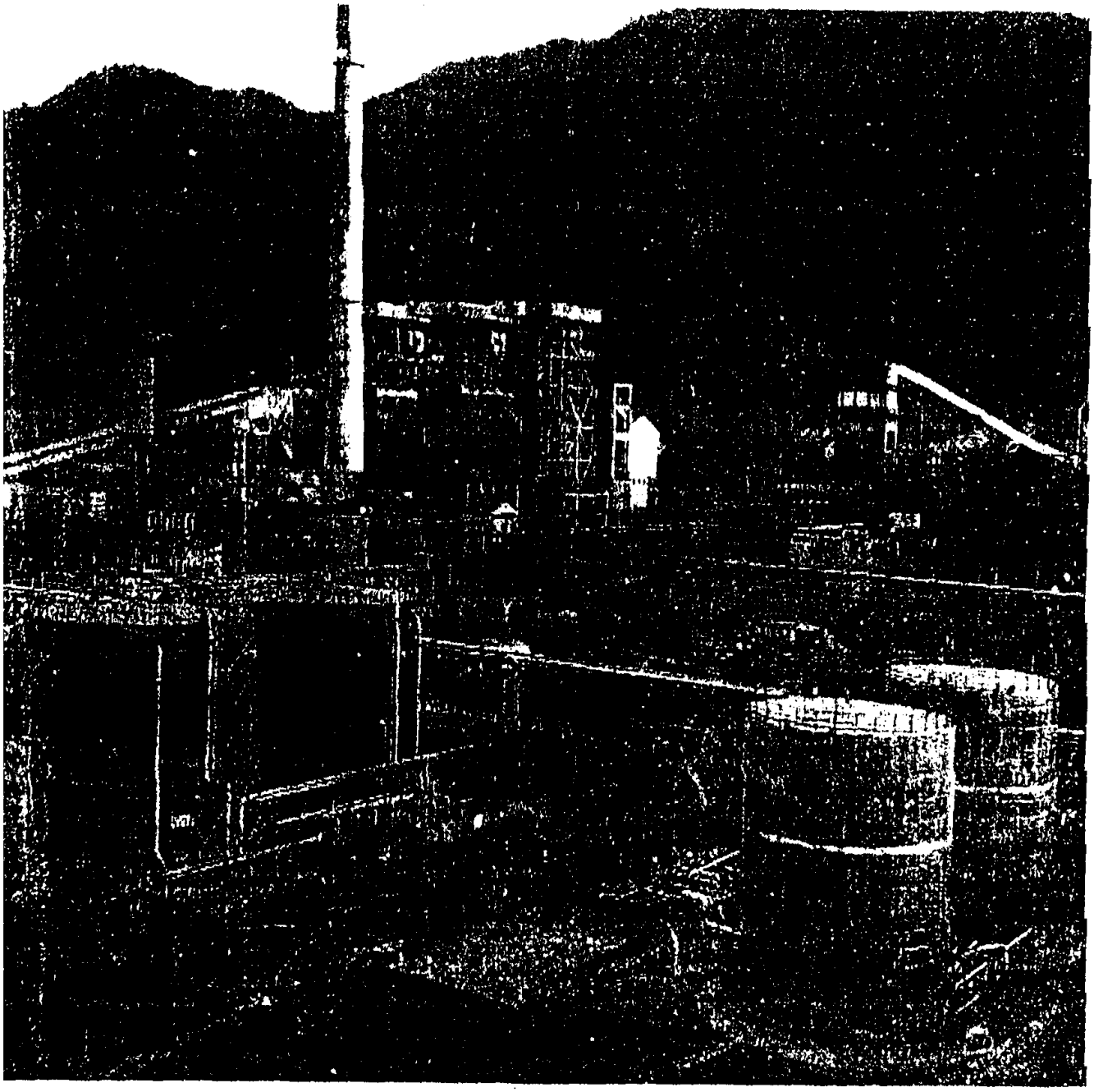
INSPECTION REPORT ON M/S. VEDANTA ALUMINIUM LIMITED, LANJIGARH, KALAHANDI



SATE POLLUTION CONTROL BOARD, ORISSA

Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-VIII, Bhubaneswar-751012

INSPECTION REPORT OF M/S. VEDANTA ALUMINIUM LIMITED, LANJIGARH, KALAHANDI

Introduction:

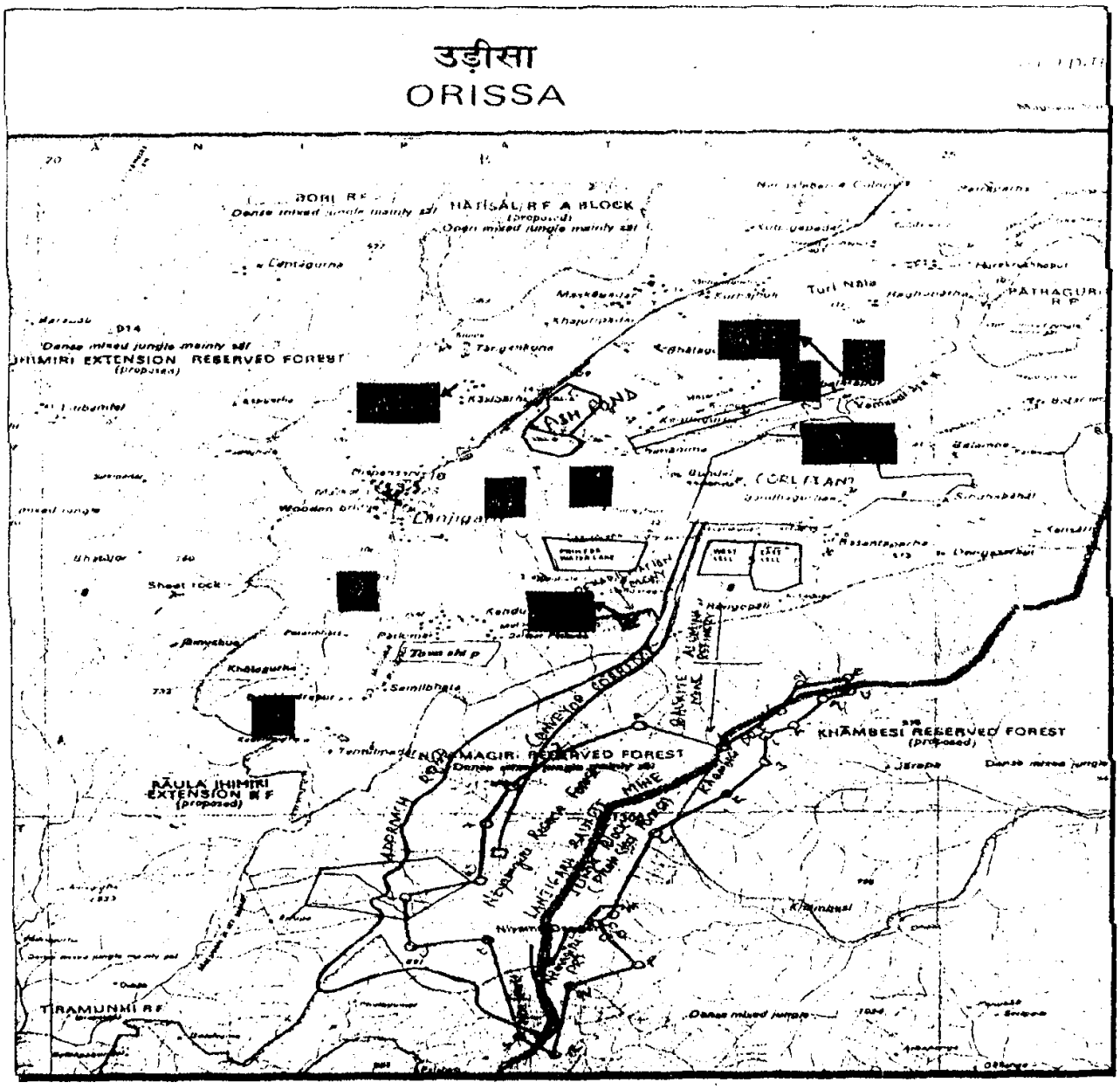
M/s. Vedanta Aluminium Limited has established a refinery plant of capacity to produce 1 MTPA of alumina. The plant comprises of two alumina production streams of capacity 0.5 MTPA each and three steam generation plants. The steam generation plants not only cater the requirement of steam for production of Alumina from bauxite but also electricity of 75 MW is generated for plant uses. Consent to operate has been granted to the unit under both the Air and the Water (PCP) Act valid up to 31.3.2008. Reportedly, the stream -I was put into commission on 26.3.2007 and operation of stream-II is yet to be started. Presently, the stream-I is in operation with full load. Soon after commencement of operation, there was public complain against the industry on environmental pollution being caused due to emission and discharges from the plant. In order to assess the adequacy of various measures taken by the industry for prevention and control of pollution, impact of industrial emission and discharges on its surrounding environment, a detail inspection was conducted by the following team on 2.11.2007 to 4.11.2007.

1. C.R.Nayak, Env. Scientist
2. P.C. Rout, Regional Officer
3. S. K. Mohanty, Asst.Env. Scientist
4. S.G.Pradhan, Asst. Env.Scientist

- The production process, sources of both air and water pollution and its adequacy, compliance status of various environmental protocols and standards, wastewater and storm water management practice, emission from point sources, ambient air quality, surface and ground water quality in and around the plant were inspected, monitored during the inspection period. While monitoring of ambient air quality at Chatrapur (HVS placed on the roof top of the building belonging to Sri Nayak Senapati(village Sarpanch) interacted with village people on the issues related to environmental impacts due to operation of the industry. Dr. R.C. Rout, AGM, SHE accompanied the team throughout the inspection of the industry. Discussed various issues related to pollution prevention & control with Dr. Mukesh Kumar vice president, operation.

Location of the Industry:

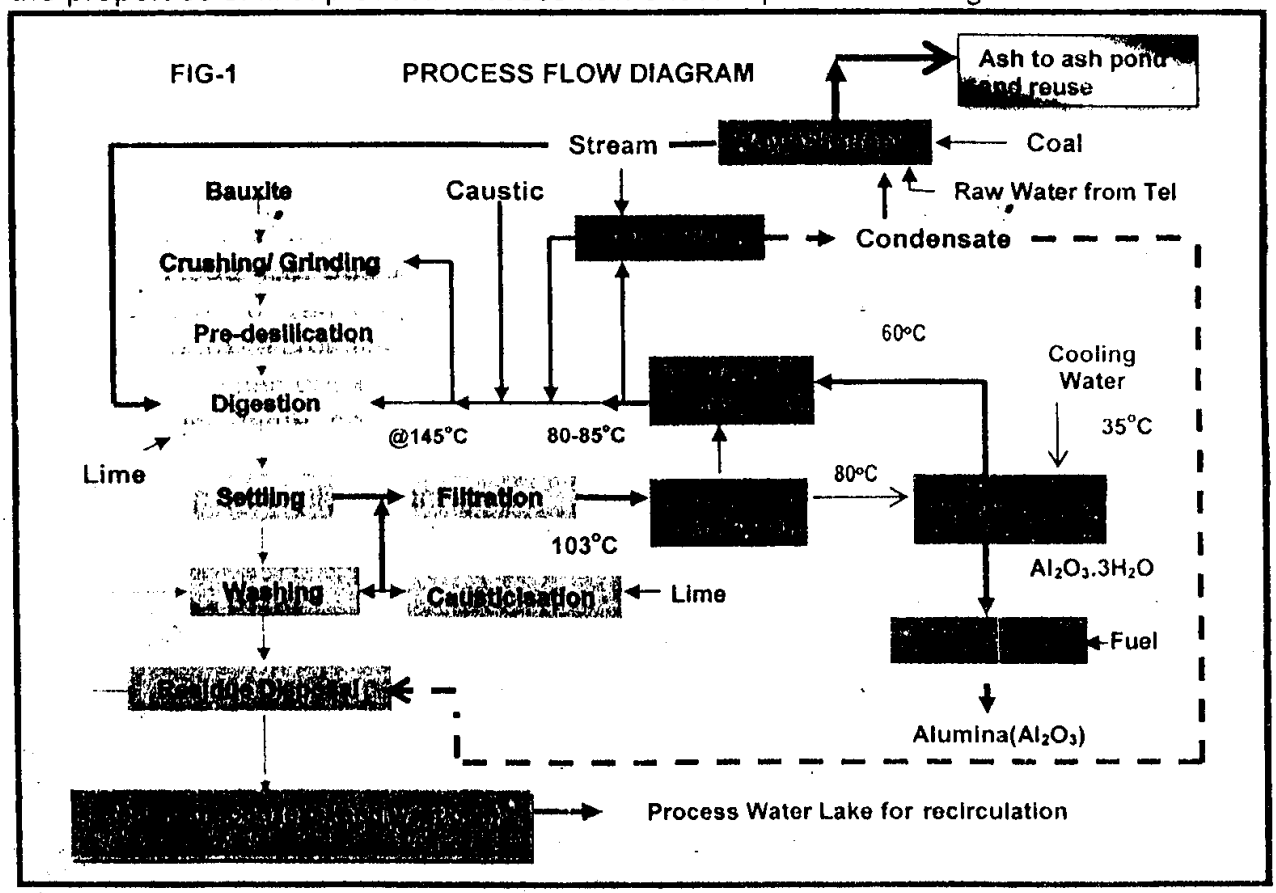
The refinery unit is located in the catchment area of river vamsadhara. The core plant is located almost on the foot hill of Niyamgiri parbat towards south of Vamsadhara river. The river vamsadhara flows close to the northern boundary of the core plant. The ash pond has been constructed on the opposite side of vamsadhara towards NW side of the core plant. Red mud pond and process water lake are constructed on the plateau outside the main plant. There are numbers of perennial streams all around the plant and few streams within the core plant itself. The location of the plant and other waste containment facilities are shown on the topo sheet of the area.



Production Process:

The industry has adopted the Bayer process to produce Alumina from bauxite. About 2.61T of bauxite ore used for production of 1 Ton of Alumina. Presently, the bauxite obtained mainly from Korba is used for the production of alumina. Reportedly, the plant will be utilizing the bauxite available in nearby Niyamgiri hill after start of operation of the mine.

Precisely, the production process involves crushing and grinding of bauxite and then dissolved in caustic soda (Sodium Hydroxide) at a high/medium pressure and temperature. The resulting liquor is a solution of sodium aluminates and un-dissolved bauxite residues containing iron, silicon, and titanium. These residues sink gradually to the bottom of the settling tank and removed as red mud. The clear sodium aluminates solution is then pumped into tanks called precipitator. Fine particles of alumina are added to seed the precipitation of pure alumina particles. The particles sink to the bottom of the tank, are removed and then calcined (two calciners) to drive off the chemically combined water (about 6% as reported) and the end product is nothing but white powder, pure alumina. Calcination process is carefully controlled as it dictates the properties of final product. Process flow sheet is presented in fig.-1



Raw material consumption:

Raw material	Unit	Consumption
Bauxite(dry)	t/t	2.61
Caustic soda	kg/t	70.0
Lime	kg/t	44.0
Fuel Oil	Lit/t	80.0

Other Utilities:

- **Coal** - 1MTPA from IB valley coal fields to meet the requirement.
- **Water** - 30 M liters per day from Tel River via 65 km pipeline.

Alumina production status

Date	Quantity of production in TPD
1st- November,2007	369.0
2nd- November, 2007	220.0
3rd -November,2007	1291.0
4th- November, 2007	1335.0

Pollution potential:

The industry is basically both air and water pol'uting in nature. The major sources of pollution are as follows:

Sources of air pollution

(a) **Alumina production unit**

- Bauxite stacking area
- Road near bauxite stack yard
- Bauxite transfer points from the stack yard
- Bauxite crushing unit
- Crushed bauxite transfer point to silo (inlet point) at the top
- Discharge point of silo at the bottom
- Conveying system
- Lime handling plant
- Calcination plant

(b) **Power Plant**

- Coal staking area
- Coal transfer point
- Coal crushing & grinding unit
- Boiler emission

Sources of water pollution

(a) **Alumina production unit**

- Fuel oil caustic storage facility
- All bauxite processing units

Generation of red mud slurry is the major wastewater of the production process of alumina plant. Alkaline/non alkaline wastewater is also being generated in from of spillages, gland leakages, floor washings and blow down from alkaline/non-alkaline cooling tower etc.

(b) **Power plant**

- DM Plant
- Boiler blow down
- Cooling tower blow down
- Ash handling unit

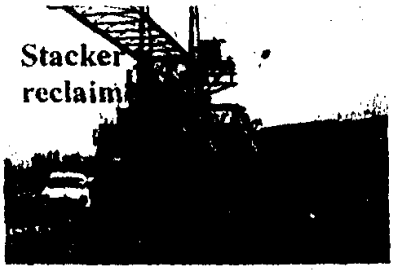
Generation of ash slurry is the major wastewater of the power plant from ash handling system, besides alkaline and acidic wastewater from DM plant.

(c) **Sewage effluent from industry and township.**

Existing pollution control measures:

Air Pollution Control

i) The bauxite from the stack yard is lifted by stacker reclaimer and transferred through conveyor to the



crushing unit and then to silo. All the transfer points and crushing unit have in-built dry fog system for prevention and control of fugitive dust generation.

ii) The bauxite after crushing is transferred to silo. The in let point and out let point of silo has inbuilt atomized water spray system for control of dust emission.

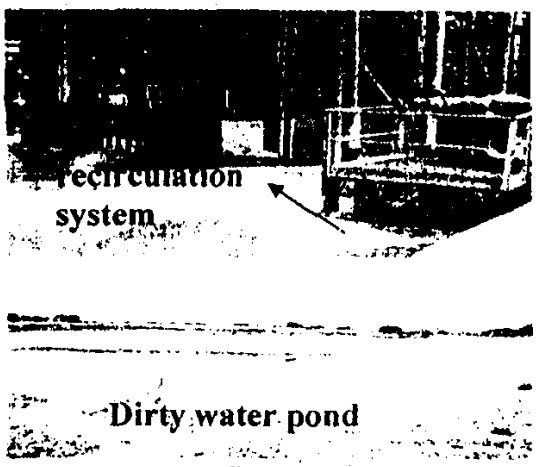
iii) Bauxite conveying systems from the transfer points to grinding unit (wet grinding)are closed to prevent the dust being air borne.

iv) Lime handling plant has in-built wet scrubbing system.

v) Electrostatic Precipitator (3 fields in each ESP) having adequate particulate matte removal efficiency has been installed in each calciner and is connected to stack (tw nos.) of height 120m from GL.

vi) Coal transfer points and crushing and grinding units have been provided with dr fog system and coal conveying is done through closed conveyor belt to the boiler Electro static precipitator (ESP having 8 fields) in each boiler has been installed fo removal of fly ash from the gas stream and is connected to a stack of height of 145m from GL.

Wastewater management



i) Wastewater generated from all process units (other than red mud) in the form of washings, spillages, leakages, blows down etc.are highly alkaline in nature. In all process areas containment bunds with sump and recirculation system have been provided. In case of any upset condition in the plant or in the recirculation network, provision has been made in all process areas to divert the alkaline wastewater to dirty water drain and finally to dirty water pond (DWP). Further, uncontrolled spillages and leakages from the process areas and blow downs are diverted to the dirty water drain for ultimate collection in the dirty water pond. Recirculation arrangement at dirty water pond is in place for sending back the alkaline wastewater to the process. The dirty water pond has been constructed with due care (impervious lining)to prevent any seepages.

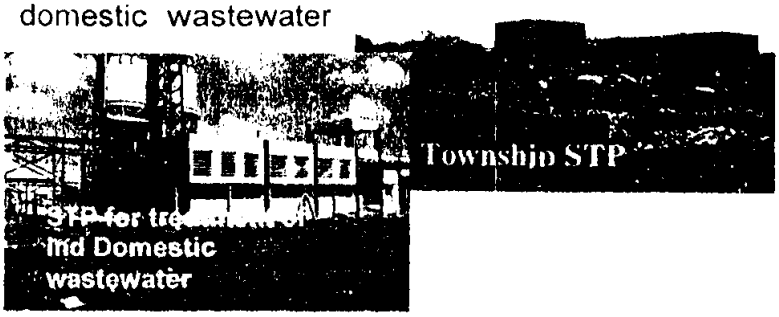
ii) Red mud generated from the plant is discharged to red mud pond (currently in west cell) in the form of slurry. The decanted water from slurry disposal area was initially proposed to be evacuated through pipe lines by gravity to the process water lake from where it was to be pumped back to the plant for reuse in the process. Since the process water lake is not ready for use, the decanted water is at present collected at one corner of the said red mud pond and pumping arrangement has been provided there for sending alkaline water back to the plant for reuse. The east cell is of the red mud pond is under construction.

iii) Alkaline /acidic effluent generated from the DM plant is neutralized and reused for slurry making purpose. The boiler and cooling tower blow down water is similarly used for ash handling and a closed network for collection and use of this water has been provided.

iv) The ash slurry generated from the power plant is discharged to ash pond. Provision has been made for collection of decanted water in a separate pond from where it will be pumped back to the plant for reuse (ash handling purpose). Ash water is now contained in the slurry pond. No recirculation system has been installed as yet for decanted water. Reportedly, the recirculation system will be ready by the time overflow of the decanted water takes place from the slurry pond to the decanted water pond.

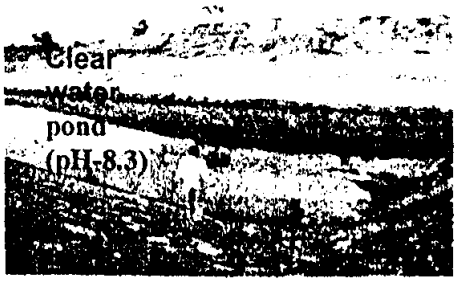
v) Oil separator system has been provided in the oil storage area for collection of spillages during unloading/handling of oil and the reclaimed oil is send back to the storage tank. Provision has been made for further separation of oil from the water and the water free from oil to be discharged to the sewage treatment plant (STP inside the plant).

vi) Sewage treatment plant (STP) has been constructed for both industrial domestic wastewater and wastewater generated from the township. Construction of the STP(s) is almost completed, but will take some time to be ready for use. Presently, sewage effluent is being managed in the soak pits. It has been proposed to utilize the treated wastewater for horticultural purpose. During monsoon the treated wastewater is likely to flow into river vamsadhara, incase any alternative arrangement is not made for reuse.

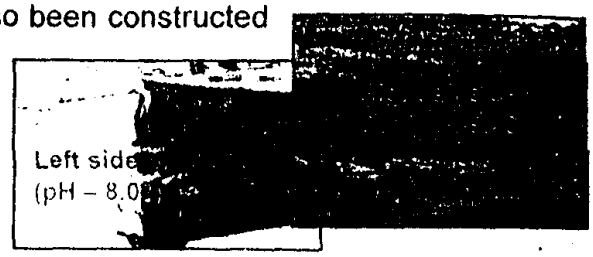


Storm water management

i) A clear water pond has been constructed for collection of storm water from the power plant and from part of other areas of the plant. The water thus collected in the pond has been proposed to be used for ash handling and for gardening. Return water pipe line has already been laid, but the pump house is yet to be constructed.



ii) Separate storm water drains have also been constructed in the process areas(at some places parallel to the dirty water drain) and the water flows in the drain finally discharged through an out let near dirty water pond and through another outlet at the right side the dirty water pond to vamsadhara as shown in the picture.



MONITORING REPORTS

i) Stack emission

Table-1

Location of the sampling point	Date and time of Monitoring	Particulate Matter (PM) Emission in mg/Nm^3	
		Result	Prescribed standard
Duct connected to stack after ESP of CF Boiler-3	3.11.2007at 4.30pm	795.0	150.0
Duct connected to stack after ESP of Calcination plant-1	4.11.2007 at 11.0am	32.0*	

*Port hole is at a turbulence zone as it is close to ID Fan

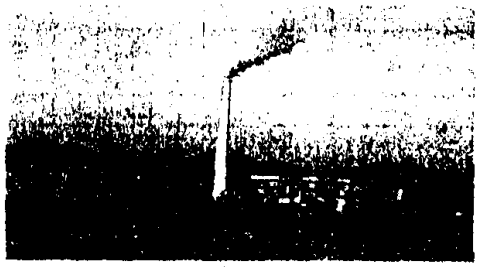


Photo taken at 4.51pmon2.11.2007

Photo taken at 5.36pm on3.11.2007

ii) Ambient air quality monitoring report

Date of Monitoring: 02.11.2007.

Table-2

Sl. No.	Location	RSPM (µg/m^3)	NRPM (µg/m^3)	SPM (µg/m^3)	SO_2 (µg/m^3)	NOx (µg/m^3)
A1	Rehabiiitation colony in South West direction (R)	**147.0**	77.0	**224.0**	26.8	41.0
A2	Over raw water treatment Plant (I)	**471.0**	330.0	**801.0**	84.6	68.8
A3	Kasibari village (R)	20.0	42.0	62.0	BDL*	12.1
A4	Chatrapur Village (R)	80.0	124.0	**204.0**	11.6	14.4
	Standard for 24 Hr (R)	100	-	**200**	80	80
	Standard for 24 Hr (I)	150	-	**500**	120	120

(R) : Residential,
(I) : Industrial area
* BDL : Below detection limit

iii) Analysis report of water samples collected in and around the industry

Table-3

(a)River water

Sl. No.	Location of the Sampling Point's	Parameters		
		pH -	TSS (mg/l)	Na (mg/l)
01.	Vamsadhara near Tentulipadar (U/s)	7.37	27.0	15.6
02.	Vamsadhara near Kendubadi (U/s-2)	7.63	9.0	9.5
03.	Vamsadhara river near Narayani culvert (Down stream point of process water lake)	7.57	11.0	17.2
04.	D/s. point of Process water lake	8.02	19.0	7.9
05.	Vamsadhara near Chatrapur culvert, D/s of M/s Vedanta Aluminium Ltd.	8.16	14.0	9.0
06.	D/s of Vamsadhara after discharge of storm water from plant side near Chatrapur	8.12	16.0	8.3
	Prescribed standard – Class B	***6.5-8.5***	-	-

(b)Storm water drain inside the plant area

Sl. No.	Location of the Sampling Points	pH -	TSS (mg/l)	Na (mg/l)
01.	Storm water drain inlet to clear water pond (no disposal of water to out side from the pond)	8.3	34.0	51.0
02.	Storm water drain discharged to river Vamsadhara near dirty water pond	8.03	51.0	14.9
03.	Plant effluent discharged through cover drain to dirty water pond (Two pumps are installed for recirculation)	12.97	5216.0	3740.0
04.	Drain around the red mud pond side	7.93	9.0	5.1
05.	Strom water drain near railway Crossing (Inside plant) leads to river Vamsadhara	9.46	13.0	22.3
06.	Seepage water drain at the toe of red mud pond dyke discharge to Vamsadhara river	11.06	96.0	290.0
07.	Accumulated water in the process water lake which is not ready for use	11.62	15.0	326.0
	Prescribed standard	***5.5-9.0***	***100.0***	-

(c) Test wells around red mud pond, process water lake, ash pond and dirty water pond

Sl. No.	Location of the Sampling Points	pH -	TSS (mg/l)	Na (mg/l)
01.	Test well near Red mud pond south side	6.88	49.0	5.9
02.	Test well near Red mud pond North side	7.09	34.0	9.6
03.	Test well no-2 around red mud pond in S-W Direction	6.86	5.0	23.4
04.	Test well no-4 around process water lake in N-W direction	6.57	23.0	4.4
05.	Test well no -5 near process water lake in N-E direction	6.55	4.0	7.1
06.	Test well no-7 near Ash pond in N-W direction	7.58	3.0	33.3
07.	Test well No-8 near Ash pond in North direction	7.67	5.0	15.9

08.	Test well No-6 near Ash pond in N-E direction	6.95	52.0	14.5
09.	Test well near dirty pond (9)	7.58	1.0	51.0
10.	Test well near clear water pond	7.24	5.0	30.4
	Drinking Water Quality standard	***6.5-8.5***	-	-

(d)Tube wells of nearby village

Sl. No.	Location of the Sampling Points	pH -	TSS (mg/l)	Na (mg/l)
01.	Tube well in Chatrapur village	7.59	3.0	42.4
02.	Tube well water at Bundel	7.53	2.0	11.8
	Drinking Water Quality standard	***6.5-8.5***	-	-

Discussion vis-a vis monitoring results

i) The particulate matter emission from boiler-3 as shown in the table-1 has been observed to be 795 mg/Nm^3 against the prescribed standard of 150 mg/Nm^3. Such high emission within a valley has potential to cause atmospheric pollution in the vicinity and health hazards. Suspended particulate matter concentration measured at residential areas (rehab colony and chatrapur village) is observed to be more than the prescribed standards for residential area. Further, the SPM concentration inside the plant has been observed to be beyond the prescribed standard of 500μ gm/m^3 (table-2). The concentration of respirable particulate matter in the rehab colony and inside the plant is also found to be beyond the prescribed standards. High concentration of suspended particulate matter in the ambient air is attributed to improper dispersion of such high emission of particulate matter from boiler stack. Locations of ambient air quality monitoring conducted are shown in the fig-1.

ii) Water samples of river from up-stream and downstream points of the industry have been collected and analyzed for the parameters like pH. TSS and Na and the results are shown in table-3. It is observed that the parameters are within the prescribed standard of class-B river water quality. However, the pH level has shown increasing trend towards the downstream points indicating some contribution from the plant through storm water drain discharges to the river.Though the matter do not seems to be significant now, the situation may become serious unless appropriate action is taken for prevention of discharge to the river .

iii) The plant storm water discharges to river were also monitored to find out the quality of discharge. It is observed that the storm water near railway crossing within the plant premises discharged to river vamsadhara has high pH value

(9.46) as shown in table-3b, which may be due to alkali contamination from the plant process areas due to spillages.

iv) Water samples collected from test wells around the red mud pond, process water lake, ash pond, dirty water pond and tube wells of nearby villages however do not reveal any contamination of ground water at present (table-3,c&d).

Views on adequacy of existing pollution prevention and control system:

i) It may be seen from the monitoring result that the particulate matter emission in the boiler stack is quite high. From such high level of stack emission it can be stated that the ESP installed in the boiler is not adequate. Though the emission from the calciner stack was observed to be within the limiting standard of 150mg/Nm3, the monitoring was however conducted at a highly turbulence zone. The industry was therefore advised to relocate the sampling point (port hole) at the appropriate place for proper monitoring of emission and adequacy of ESP can be assessed after that. The visible emission from the stack attached to the calciner was however found to be quite insignificant during inspection and monitoring.

ii) There was no visible emission of fugitive dust from bauxite handling, lime handling and coal handling plants. The de-dusting system installed at all strategic dust generation points are working satisfactorily and seems to be adequate. However, all these air pollution control systems need to be maintained and operated so that generation of fugitive dust can be prevented effectively.

iii) The alkaline waste water containment system with recirculation arrangement in all the process areas seems to be adequate. However proper care needs to be taken to prevent any discharge of seepages/leakages to the storm water drains.

iv) Though the systems are in place for containment of red mud slurry and ash slurry, these are required to be re examined from different angles like whether conducive to permanent seepage or not, safety and stability of all dykes are good enough to prevent any breach etc. Further, adequacy of the system is a question when the red mud slurry with inappropriate consistency (not HCSD) is

discharged at present to the ponding system and timely evacuation of decanted water does not takes place.

(i) The arrangement made for dirty water collection and its reuse seems to be adequate at present.

(ii) Arrangement made by constructing clear water pond for collection of part of storm water of the plant and its reuse proposal seems to be a good practice.

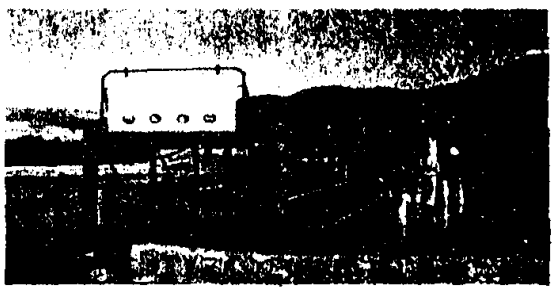
Deficiencies observed:

i. Bauxite residue which is now being discharged to red mud pond (east cell) does not seem to be of high concentration slurry (55-60%). High concentration slurry disposal (HCSD) system is not being scrupulously followed by controlling the process parameters to achieve the desired concentration before being pumped for disposal.

(Red mud slurry discharged to the pond situated almost on the foot hill of Niyamgiri.)

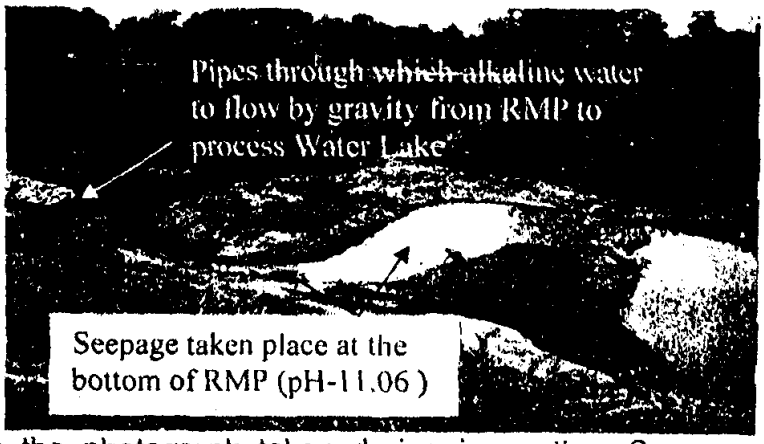
ii. Inside the red mud pond (East cell) a particular portion near the toe of the dyke has been eroded exposing the subsurface as shown in the photograph. From the exposed area it seems proper compaction of the bottom has not been done.

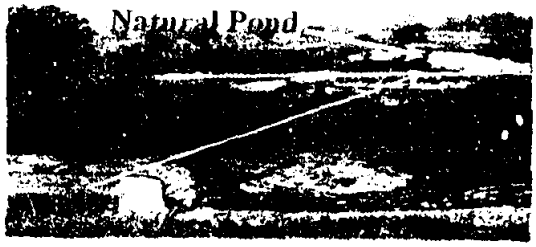
iii. It was proposed to discharge high concentration red mud slurry to the pond and the alkaline water in it was supposed to flow down slowly from the slurry deposition area and ultimately to the process water lake by gravity for recirculation. It was observed that water in the red mud pond has been accumulated at one corner of the red mud pond and recirculation system has been installed there as shown in the picture. The water level in the mud pond has almost touched the highest level of the dyke. No disposal to the process



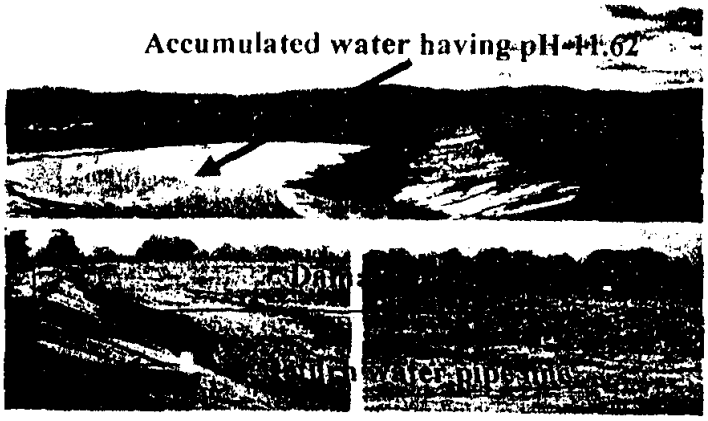
water lake is there at present as the process water lake is not yet ready for use. **Accumulation of water as shown in the picture is likely to affect the safety and stability of the dyke and enhance the seepage of alkaline water from the pond.** Moreover, such practice of management of alkaline wastewater was neither envisaged by the industry nor approved by the Board.

iv. Construction of red mud pond does not seem to be done carefully to prevent seepages of alkaline wastewater to outside. As such seepage from the red mud pond has already been started as shown in the photograph taken during inspection. Seepage water at the bottom of the dyke was collected to verify the level of pH and the analysis result shows alkaline nature. This is a cause of concern because; any seepage from the pond will ultimately find its way to river Vamsadhara passing through natural ponds, agricultural fields etc. The pond is being used by local people for bathing.



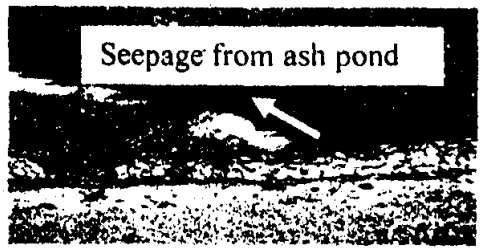


v. The process water lake constructed is in a bad shape. HDPE linings in the lake (both bottom as well as dyke) was found to be in damaged condition and at some places taken out. Besides construction of the recirculation the system is yet to be completed. Though the system is yet to be taken into line, accumulation some quantity of water was found to be there in the lake and pH of this water is alkaline in nature.



vi. High concentration ash slurry disposal (HCSD) as envisaged does not seem to be followed. Visibly solid content in the slurry was less than 50% against design quality of 60-70% solid.

vii. Seepage from ash pond was noticed as shown in the picture and ultimately going to river Vamsadhara through natural pond and paddy field. Since the filtrate water pond is yet to be taken into line, the ash water was found to be accumulated at one corner of the slurry pond from where seepage has started. Recirculation system for filtrate water is yet to be constructed.



viii. Parapet wall around the alkaline wash water storage tank area inside the plant was not found to be full proof. Seepage of accumulated water (pump and gland leakages) to outside the containment area was found to be there. Any seepage/leakage/overflow from the containment area of all process units will naturaly flow to the open storm water drains and contaminate the water that flows almost throughout the year in the drain.

ix. No action has been taken to contain the surface run off to be generated from the bauxite stacking yard during monsoon. In absence of such facility the surface run off is likely to flow into the storm water drains and contaminate it.

x. On line monitoring system for pH in all storm water drains is yet to be installed.

xi. Construction of Sewage treatment plant (STP) for both township and plant is ye to be completed.

xii. Emission of particulate matter in the boiler stack is very high (795mg/Nm^3 against the standard of 150 mg/Nm^3).Either the fields (8 fields in each ESP) are inadequate or there is a design defect in the ESP for which such high particulate matter has been observed in the stack emission.

xiii. Online monitoring system for measurement of particulate matter emission in both boiler and calciner stacks is yet to be installed.

xiv. Bauxite storage area and coal stacking yard do not have fixed water sprinkling arrangement for control of fugitive dust.

Recommendations:

1. Necessary corrective action must be taken immediately to increase the efficiency of ESP (S) so that emission through the stack will never exceed the prescribed limit of 150 mg/Nm^3. Under no circumstances any boiler shall be operated resulting emission beyond 150mg/Nm^3.The industry needs to inform the Board regarding the detail design of the ESP and explain the reason for such high emission.
2. Atomized water sprinkling arrangement needs to be provided around the bauxite & coal stacking areas.
3. Necessary action must be taken immediately to stop seepage of alkaline water from the red mud pond. However, a permanent containment system must be in place for collection of any uncontrolled seepage from the red mud pond area as well as from process water lake with arrangement for pumping back either to the pond or to the plant directly for reuse.
4. The safety and stability of the dykes, possibility of any permanent seepages from the red mud pond and process water lake(decanted water pond) must be studied thoroughly again by an expert team and necessary corrective measures be taken if required. The details shall be furnished to the Board.
5. High concentration red mud slurry disposal practice must be strictly followed.
6. Alkaline water accumulated in the pond needs to be evacuated immediately by pumping it back to the plant for reuse. Impoundment of water in the red mud pond should be avoided under all circumstances.
7. Construction of process water lake (decanted water pond) should be completed and taken into line as quick as possible so that the pressure on red mud pond will be minimized. All accumulated alkaline water in the process water lake also needs to be evacuated to prevent ground water contamination.
8. High concentration ash slurry disposal must be scrupulously followed and immediate action be taken to stop seepages from the ash pond. Recirculation system for decanted water from the ash pond should be constructed as quickly as possible to evacuate the accumulated water in the pond.

9. The height of parapet walls at the process areas needs to be adequately raise for effective containment of washings, spillages and leakages etc., and t prevent ingress of rain water to the process floor during monsoon.

10. The industry should take action to stop any discharge of water through ston water drain to river Vamsadhara as it is likely to be contaminated wit spillage/leakage alkaline wastewater from the process areas. It should be eithe diverted to dirty water pond for recirculation or a separate arrangement be mad for containment at the appropriate place within the plant and reuse the storr water in the process. Such action will reduce the fresh water consumption of th plant.

11. Relocation of sampling point should be done immediately for monitoring th emission from calciner.

12. Sewage treatment plant for both township and plant must be ready and put in t use as quick as possible. Arrangement should also be made to reuse th treated water besides using this water for horticultural purpose.

13. Containment pond by the side of bauxite storage yard and coal stack yar should be provided for collection of surface run off with arrangement to use thi water for sprinkling purpose at the dust generating points.

14. Online pH meter in all storm water drains of the plant must be installed to have a close eye on contamination if any due to seepages or leakages from the process areas and necessary action be taken to ensure prevention o contamination.

15. Online monitoring system for particulate matter in the attack emission (both ir boiler and calciner stack) needs to be installed.

16. A detail report on storm water management of the plant must be prepared and submitted to the Board within one month.

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