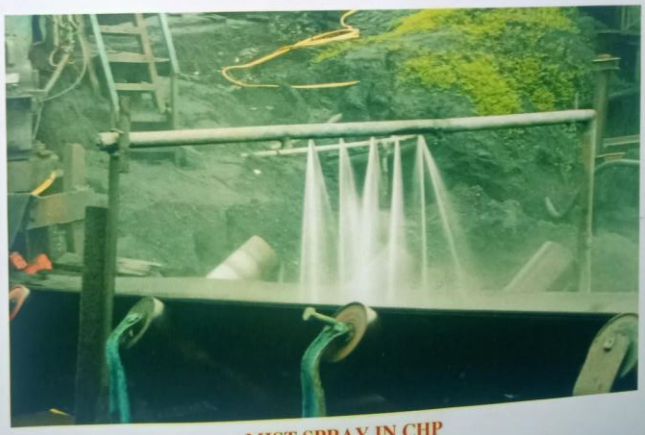
AIR POLLUTION CONTROL MEASURES

- Mobile Water Sprinklers: Sufficient numbers of 70 KL & 28KL capacity , are used for dust Suppression in mine haul roads & 9 KL capacity mobile water sprinklers are used in coal tipper roads for dust suppression.
- Water Sprinkling arrangement is working effectively to suppress dust at all along the conveyor belt system, Transfer Points, CHP, Silo's and at the 30,000 T Ground Bunker.
- Mist Spray Water Sprinklers are operating for dust control at crusher/ Feeder breakers and at 5000 Te capacity Ground Bunker.
- Trucks are optimally loaded to prevent spillage on haul roads. Coal loaded trucks are covered before leaving the mine premises.
- The accumulated coal dust / slurry on Haul roads and other roads of Mine premises is cleaned by the use of Graders & loaders.

MOBILE WATER SPRINKLERS

WATER SPRINKLING

BELT CONVEYOR OF CHP



MIST SPRAY IN CHP

FEEDER BREAKER

- Introduction of Surface Miners reduced the requirement of drilling & blasting and further crushing at in Pit & Surface crushers.
- Surface Miners are provided with inbuilt water spraying arrangement.
- Dust extractors are working effectively in Drills to reduce dust emission.
- Extensive Plantation done on overburden dumps, which act as dust & noise barrier between mine area and residential area.
- Thick green belts developed around residential areas. Also plantation done along colony roads and around other mine infrastructures.
- Till date about 4072183 No. of plants have been planted on an area of **1026.62 Ha.** in and around the project area.
- Employees are provided with LP Gas connections & free LPG Cylinder, restricting burning of coal for domestic use.
- All approach roads to mine and all other roads which are in regular use are concrete.
- Continuous Ambient Air Quality Monitoring System (CAAQMS) has been installed for continuous monitoring of Ambient Air quality.

SURFACE MINER

DRILLS

PLANTATION

GREEN BELT

YEAR WISE DETAILS OF PLANTATION : GEVRA OCP

- Total of Plantations done till date (31 January 2017) - 40.72 Lakh
- Total of Grass Beds done till date (31 January 2017)- 251125 Sq Mt.

CONCRETE ROADS

NOISE POLLUTION CONTROL MEASURES

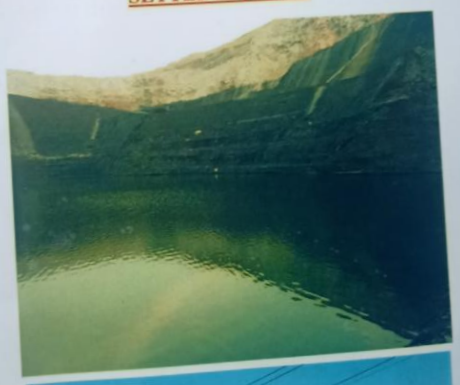
- About 40.72 lakh saplings already planted for noise attenuation.
- High capacity machines like 42 CuM Shovels & 240 Te Dumpers deployed in mine. This has resulted in reduced number of vehicular trips, there by reducing noise levels.
- Reduced quantity of blasting has resulted in lower noise levels. Lined Chutes in Silo.
- Surface miner deployed to eliminate Blasting & Crushing of Coal, thereby reducing noise levels.
- Ear muffs provided to employees posted in high noise areas.
- Regular monitoring of environmental attributes is undertaken.
- Routine maintenance of HEMM (Heavy Earth Moving Machinery) is ensured to reduce noise levels.

SHOVEL DUMPER

WATER POLLUTION CONTROL MEASURES

- Oil and Grease trap is in operation for treating effluent water from **HEMM washing**. After treatment, water is **reused** for HEMM washing. This Oil & Grease Trap is a **zero discharge plant.**
- Settling Ponds are provided for treating the mine water discharge as well as OB dump run-off.
- Construction and maintenance of Catch Drain around the active Mine. Check dams are provided in the catch drains.
- Domestic Effluent Treatment Plant (DETP) of 3.00 MLD capacity is constructed for treating domestic Effluent of the residential colonies.
- Properly constructed storm water drains have been maintained in the colony.

SETTLING PONDS



MEASURES TO CONTROLL HAZARDOUS MATERIALS AND WASTES (AS PER MOEF'S GUIDELINES)

- Hazardous materials like Oil, Grease etc are kept on concrete floor to prevent contamination of soil & ground water, if spillage /leakage of containers do arise.
- During maintenance of HEMM and light vehicles 'Oil recovery trays /drums' are used to prevent spillages of burnt oil.
- Used oil/Burnt oil are stored in specified drums at work sites on concrete floors.
- Oil & Grease trap is functioning at Workshop to separate& recover oil & Grease from the effluents generated from HEMM washing.
- Recovered used oil /burnt oil are sold to MOEF authorized dealers / recyclers.
- Used filters, hose pipes, oily wastes etc are properly collected and stored in specified "Hazardous Wastes collection tanks" at work sites.
- Above Hazardous materials, sludge from Oil & Grease trap etc is transported for final disposal at earmarked, "Hazardous Wastes Disposal Site".
- Regular thorough checking of HEMM & light vehicles are undertaken to avoid any possible bursting of hoses and leakages from any other part.
- Regular up keeping of workshop floors are done to give a healthy working atmosphere.

HAZARDOUS WASTES DISPOSAL SITE

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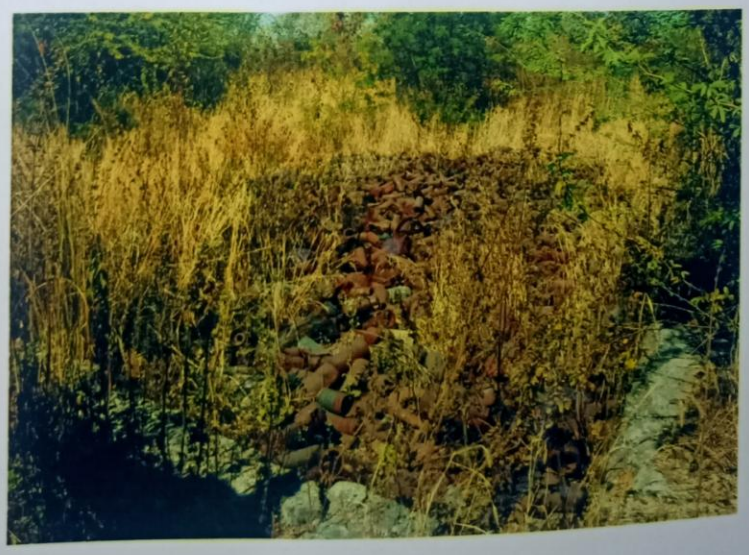
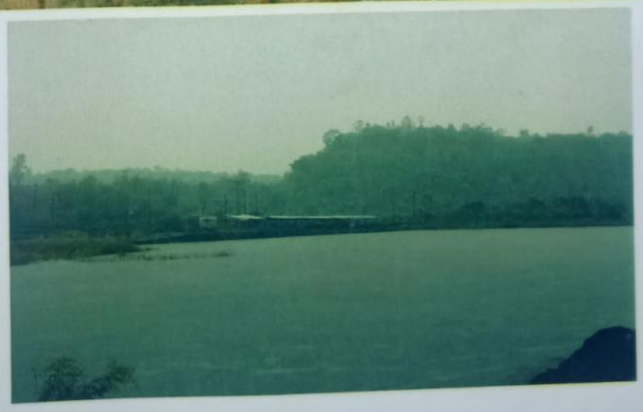
HAZARDOUS WASTES DISPOSAL SITE



GARLAND DRAINS & SEDIMENTATION POND



REFERENCE

1. DATAS ARE GIVEN BY SECL GEVRA EMPLOYES.
2. INDIAN STANDARD METHODS OF TEST FOR COAL.