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ECO-FRIENDLY BAUXITE MINING OF JHARKHAND REGION-A CASE STUDY

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ABSTRACT

Bauxite is the third most abundant element in the earth crust, but does not occur as a metal naturally. The first step in producing. Aluminium is mining its ore- bauxite. Unlike the base metal ores, bauxite does not require complex processing because most of the bauxite mined is of an acceptable grade. Ore quality can be improved by relatively simple and inexpensive process for removing clay, known as "beneficiation" which includes washing, wet screening and mechanical or manual starting. Mining can be made sustainable activities by zero accident and environment hazards.

Keywords- *Eco-friendly, Bauxite etc*

I. WHAT IS BAUXITE?

Bauxite is not a mineral. It is a rock formed from a laterite soil that has been severely leached of silica and other soluble materials in a wet tropical or subtropical climate. It is the primary ore of aluminium. Almost all of the aluminium that has ever been produced has been extracted from bauxite.

- **What is Bauxite's Composition?**

Bauxite does not have a specific composition. It is a mixture of hydrous aluminium oxides, aluminium hydroxides, clay minerals, and insoluble materials such as quartz, hematite, magnetite, siderite, and goethite. The aluminiummineralsin bauxite can include: gibbsite $Al(OH)_3$, boehmiteAlO(OH), and, diaspore, AlO(OH).

- **Physical Properties of Bauxite**

Bauxite is typically a soft (H:1-3), white to grey to reddish brown material with a pisolitic structure, earthy lustre and a low specific gravity (SG: 2.0-2.5). These properties are useful for identifying bauxite; however, they have nothing to do with bauxite's value or usefulness. This is because bauxite is almost always processed into another material with physical properties that are distinctly different from bauxite.

- **Bauxite Used for Aluminium Production**

Bauxite is not a mineral. The term Bauxite refers to a rock consisting chiefly of hydrated aluminous oxide viz.- Gibbsite- (Trihydrate$Al_2O_3.3H_2O$), Boehmite and Diaspore (Monohydrates-$Al_2O_3.H_2O$). It is to be noted that bauxite is an aluminous rock of which the main constituent is aluminium hydroxide with varying proportions of iron oxide, silica and generally titanium oxide. The iron oxide in bauxite ore is present as hematite or goethite, silica occurs partly as clay and partly as free quartz and titanium occurs in the form of leucoxene or rutile. Most bauxite deposits have resulted from the decay and weathering (mostly chemical) in warm, moist, tropical or subtropical climates of rocks rich in alumina and low in free quartz like Granite, Gneiss, Basalt, syenites, nephelinesyenites, feldspathicgneisses, schists and granulite etc. A bauxite deposit thus represents the residual concentration of the aluminium hydrates after practically all the other constituents of the parent rock have been removed. Major use of bauxite is for aluminium industry.

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The Laterite is formed by chemical weathering process of Aluminous Silicate rocks as described in above. The Duricrust Horizon or Laterite zone is the upper part of the main accumulation zone of the weathering profile. This is normally formed due to recrystallized iron minerals and is therefore the hardest part of profile. The produced laterite from this mine shall be sold to the Cement industries located in Ramgarh& Ranchi region.

- **Substitutes for Bauxite**

Bauxite resources are adequate for decades of production at current rates. Other materials could be used instead of bauxite for alumina production. Clay minerals, alunite, anorthosite, power plant ash, and oil shale could be used to produce alumina but at higher costs, using different processes. Silicon carbide could be used in place of bauxite-based abrasives. Synthetic mullite could be used in place of bauxite-based refractories.

- **Bauxite Localities in Jharkhand Region**

- Lohardaga
- Gumla
- Palamu
- Ranchi

- **Regional Geology**

The Chhotanagpur Plateau is geologically the oldest terrain having less geological disturbances. On the remnants of the Earth's first crust modification have brought many changes in the geology. Slow destruction and side – by – side construction have brought forward the different type of rock formations. The past geographical and physical conditions have played a good role in producing a different shape to the geology of the area.

The bauxite and laterite bearing plateau of Jharkhand are the remnants of the great table land of the trappean character. Due to prolonged weathering and denudatic most of the table land has been washed away and small portion has escaped largely due to extensive laterization. The general stratigraphic succession is as follows:

Recent	Soil – laterite and Bauxite concentration and lithomarge	
Upper cretaceous To Ecocene	Deccan trap – Basaltic flow intertrappens	
----------UNCONFORMITY----------		
Cuddapah or early Archean	Chhotanagpur Granite gneiss	Newer dolerite, vein rock, pegmatite in granite, etc.
Dharwar or older metamorphic	Iron ore series Lime silicates & basis rocks.	Phyllite, Mica Schist, Quartzite

In the sequence given above laterite is resting over the older formations. The transitional zone between the laterite and the Archaean is very much covered by the detrital material.

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Bauxite deposits are mostly associated with high level laterite; occur as thin, irregular and discontinuous lenses or tabular bodies within the laterite capping. The development of bauxite is very irregular in general. In case of high grade material, sandwiched between the laterite horizons, may occupy fairly extensive zones or may confine to the limited portions of the laterite caps. Out crop along the edge of the laterite blankets scarp are found. A typical scarp face shows the following sections from the top of the plateau down to 30 M.

Concretionary ferruginous laterite Pink, grey or green colour bauxite
Lighter shade of aluminous laterite.
Thick basal portion of dark red laterite.
Tuffaceous or lithomargic clay.

A thick patch of dark red laterite and bauxite follows the occurrence of lithomarge clay at the base of the laterite profile. The bauxite zone of the laterite profile may be directly overlain by a bed of pisolitic concretionary ferruginous laterite or may be interposed by another zone of aluminous laterite. It is generally believed that the deposit of bauxite in high level laterite is mostly from wedge shaped bodies thinning inwards from the scarp faces.
Bauxite deposits are associated with high level laterite occurring as thin, irregular and discontinuous lenses or tabular bodies within the laterite capping. The colour of the bauxite varies from white to pale cream, pink or yellow and red. It is mostly soft and hard having uneven to conchoidal fractures. The red color indicates enrichment of iron within Bauxite whereas grey cream color indicates less iron content.

- **Climate:**

Climatically the year in the region may be divided into three seasons.The climate of the area is generally cold in winter between November and February and hot in summer during March and June.T he monsoon sets in late June and continues up to the end of August.

- **Temperature**

The temperature shows a steady increase trend from the beginning of March till May, the hottest month. The max. Temperature is 42°C to 45°C and min. temperature is 02°C to 12°C.
With the onset of the Southwest monsoon by about mid-June the day temperature drops appreciably and continues in the same range up to September. With the withdrawal of monsoon, the day and night temperatures start falling from October heralding the onset of winter.
The month of November marks the setting in of winter season with both day and night temperature decreasing till January, with is the coolest month. The mean day maximum and minimum temperature in January are 20°C and0.02°C ,respectively.

- **Rainfall**

The rainy season in the area extends from mid-June to September. The average rainfall of the region is between 1000mm to 1200mm for whole year. The average number of rainy days varies from 15-20 in the monsoon months. The rainfall is not spread throughout the year. Nearly 87%of the rainfall occur during June to October period.

- **How Bauxite is formed**

It is a rock from a laterite soil that has been severely leached of silica and other soluble materials in a wet tropical or subtropical climate. It is a primary ore of aluminium.

- **Mining Activities**

The surface exposures of Bauxite in the form of big boulders, was observed in the lease area. Surface outcrops as well as existing quarries (within & outside the lease) clearly indicate that there is substantial quantity of deposit of Bauxite and Laterite in the form of Blankets, pockets and sheets covering the parent rock or interstratified with sediments. The principal ore body is in western part. There are more ore bodies within the leasehold, which need further exploratory work. The lithological succession as observed in existing quarry and trial pits of the area is given in below Table.

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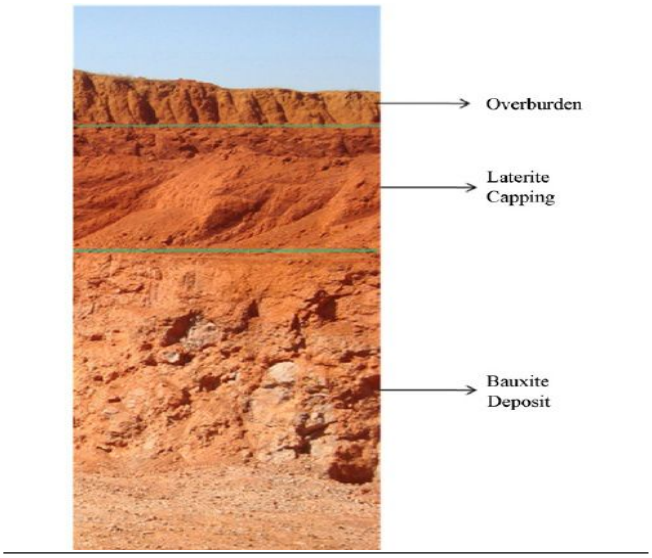
Lithology Sequence

Zone-A		Zone-B	
Litho-Units	Thickness (m)	Litho-Units	Thickness (m)
Soil and Alluvium (O/B)	2.0 (max.)	Laterite	2.70 (max)
Bauxite	2.7 (max.)	Bauxite	1.15 (max)



➢ Methods of Mining

The mining operation was done by open cast semi mechanized / mechanized method. The area contains Bauxite in the form of pocket deposit, since the inception of mining operation, production of Bauxite was not constant. It is proposed to carry out mining operation by open cast OTFM method by using HEMM mainly Excavator of 0.9 cum bucket capacity in combination with 10 MT dumpers. The existing quarry is proposed to develop for the production of Bauxite to meet the requirement of different consuming industries. The excavation work shall be done by Excavator. As most of the Bauxite ore zone is soft in nature, thus Drilling/blasting is proposed in harder patch only. The total excavation in ore zone requires sorting of intercalated waste and sizing of ore which will be done manually. After that the ore shall be loaded into dumpers by manual means. Hence, open cast OTFM method of mining has been proposed to be continued. The waste to be generated during the plan period shall be dump over the earmarked non mineralized area.

It will be a mechanized opencast mine, Ore and laterite to are broken by explosives, and face in OB will always be kept in advance of the ore face. Faces in the quarries will be properly benched. System of benching followed in OB would be such that no bench shall be more than 6m height maximum x 6m width minimum, whereas in quarry, ore bench would be 6m height x 6m width. The sequence of operations followed will be (a) cutting and removal of soil by poclain dumper combination wherever present in the bench; (b) cutting of morrum and laterite by poclain dumper combination (c) drilling of holes by wagon drill compressor combination upto a depth of 6.0m (d) charging and blasting of holes; (e)separation by hand of bauxite from waste in the ore zone; (f) removal of OB and waste in dumper to the dump site or backfills, as the case may be.

The face in top soil would be at least one bench ahead of the latetite, and that of the laterite would be one bench ahead of the bauxite face. The sequence of operation will be so followed to maintain the system of benching as said. The floor of the quarry is almost flat and, therefore, the OB removed would be dumped regularly within the quarry. The line of dumping will be so followed that at least about 8m of space is available between the bauxite face and the lower slops of the dump. The overburden and waste will be backfilled at the worked out quarry as proposed in the development plan. The recovery percentage of ore is about 80% of the ore zone will constitute despatch able bauxite. Taking mining losses at low figure of 20% overall recovery will of the order of only about 80% of the ore zone. Forked shovels will be used to recover smaller pieces of bauxite and minimize mining losses.

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Mechanized mining is proposed; hence powered equipment will be deployed. Crowbars, picks, spades, sledgehammers and fork shovel being the only implements used for sorting and removal of Bauxite. For transporting soil overburden and waste to the respective dumping sites, dumpers will be used. The ore will be transported by trucks provided by the transport contractors of the company to stockyard at Lohardaga which is about 25 Km from the area. The trucks would be brought right up to the face and blasted and stacked ore is loaded directly in to the trucks.

1) DRILL MACHINES (100 mm Dia):

Wagon drill of 100 mm diameter is proposed to be deployed and the numbers of units required are:

For OB Removal:Two drill machines is adequate to meet the required production target and the particulars of OB drilling are given in Table -2.1

O/B REMOVAL PARAMETERS

Particulars	Details
Bench Heights	1.2 m
Burden	1 m
Spacing	1 m
Bulk density in-situ	1.5 Mt/m3
Depth of hole including sub- grade drilling	1.32 m

For Bauxite production:

Particulars	Details
Bench Height	6 m
Drill hole dia.	100 m
Burden	3 m
Spacing	3.5 m
Bulk density in-situ	2.4 Mt/m3
Depth of hole including sub- grade drilling	6.6 m

Details of drilling machine:

Type	Nos	Dia of drill hole in mm	Capacity	Make	Motive power	HP
DTH	4	100	25 m/hour	Atlas capco cm 785	Diesel	440

2) **EXCAVATORS**:(Loading Equipment)

For Bauxite Production: Two excavators will be sufficient to handle the required targeted production.

For Top Soil and OB Excavation: One excavator will be sufficient to handle the required targeted development.

Detail of excavator:

Type	Nos	Bucket capacity in cum	Make	Motive power	H.P
Hydraulic Excavator	4	0.9	Komatsu Pc 200	Diesel	124

3) HAULAGE AND TRANSPORT EQUPMENTS:

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Details of Hauling/ Transport Equipment:

Type	Nos	Size/capacity	Make	Motive Power	H.P
Tippers for Top soil & transportation	2	10 MT	Ashok Leyland	Power Diesel	98.5

4) MISCELLANEOUS:

Miscellaneous Equipment Details

Description	Quantity	Capacity
Explosive van	1	10 MT
Water tank	1	5000 Lt
Tractor with trailer	1	
Jip crane cum fork lift	1	
Portable welding machine	1	
Ambulance van	1	
Field service van	1	
Jeep	1	

➢ **BLASTING**

The overburden, ranging from 1.5 m to 3.5 m in thickness, and consisting of murrum and laterite, is soft enough to be directly excavated. The harder murrum and laterite are drilled by using 100mm dia. drills and blasted, before removing. The wagon drill with compressed air drill shall be used for drilling the hole.

The bauxite bench height is a maximum of 6.0 m if ore thickness is below this figure. However, where ore thickness exceeds 3.0 m, a second bench is worked. 100mm drills drill the benches. Burden and spacing are maintained 3m and 3.5m depending upon the compactness of formation. Holes will be drilled in square/scattered pattern. The holes are charged with explosives. Shot firing is done usually with the help of safety fuse and ordinary detonator.

The following blasting parameters are being adopted:

	Overburden	Bauxite
Explosive	Power gel	Power gel
Charge/ Hole	0.5 kg	24 kg
	1 raw of 10-20 holes in one round	1 raw of 10-20 holes in one round
Explosive	10 kg of slurry explosive (20 holes)	480 kg of slurry explosive (20 holes)

SITE SERVICE:

The following site services will be provided in the mine:

1) Pit Office
2) First aid centre
3) Rest shelters
4) Blasting shelters
5) Canteen
6) V.T Centre
7) Worksop

Manpower Requirements

	No of persons
Mining Engineer	1
Manager	1
Geologist	1
Foreman	1
Surveyor	1
Mining mate	1
Blaster	1
Blaster helper	1
Store keeper	1

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Attendance clerk	1
Quarry munshi	2
Driller	5
Poclain operator	3
Dumper operator	3
Miners (semiskilled)	30
Unskilled	5
Total	**58**

Water requirement

Sr. no	Water requirement	Quantity (m3/day)
1	Drinking	0.45
2	Water sprinkling to suppress dust at loading face, wet drilling, spraying on haul roads & plantation etc.	10.9
3	Greenbelt	7.0
	Total	**18.35**

➢ **Generation of Waste**

During the mining operation three types of wastes will be generated. They are topsoil, laterite and mineral rejects. However, the types of wastes will be as follows: (i) Top Soil: The topsoil is greyish brown in colour and gritty in nature. (ii) Quarry Wastes: Quarry wastes are mainly waste generated during the course of mining operation. The quarry wastes are mainly very small fraction of bauxite and laterite contaminated with morrum etc. ant cannot be used in the alumina plant due to less than 30% alumina and more than 10% silica content.

ENVIRONMENTAL MONITORING PROGRAMME

Introduction

The industrial development of any area needs to be intertwined with judicious utilization of non-renewable resources of the study area and within the limits of permissible assimilative capacity. The assimilative capacity of the study area is the maximum amount of pollution load that can be discharged into the environment without affecting the designated use and is governed by dilution, dispersion and removal due to physico-chemical and biological processes. The Environment Monitoring Programme is required to ensure sustainable development in the study area (10 km) of the project site, hence it needs to be an all-encompassing plan for which the plant authorities, Government, Regulating agencies like Pollution Control Board etc. working in the region and more importantly the affected population of the study area need to extend their co-operation and contribution.

Implementation Schedule of Mitigation Measures

S. No	Recommendation	Time requirement	Schedule
1	Air pollution control measures	Before commissioning of respective units	Immediate
2	Water pollution control measures	Before commissioning of the mine	Immediate
3	Noise control measures	Along with the commissioning of the mine	Immediate
4	Ecological preservation and up gradation	Stage-wise implementation	Immediate & progressive

Administrative Aspects & Environmental Monitoring Program

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigatory

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steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. Usually, as in the case of the study, an Impact Assessment study is carried over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality.

Institutional Arrangement for environment protection & Conservation.

The mine will be supervised and controlled by an independent Mines Manager supported by adequate team of technically and statutorily qualified personnel apart from the operating staff ofskilled, semi-skilled, unskilled and other categories. This Environment Cell is responsible for the management and implementation of the environmental control measures. Basically, this department will supervise the monitoring of environmental pollution levels viz., ambient air quality, water and effluent quality, noise level either departmentally or by appointing external agencies wherever necessary. In case the monitored results of environmental pollution are found to exceed the allowable limits, the En vironment Management Cell will suggest remedial action and get these suggestions implemented through the concerned authorities. The actual

Operation and maintenance of pollution control equipment of each unit is under the respective in-charges.

Environment Monitoring Programme

Monitoring shall confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological/biological, physical and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

The environmental monitoring will be conducted in the mine operations as follows:

- Air Quality
- Water & waste-water Quality
- Noise Level
- Soil Quality
- And Greenbelt Development

ENVIRONMENT MANAGEMENT PLAN (EMP)

The environmental management plan consists of the set of mitigation, management, monitoring and institutional measures to be taken during the implementation and operation of the project, to eliminateadverse environmental impacts or reduce them toacceptablelevels. The present environmental management plan addresses the components of environment, which are likely to be affected by the different operations in a minearea.

The aims of EMP are:

- Overall conservation of environment.
- Minimization of waste generation and pollution.
- Judicious use of natural resources and water.
- Safety, welfare and good health of the work force and populace.
- Ensure effective operation of all control measures.
- Vigilance against probable disasters and accidents.
- Monitoring of cumulative and long time impacts.
- Ensure effective operation of all control measures

Air Quality Management

Dust emissions due to mineral handling, during mining operations are not much and restricted to the lease area only. Air pollution is caused mainly due to dust generation added with gaseous emission from transportation activities along with mining operation like loading, haulage etc.

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Control of Fugitive Emissions

- Wet drilling arrangements will be made.
- Use of Personal Protection Equipment (PPE) like dust masks, ear plugs etc. by the mine workers
- Regular water sprinkling on haul roads & loading points will be carried out.
- Development of green belt/plantation around the lease boundary, roads, dumps etc.

Noise Abatement and Control

- Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce the generation of noise.
- Adequate silencers will be provided in all the diesel engines.
- Plantation along the sides of approach roads and mine area will be done to minimize the propagation of noise.
- Personal Protective Equipment (PPE) like earmuffs/earplugs will be provided to all operators and employees working near mining machineries or at higher noise zone.
- Periodical noise level monitoring will be done.

Water Quality Management

As there is no seasonal nalla or water body within the leaseholdarea, therefore no change will be observed due to mining operation. Analysis results of surface water samples collected from rivers and nallas in the buffer zone indicate that the pH, total dissolved solids (TDS) are well below the prescribed limits. No wastewater generation is envisaged due to the mining operations. The sanitary wastewater will be sent to septic tanks. No impact of wastewater generation on the surface water is envisaged, as there is no discharge into surface water resources. No impact on water quality by the proposed mining project is envisaged.

Waste Management

Nature of waste: Waste material is soil, Over Burden and quarry waste. Soil will be spread over old dump and backfilled area after mining of Bauxite and quarry wastes will be used as concurrent backfilling the void created due to mining. Since the waste material is to be utilized for back filling it is proposed to dump them close to the quarries but sufficiently away keeping in the view of the lateral extension of the quarries so thatdouble handling is not necessary.

Selection of Dumping Site:

The entire overburden & waste will be used for concurrent backfilling of the worked out quarries. So, no external dump is proposed for dumping.

Maximum height & spread of dumps:

The over burden and quarry waste will be dumped first to back fill the area and after backfilling it will be levelled and top soil be spread over it to reclaim the area. The maximum area covered by the reclamation and height of the reclaimed area.

Greenbelt and Plantation:

So far as a forestation is concerned, saplings would be planted at a spacing of 2.5 m along the boundaries of the M.L. area. Local species will be planted in the area as per availability. A table showing year wise a forestation scheduled.

Year wise afforestation scheduled

S. NO	Particulars	No. Of sapling	Area in ha
1	1st year	400	0.16
2	2nd year	400	0.16
3	3rd year	425	0.17
Total		**1225**	**0.49**

The following characteristics should be taken into consideration while selecting plant species for green belt development and tree plantation.

- They should be fast growing and tall trees.
- They should be perennial and evergreen.
- They should have thick canopy cover.

Plantation should be done in appropriate alternate rows around the proposed site to prevent lateral pollution dispersion. The trees should maintain regional ecological balance and conform to soil and hydrological conditions. Indigenous species should be preferred.

Biological Management Measures

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There is a requirement to establish a stable ecosystem with both ecological and economic returns. Minimization of soil erosion and dust pollution enhances the beauty of the core and the buffer zone. To achieve this, it is planned to increase plantation activities. The basic objectives of plantation are as follows:-

- Improvement of Soil quality
- Quick vegetative cover to check soil erosion
- Improvement in mining site stability
- Conservation of biological diversity
- As dust receptor which likely to produce during mining

Greenbelt Development Plan

Green belt is plantation of trees for reducing the pollution as they absorb both gaseous and particulate pollutant, thus removing them from atmosphere. Green plants form a surface capable of absorbing air pollutants and forming sinks for pollutants. It improves the aesthetic value of local environment. Under present project, green belts have been planned with emphasis on creating biodiversity; enhance natural surroundings and mitigating pollution. The greenbelt development plan aims to overall improvement in the environmental conditions of the region. The plan with a five-fold objective addresses issues such as providing sink for air pollutants likely to emitted from the project; enhancing the forest cover for increasing the biodiversity of the region; providing aesthetic value to the project area enhancing the ecological equilibrium of the area; and to a large proportion in combating soil erosion.

- Afforestation on degraded forest area, forest protection /conservation will be carried out every year by the mine owner.
- This activity will promote the emergence of the primary succession species; hence it will be a silvicultural operation, extremely important for maintaining ecology and environmental health of the area.
- This helps in regeneration & establishment of pioneer plant species saving expose land & land cutting.

Afforestation will be done along the boundary barrier and quarry roads. Considering a grid of 2.5m x 2.5m about 0.4 hectares area, Numbers of plants of different species, mainly fruit –bearing plants like Mahua, Mango, Jackfruit, Sakhua (as per availability) will be planted. About twice the area recommended for mining will be used for afforestation/greenbelt as per the "Forest (Conservation) Amendment Rule, 2004".

The scheme of plantation around the project site is given as follows:

i) Afforestation will be put under a protective regulatory framework to ensure that it is not degraded or disturbed. No ecologically disruptive activity will be allowed in this zone.

ii) Afforestation will cover a total of 0.49ha. Jharkhand comes under Eastern plateau hills agro-climatic zone whereas the present project area comes under Eastern plateau sub zone. The plants recommended for afforestation are as per Guidelines for Developing Greenbelts, CPCB, March 2000 and listed in

Species Recommended for Greenbelt Development

S. No	Name	Botanical Name	Status
1	Bel	Aeglemarmelos	Tree
2	Siris	AlbiziaLebbek	Tree
3	White Siris	Albiziaprocera	Tree
4	Dhaura	AnogeissusLatifolia	Tree
5	Neem	AzadirachtaIndica	Tree
6	Golden Bamboo	Bambusa Vulgaris	Grass
7	Butterfly Tree	Bauhinia Purpurea	Tree
8	Semla	Bauhinia Semla	Tree
9	Kachnar	Bauhinia Variegata	Tree
10	Bottle brush	Callistemon Citrinus	Tree
11	Amaltas	Cassia Fistula	Tree
12	Shisham	DalbergiaSissoo	Tree
13	Gulmohar	DelonixRegia	Tree
14	Bamboo	DendrocalamusStrictus	Grass
15	Amlaetc	DiospyrosMelanoxylon	Tree

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Occupational Hazards and Safety

Occupational safety and health is very closely related to productivity and good employer-employee relationship.The factors of occupational health in Bauxite. Mining project is mainly dust and land degradation. Safety of employees during operation and maintenance etc. shall be as per Mines rules and regulations.

To avoid any adverse effect on the health of workers due to various pollutants, sufficient measures relating to safety and health will also be practiced:

- Provision of rest shelters for mine workers with amenities like drinking water etc.
- All safety measures like use of safety appliances, such as dust masks, helmets, shoes, safety awareness programs, awards, posters, slogans related to safety etc.
- Training of employees for use of safety appliances and first aid in vocational training center.
- Regular maintenance and testing of all equipment as per manufacturers' guidelines.
- Periodical Medical Examination (PME) of all workers by a medical Officer.
- First Aid facility is provided at the mine site.
- Close surveillance of the factors in working environment and work practices which may affect environment and worker's health.
- Working of mine as per approved mining plan and environmental plans.

Environmental Policy

- The Owner of Bauxite Mine believes that responsible environmental stewardship comprises diligent application of well-established natural resource management, controls and practices for the protection, reclamation of the mined out land, preservation of biodiversity and proper disposal of waste following the best environmental practices duringthe process of mining of bauxite,
- Environmental policy prescribed for standard operating process to bring into focus any violation/deviation of the environment and forest norms/conditions that the company operations will implement operational and risk management practices that provide for maximum protection of people and the environment. To this end, the owner resolves that company will follow the below mentioned practices.
- Operate in accordance with prescribed industry standards while complying with all applicable environmental, health and safety laws and regulations.
- Establish and maintain a well defined environmental, health and safety management system to guide its operations.
- Ensure that all employees, officers and directors understand and adhere to its environmental, health and safety management program.
- Provide operations with the necessary resources, expertise and training to effectively carry out its EHS management programs.

II. CONCLUSION

As discussed, it is safe to say that the project is not likely to cause any significant impact on the ecology of the area, as adequate preventive measures will be adopted to contain the various pollutants within permissible limits. Green belt development around the area will also be taken up as an effective pollution mitigative technique, as well as to control the pollutants released from the premises of the Bauxite Mine.

REFERENCES

1. *Thermal Engineering by Rajput R.K*
2. *Mechanism and Machine Theory by Ambekar A.G*
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