Bauxite in India was once believed to be exclusively confined to the scattered residual laterite profiles developed over the Deccan Trap basalts of central and western India. The bauxite reserves in these pockety occurrences were estimated to be of the order of 350 million tones in 1970, and none of the deposit was found to contain more than 50 million tones of the ore. The discovery of Eastern Ghat bauxite during seventies in the state of Orissa and Andhra Pradesh brought a sea change in the country’s bauxite resource position. Today with 3011 million tones resources, India is on the threshold of massive expansion and development of bauxite alumina industry (Nandi, 1992).

A review was undertaken of the interaction between bauxite mining, its restoration, and the hydrology of the Plateau areas. The mining operation is predominately within the water supply catchments area, giving rise to three hydrological issues: turbidity, stream yields, and stream salinity. Turbidity management is effected through attention to detail in day-to-day operations (Croton et al., 2007).

Some salient features of bauxite mining, techno-economic evaluation, uses and specification of the bauxites are discussed in the following pages.

8.1 PROSPECTING AND EXPLORATION OF BAUXITE:

Detailed prospecting of bauxite at Mainpat was taken up by the Directorate of Geology and Mining (DGM, 2003-04), Chhattisgarh, since 1995 to continue. Systematic pitting and drilling work was under taken by this agency. Further exploration work and mining in this area could not be taken up by DGM because of objection raised by forest department. However, private/semi private agencies Bharat Aluminium Company (BALCO) are involved in mining at north and south eastern part of the plateau.

8.1.1 PITTING, TRENCHING AND DRILING:

Pits were made in the area having dimension of 2 x 2m, with depth varying from 1 to 7m. Pits were made to study the nature of ore body and quality and
quantity of bauxite. Pits were made in grid pattern and at some places 100 x 100m spacing was given. At some places trench are dug having dimension of 1m x 10-12m, with depth varying from 1 to 3m. Some pits and trench showed high grade and unusual thickness of bauxite ore body (43 – 58% Al$_2$O$_3$ and 5 – 8m thickness).

Shallow core drilling was used in the Mainpat area during exploration and many bore holes were drilled on the grid pattern at an interval of 100m maximum thickness of bauxite (approximate 13-15m) was recorded by DGM. On the other hand some bore holes were found barren or devoid of industrial grade bauxite.

8.1.2 RESERVE AND GRADE OF ORE:

DGM, Chhattisgarh has chemically divided the bauxite into three grades, as follows-

Grade A – Al$_2$O$_3$ – >55%, SiO$_2$ <3%.
Grade B – Al$_2$O$_3$ – 42-55%, SiO$_2$ <3%.
Grade C – Al$_2$O$_3$ – <42.5%, SiO$_2$ <5%.

As per Indian Minerals Year Book (1992), DGM carried out detailed geological mapping, pitting trenching and drilling in the area and total proved reserves of bauxite was worked out about 33 million tones. While considering 20% loss during mining the total extractable reserves of bauxite are of the order of 27 million tones.

8.2 MINING OF BAUXITE AT MAINPAT PLATEAU:

Bauxite deposits of Mainpat area is being mined by BALCO on lease basis. The State Mining Corporation and Directorate Geology and Mining are not involved in bauxite mining. Some other private companies are applied for mining lease in the area. In these deposits, bauxite is manually mined after the blasting of ore zone. The mines are open cast and thickness of overburden is very low or negligible.
There is no systematic plan of mining in the area. Thus, mining method applied in this area may be called simply quarrying or stripping. First of all, thin soil cover, covering laterite/bauxite is removed and quarrying upto a depth of 2 to 3 meters is done along scarp boundary, so that bauxite bearing laterite face is exposed. Then explosive are used to blast the hard material and big bauxite/laterite boulders are obtained. Boulders obtained through blasting are further reduced by hand-operated air compressor drills. Material is further broken with big hammers into small pieces of appropriate size. Material thus obtained, is manually sorted into three types, i.e. laterite (very low grade iron rich bauxite), aluminous laterite (low grade bauxite) and bauxite. After sorting of material into these three categories, samples from each category are analysed for alumina and silica, and it is again sorted grade wise, i.e. grade ‘A’ grade ‘B’ and grade ‘C’ material. ‘A’ and ‘B’ grade bauxite is loaded into trucks and dumpers and brought down to the hill and sent to Korba plant of BALCO.

**8.3 DRAWBACKS IN PRESENT MINING:**

The mining method, which is being used in the study area, is an unplanned, open cast quarrying which has following drawbacks-

1. Distribution of bauxite at Mainpat area is erratic and pockety. Mining in these areas is not systematic, bench wise, but it is scattered and irregular manner. In this process only high-grade material is erratically recovered and marginal/sub-marginal grade ores are through out.

2. Mining is confined mostly all along scarps, where over burden is thin. Flat middle part of the plateau is untouched, because of thick overburden in the central part of the plateau.

3. Manual sorting of the material is done, based on color of the material. No systematic method of mine sampling is used in these deposits.
4. Low grade material is not fully being used for any purpose. It is simply thrown out as waste material in and around the plateau.

5. Ore dust or fine material is also not used for any purposes.

6. Mine are not mechanized expect dumper, trucks and excavator are used for loading, unloading and transportation. Therefore, rate of mining and production is low.

7. Mining as well as transportation of ore is affected during rainy season.

**8.4 ENVIRONMENTAL IMPACT:**

Like other surface mining activity bauxite exploitation causes definite disfiguration of the earth and reddish-brown patches appear on the plateau top. Bauxite mining operation may cause following distinctive impact on environment-

8.4.1 DEFORESTATION:

Since bauxite mining at the area is confined along the periphery of the plateaus, deforestation is limited and localized. The top of the plateau are mostly devoid of thick forest due to the formation of hard ferruginous duricrust at places of bauxitization, where iron moves up during alumina enrichment. The slopes of valleys in between the plateau are characterized by the presence of highly weathered parent rock and other rock types, which retains water and favours luxuriant vegetations. Therefore, density of trees at plateau top is about 275 to 300 tree per hectare, as compared to 600 to 750 trees per hectare at slope and valleys.

8.4.2 BAUXITE MINING AND RECLAMATION:

Mining operation at the area is not being carried out in a systematic manner. Quarrying is done wherever pocket of high grade ore body are present on the plateau. The total excavation consists of soil, overburden, associated laterite and clean ore. The soft overburden is nothing but loosely packed ferruginous pisolitic laterites associated with soil, which can easily be removed. The hard
overburden is made up of massive ferruginous laterite and requires blasting for their fragmentation. Here, the waste material is not back filled into the excavated area as in other mining areas like Amarkantak etc; in rainy-season water is percolated through open mine faces which may cause serious instability of slope in near future.

8.4.3 SURFACE WATER:

Several small streams and springs, mostly seasonal are observed in the valleys, slopes and top of the plateau. There are many springs located in the area which act as main source of water for the drinking and other uses. On altitude of 1020 to 1100m above mean sea level.

The horizontal top of the plateau are traversed by seasonal nalas which act as run off channels in rainy season. These channels and nalas expose the bauxite at several places along their flow direction near the plateau peripheries. The bauxite mining is restricted only to peripheral areas which gradually losses adequate solid peripheral barrier and top soil, bauxite and laterite fines freely go along with the surface run off. The bauxite/laterite fines do not dissolve in water, but it may produce slight reddish turbidity in water. It may also slightly affect the pH value of surface water.

8.4.4 GROUND WATER:

No significant differences were noticeable in the water levels in the mined or in virgin areas. Even minor variations were not found attributable to the mining. The natural process of recharge is retarded at many places of virgin bauxite plateau, due to thick capping of lateritic crust at the surface, beneath the shallow cover of soil. The mining operations at the area may create additional fractures and cracks by blasting and thus may increases the secondary porosity. Even permeability of soil of mined areas may be slightly higher than the virgin area.
This may clearly indicate that, there is no effect whatsoever of mining on the recharging of the aquifer in the area.

### 8.5 Techno-Economic Evaluation:

Salient techno-economic features of the bauxite deposits of the study area are as follows-

1. Bauxite quality is good at the area for alumina production. Bauxite supplied for alumina production has average 52% Al$_2$O$_3$ and 3-8% SiO$_2$.
2. Reserves of these deposits are very high; therefore, they sustain Greenfield alumina plant based on these deposits.
3. This deposit is regularly supplying ore to BALCO Korba plant.
4. A very high alumina and medium to low iron bauxite can be selectively mined, which can be used for refractory/abrasive purposes.
5. Bauxite can be beneficiated to reduce iron and silica content to use them in refractory or abrasive industries and low grade ferruginous laterite can be used in steel or cement plants.
6. Transportation cost of this deposit is higher than the mining cost.

### 8.6 Uses and Specifications:

The Indian Bureau of Mines (1992) estimated, about 89% of India’s total bauxite production is used in metallurgical industries (aluminium production), 4.2% in refractory, 4.06% in cement, 1.46% in abrasive and rest 1.18% in chemical, iron and steel, ceramics and alloy-steel sectors. About 87% bauxite ore used for alumina/aluminium production of the total reserves of the country. Thus the main area of emphasis for specification of bauxite must be in the direction of aluminium production.
Table 8.1 Standard specifications of the bauxite used in different industries.

<table>
<thead>
<tr>
<th>Oxides/Industry</th>
<th>Aluminium</th>
<th>Cement/Steel</th>
<th>Chemical</th>
<th>Refractory</th>
<th>Abrasive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>45-47 % min</td>
<td>42-45 % min</td>
<td>58% min.</td>
<td>87 % min</td>
<td>86 % min</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>15-25 % max</td>
<td>10-25 % max</td>
<td>2.5% max</td>
<td>1.5% max</td>
<td>2.0% max</td>
</tr>
<tr>
<td>SiO₂</td>
<td>4-5 % max</td>
<td>10 % max</td>
<td>2-5%</td>
<td>5.5% max</td>
<td>6.0% max</td>
</tr>
<tr>
<td>TiO₂</td>
<td>3-4 % max</td>
<td>3-4 % max</td>
<td>4%</td>
<td>2.5% max</td>
<td>4.5% max</td>
</tr>
</tbody>
</table>

The chemical analysis of the Mainpat bauxite (Table 8.1) shows that it may be used for different industrial purposes. The gibbsitic bauxite is considered most suitable for alumina production because of their favorable mineralogy for low pressure digestion, alumina silica factor and bauxite mining factors. In the refractory industry, the main problem with this bauxite is their high iron oxides and titanium contents. They can not directly used for refractory industry despite selective mining. The normal criteria for assessing the acceptability of calcined bauxite for the production of brown corundum (abrasive) are both chemical and physical. The aluminium content should be as high as possible (min 80% Al₂O₃ in calcined form). The mineralogical form of the alumina is not criteria although gibbsitic-bauxite does comprise the bulk of feed stocks.

The chemical industry may use this bauxite, after proper beneficiation to reduce the iron and silica content. Cement industry is using the bauxite of the study area, but iron and titanium content posses the problem and makes them difficult to use for this purpose.

Bauxite must be beneficiated using more specialized techniques such as magnetic separation, reduction roasting followed by isodynamic separation etc to reduce iron, titanium and silica content and to make them suitable for different industries.