ISSN 0972-2173

SGAT bulletin

Journal of the Society of Geoscientists and Allied Technologists

Volume 6 • December 2005 • No. 2

SPECIAL PUBLICATION FOR
SILVER JUBILEE CELEBRATION
AND
INTERNATIONAL SEMINAR ON
VISION MINERAL DEVELOPMENT 2020 (VMD-2020)

ISSN 0972-2173
RNI Regd. No: ORIENG/2000/2296

SGAT bulletin
Bi-annual

Vol. 6•December 2005•No.2

Publication of the Society of Geoscientists and Allied Technologists
Complementary for Members of the Society

SGAT Bulletin

Vol. 6 December 2005 No. 2

CONTENTS

SGAT Bulletin
Vol.6, No.2 December2005 pp.1-24

INDUSTRIAL ENVIRONMENT IN ORISSA

M.C. Dash,
Former Vice-Chancellor, Sambalpur University &
Former Chairman, State Pollution Control Board, Orissa.
N-4/58(1st Floor), IRC Village, Nayapally, Bhubaneswar

ABSTRACT:

The major Industries of Orissa are the Iron and Steel, Sponge Iron, Aluminium, Thermal Power, Mining and some other. Out of 111 large-scale industries, 60 industries are either metal based or mineral processing and 10 are thermal power. Besides more than 170 operating mines exist in Orissa. Some 7.0 million tonnes of Iron and Steel and sponge Iron are produced annually and resource consumption is about 11 million tonnes of Iron ore, 9 million tonnes of coke and coal and 20 to 40 million cubic meter of fresh water per year. The industrial production and resource consumption for Aluminium and some other industries have been discussed. Since there is heavy pressure on fresh water consumption, its impoundment and management strategy for the state is required.

Brahamni river receives 24 times higher pollution load than Mahanadi river system. The BOD and COD load to river Brahamani is about 66 times and 44 times respectively more than Mahanadi river. The SPM level in air at Augul-Talcher and Rourkela requires abatement measures. Green House gas generation is high at Anugul-Talcher region. The industries generate about 13 million tonnes of fly ash and 1-3 million tonnes of red mud annually. Besides, about 81,000 tonnes of Hazardous waste are generated. These require Management Strategy on Priority basis.

Key words: Industrial production, Resource consumption, Water pollution, Carrying capacity.

INTRODUCTION

The mineral resources and other natural resources are the productive capital of the Nation. Industrial development depends upon utilization of the productive capital and thereby causing resources depletion and environmental degradation. Orissa is not a very industrialize State. Before independent, Orissa had one Glass Manufacturing Factory at Barang and Paper Mill at Brajaraj Nagar. Orissa appeared in the industrial map of India after setting up of the integrated Iron & Steel plant at Rourkela during the 2nd Five Year Plan. The Hirakud Multipurpose Dam provided power and the industrial development in the State started accelerating after commissioning of Hirakud Dam

Project. The coal sector was nationalized in 1975 and consequently many Thermal Power Plants came up in Orissa. Development of the Paradeep Port triggered further development of mining activities specially Iron Ore mining for export. During the last 50 years, the Angul-Talcher area has become very much industrialized due to large scale mining both underground and surface mining setting up the Aluminium Smelter Plant and Captive Power Plant by NALCO and Thermal Power Plants by NTPC. The Sukinda Valley is known for the Chromite reserves and mining activities became intense. The Ib Valley of Western part of Orissa houses coal mines and Hirakud Dam Water Reservoir. The Coal, Lime Stone, Dolomite Ore Mines, Hydro Electric Power Plants, Thermal Power Plants, Refractory, Aluminium Smelter by INDAL and Cement Plants have come up. Recently many iron and steel industries and Sponge Iron Plants have also come up. The Keonjhar, Barbil, Joda and Bonai area are known for iron ore reserves and the mining activities are very intensive. The Rourkela, Rajgangpur area has become another important industrial zone because of the Rourkela integrated steel plant, Fertilizer plant, Rajgangpur Cement Plant, many sponge iron plants and refractories. The South Western part of Orissa has huge deposits of Bauxite. In view of this, Bauxite mining and alumina plants have come up in South part of Orissa. After development of Paradeep Port, Oswal Chemicals & Fertilizer Ltd., the largest phosphatic fertilizer plant in the country and Paradeep Phosphate Ltd., another fertilizer manufacturing company have come up. A number of Paper and Pulp industries, Cement Plant, Sugar factories, Automobile tyre industry have also come up in different parts Orissa. **Table-1.1** shows the type and number of industries in Orissa. However, the most of the large and medium scale industries centers around the mineral based industries.

Table 1.1 Industries Operating in Orissa

Sl.	Sector	No. of Industries			
		Large	Medium	Small	Total
01.	Iron & Steel				
	(a) Integrated Iron and Steel	2	0	0	2
	(b) Pig Iron	1	0	0	1
	(c) Sponge Iron	32	13	0	45
	(d) Ferro Alloys Plant	6	3	1	10
	(e) Secondary Steel melting like Induction Furnace	2	29	3	34
	(f) Rerolling Mills and Other and Reheating Furnace	0	17	18	35
02.	Thermal Power	10	0	0	10
03.	Aluminium	2	0	0	2
04.	Fertilizer	2	1	0	3
05.	Pulp and Paper	4	2	0	6
06.	Sugar	4	1	0	5
07.	Fermentation Industries				

	(a) Distilleries	2	0	1	3
	(b) Breweries	1	0	0	1
	(c) IMFL Boiling Plant	0	7	0	7
08.	Cement	7	2	1	10
09.	Chemical Industries				
	(a) Chloro Alkali	1	0	0	1
	(b) Bulk Drugs	0	0	1	1
	(c) Dye and Dye Intermediate	0	1	0	1
	(d) Pesticides	0	1	2	3
10.	Mineral Processing and Crushers				
	(a) Stone Crushers	1	5	908	914
	(b) Chrome Ore Benefication	2	2	25	29
	(c) Graphite Benefication	0	1	25	26
	(d) Coal Washeries	1	3	0	4
	(e) Iron Ore Crushers	4	30	20	63
	(f) Mineral Sand Processing	1	0	0	1
	(g) Alumina Refinery	1	0	0	1
	(h) Coke Ovens	1	7	0	8
	(i) Iron Ore Benefication	4	1	0	5
11.	Refractory/Bricks/Tiles				
	(a) Brick Kiln	0	0	127	127
	(b) Refractory and Ceramics	2	22	8	32
	(c) Fly Ash Bricks	0	0	15	15
12.	Food Processing and Allied Industries				
	(a) Rice Mills	0	32	218	250
	(b) Sea Food Processing	0	12	8	20
	(c) Beverages	1	8	1	10
	(d) Flour Mills	0	17	19	36
	(e) Dairy/Milk Chilling Centre	0	5	10	15
	(f) Bakery	0	6	11	17
	(g) Vegetable Oil/Edible Oil	0	13	7	20
13.	Other Industries				
	(a) LPG Bottling Depot	7	21	1	29
	(b) Explosive	2	8	0	10
	(c) Poly Propylene Products	0	31	12	43
	(d) Auto Type Manufacture	1	0	0	1
	(e) Engineering	3	11	0	14
	(f) Hotels	4	8	131	143
	(g) Industrial Gases (Oxygen and Acetylene)	0	12	3	15
	(h) Poultry and Cattle Feed	0	10	6	16
	(i) Electricity conductor, cold storage, masala grinding unit, cotton yarn, aluminium utensil, concrete sleepers, glass works, plaster of paris, detergent, granite polishing, cotton ginning, vermicelli, ice cream, mineral water etc.	0	50	337	387
	TOTAL	**111**	**397**	**1953**	**2461**

PRESENT SCENARIO

Trends in Resource Utilization and Industrial Development:

Orissa is rich in repository of major minerals like coal, iron ore, chromite ore, bauxite ore, manganese ore, dolomite and limestone. Besides, Orissa has rich water resources having many rivers, especially the two major rivers Mahanadi & Brahmani of the country. The Seacoast is about 480 km. long and 31% of the total land (155707 Sq.km.) area is covered with forests. Due to availability of water and energy, mineral based plants have come up in the State and many are expected to come in the coming decade. **Table-1.2 to 1.12** provide data on production capacity and amount of resource utilized by Steel Plants, Sponge Iron Plants, Aluminium Plants, Ferro Alloys Plants, Paper Mills, Sugar Mills, Fertilizer Plants, Stone Crushers, Brick Kilns, Rice Mills and Cement Industries in Orissa as of 2004.

The industrial growth in the State centers around Iron and Steel, Aluminium and Thermal Power Plants. Of the total number of industries **(Table-1.1)** 4.5% are large, 11.5% are medium scale industries. The rest 84% are small-scale industries with investment less than 1.0 crore for each industry. Out of 111 large scale industries, 45 are metal based, 15 are mineral processing and 10 are large Thermal Power Coal based industries indicating that industries are coal and metal based and the pollution load in Orissa's rivers and air are largely from these industries.

Iron & Steel Industries:

Iron & Steel and Sponge Iron production together is around 7.0 million tonnes per year (about 5 million tonnes of steel and 2 million tonnes of sponge iron). The amount of Iron Ore consumption is around 11 million tonnes per year. The coke/coal consumption for Iron and Steel making is about 9 million tonnes per year and fresh water consumption is about 20 to 40 million kilolitre. (As per CPCB, 2001, Waster water generation per 1 tonnes of finished steel production is $16m^3$ of fresh water). However most of the waster re-circulated at present.

Sponge Iron Plants:

Some 45 nos. of Sponge Iron Plants are now operating in Orissa and about equal number of plants are in the pipeline. The Sponge Iron sectors alone consume 4 million tonnes of iron ore per year and about 3.5 million tonnes of coal per year. These are largely air polluting industries.

Aluminium Industries:

Some 4,10,000 tonnes of Aluminium are produced per year from NALCO, Angul and INDAL, Hirakud and they propose to expand the production in coming five years to 5,60,000 tonnes per year. Present resource consumption is largely Bauxite and fresh water. The Bauxite consumption amounts to 1.8 million tonnes per year and water consumption amounts to 4.2 million kilolitre. Some 0.27 million tonnes per year of Alumina is produced from Bauxite and in the process more than 1

million tonnes of red mud is produced as waste and stored in red mud pond.

Ferro Alloys Plants:

The total production capacity of Ferro Alloys is more than 4.5 lakh tonnes per year and the raw-materials consumption per tonne of Ferro Alloys production is given in **Table 1.5(A).**

Thermal Power Plants:

Table-2.6 lists the major Thermal Power Plants in the State with electricity generation capacity of 5440 MW and with coal consumption of about 30.78 million tonnes per year, indicting that about 12.93 million tonnes of Fly Ash are generated per year and stored in ash pond of different industries.

Cement Industry:

Orissa has 3 large Cement Industries namely Ultra Tech Cement Ltd., JCW (G), Jharsuguda, OCL India Ltd., Rajgangpur, Bargarh Cement Ltd., Bargarh. These three Cement industries produce about 3.0 million tonnes of cement annually and consume of 4.5 million tonnes of Limestone, Gypsum, Blast furnace slag and Fly ash. The main resource material is Limestone with clay.

Fertilizer Plants:

Both the large Fertilizer Plants are located at Paradeep area and they manufacture Di-Amonium Phosphate (DAP) and produce 3,200 tonnes of fertilizer per day (1.2 million tonnes of fertilizer per year). The raw material consumption center around Sulphur, Rock Phosphate and Ammonia. The Sulphur consumption amounts to 4.64 million tonnes per year, Rock Phosphate amounts to 0.96 million tonnes per year and Ammonia consumption amounts to 0.96 million tonnes per year. These are both water pollution and air pollution generating industries.

Paper Mills:

There are six Paper Mills in Orissa with a production capacity of about 0.259 million tonnes per year. The resource consumption like wood and Bamboo amounts to 0.54 million tonnes per year, Straw about 15,000 metric tonne per year and Waste Paper about 72,000 metric tonne per year. The water consumption for cooling and for the process is about 36 million tonnes per year. Besides, these are huge domestic consumption. The water is drawn from nearby river. But most of the paper mills have own Captive Forests and raise their wood and Bamboo.

During the last few years more than 900 Stone Crushers and 127 Brick Kilns are operating in Orissa. These stone crushers crush about 10.00 million tonnes of Boulders per year and these are largely air polluting small and medium scale industries. The largest concentration of stone crushers are in the district of Jajpur, Khurda, Dhenkanal, Angul, Sambalpur, Sundargarh, Balasore, Bolangir and Ganjam

Table 1.2 Production Capacity (Million Tonne/year) and Resource Consumption in Steel Plants of Orissa

Sl.	Name of Industry	Production Capacity (in MT/Annum)	Resource Consumption	Quantity in MT/Annum				Total
				RSP	Nilachal Ispat	KIW	BSL	
01.	Rourkela Steel Plant	1.8	Iron Ore (MTY)	2.8	1.6	0.25	3.11	4.65
02.	Neelachal Ispat	1.0	Coke/Coal (MTY)	1.9	1.2	0.20	2.4	3.30
03.	Kalinga Iron Works	0.14	Water* (MKL/year)	39.6	22.0	3.08	44	108.68
04.	Bhusan steel, Jhursuguda	2.0 (Approx.)						

* 1 tonne steel production requires about 6 M^3 water and 16 M^3 waste water generated. Most of the waste water is re-circulated at present. Calculation is based on 22 M^3 per tonne.

Table 1.3 Sponge Iron Industries Operating in Orissa & Major Resource Consumption (Based on data of 2004).

SL.	District	Nos.*	Capacity (Tonnes per day)	Iron Ore (Tonnes per day)	Coal (Tonnes per day)	Water Kilo Litre per day)
01.	Sundargarh	27	2840	4544	3976	2840
02.	Keonjhar	13	3310	5296	4634	3310
03.	Jharsuguda	2	200	320	280	200
04.	Angul	1	100	160	140	100
05.	Jajpur	1	180	288	250	180
06.	Mayurbhanj	1	200	320	280	200
	TOTAL	**45**	**6830**	**10928**	**9560**	**6830**
	TOTAL (Million Tonnes/year)		**2.50 MTY**	**4 MTY**	**3.5 MTY**	**2.5 MKLY**

* The number of stone crushers have increased to 64 and 18 are in the pipe line

Table 1.4 Aluminium Industries and Resource Consumption in Orissa

Sl.	Name of Industry	Products	Quantity in MT/Annum		Present Raw Material Consumption at Existing Capacity		
			Existing	After Expansion	Bauxite (Million Tonnes/ year)	Alumina (Million Tonnes /year)	Water (Million Kilolitre /year
01.	NALCO, Angul	Aluminium	345,000	460,000	1.46	0.584	3.65
02.	INDAL, Hirakud	Aluminium	65,000	100,000	0.32	0.128	0.457
	TOTAL		**410,000**	**560,000**	**1.78**	**0.712**	**4.107**

Table 1.5 Ferro Alloys Plants in Orissa

Sl.	Name of Industry	Products	Production Capacity (TPA)
01.	FACOR, Randia, Bhadrak	Charge Chrome/High Carbon Ferro Chrome	50,000
02.	Ferro Manganese Plant, TISCO, Joda, Keonjhar	Charge Chrome/Ferro Chrome	30,000
03.	Ferro Alloys Plant, TISCO, Bamnipal	Charge Chrome/Ferro Chrome	50,000
04.	ICCL, Choudwar	Charge Chrome/Ferro Chrome	62,500
05.	IMFA (Plant-1), Rayagada	Ferro Silicon/Charge Chrome/High Carbon Ferro Chrome	100,000
06.	Balasore Alloys	Ferro Manganese, Ferro Silicon, Ferro Chrome and Silico Manganese	95,000
07.	Nav Bharat Ferro Chrome	High Carbon Ferro Chrome	50,000
08.	IDCOL Ferro Chrome and Alloys Ltd.	High Carbon Ferro Chrome	21,607
	TOTAL		**459107**

Table 1.5 (A) Resource Consumption in Tonnes per Tonne of Ferro Alloys Production

Sl.	Product/Raw Material	SiMn	FeMn	FeCr
01.	Manganese	1.65	2.55	--
02.	Ore Coke/char Coal	0.75	0.65	0.75
03.	FeMn Slag	0.70	--	--
04.	Chrome Ore	--	--	2.5
05.	Quartzite	0.25	--	0.15

Table 1.6 Thermal Power Plants in Orissa

Sl.	Plant	Power generation capacity MW	Coal consumption TPD @ 15.50 tonne for 1 MW
1.	NTPC, Kaniha	3000	46500
2.	NTPC, Talcher	460	7130
3.	NALCO, Angul	840	13020
4.	NALCO, Damanjodi	57	884
5.	ICCL, Choudwar	108	1674
6.	INDAL, Hirakud	200	3100
7.	Ib Thermal	420	6510
8.	Rourkela Steel Plant	203	3147
9.	Nav Bharat Ferro Alloys	30	465
10.	OCFL, Paradeep	55	853
11.	Birla Tyres, Balasore	25	388
12.	Kalinga Iron Works, Barbil	12	186
13.	J. K. Papers, Rayagada	12	186
14.	BILT, Jeypore	12	186
15.	Emami Papers, Balasore	5	78
16.	Aska Cooperative Sugar Mill	1.32	20.5
	Total	**5440.32**	**84320 (30.78 million tonnne per year)**

Table 1.7 Paper Mills in Orissa

Sl.	Name of Industry	Production Capacity (Metric Tonnes/Day	Resource Consumption (Metric Tonnes/Day)			
			Wood, Bamboo	Straw	Waste Paper	Water @ 140 tonne per tonne of paper
01.	J. K. Paper Mills, Rayagada	300	800	--	--	42000
02.	Emami Paper Mill	100	1	40	130	14000
03.	SPA Straw Board	20	--	--	--	2800
04.	COSBOARD Industries	30	--	--	65	4200
05.	BILT (SEWA)	240	650	--	--	33600
06.	JB Agro Industries	20	16	--	1.0 (Pulp)	2800
	TOTAL	**710**	**1467**	**40**	**196**	**99400**

Table 1.8 Sugar Mills in Orissa

Sl.	Name of the Industry	Average Crushing Capacity (TPM)	Average Sugar Production (TPM)
01.	Shakti Sugar Ltd., Dhenkanal	45000	4500
02.	Shakti Sugar Ltd., Badamba	37500	3375
03.	Aska Sugar Ltd., Aska	75000	2250
04.	Bargarh Co-operative Sugar Ltd.		
05.	Nayagarh Sugar Ltd.	45000	3750

Table 1.9 Fertilizer Plants in Orissa

Sl.	Name of Industry	Products	Production Capacity (TPD)	Raw Material Consumption in Metric Tonne/Day		
				Sulphur	Rock Phosphate	Ammonia
01.	Oswal Chemicals & Fertilizer Ltd.	DAP	6400	2400	10000	1800
02.	Paradeep Phosphate Ltd.	DAP	2400	800	2700	810
	TOTAL	**8800**	**3200**	**12700**	**2610**	**2610**

Table 1.10 Districtwise Stone Crushers in Orissa

Sl.	District	No. of Stone Crushers
01.	Angul	45
02.	Balasore	37
03.	Bargarh	24
04.	Bhadrak	03
05.	Bolangir	32
06.	Boudh	05
07.	Cuttack	13
08.	Deogarh	12
09.	Dhenkanal	89
10.	Gajapati	01
11.	Ganjam	39

12.	Jajpur	224
13.	Jharsuguda	12
14.	Kalahandi	23
15.	Kandhamal	01
16.	Kendrapara	01
17.	Keonjhar	21
18.	Khurda	155
19.	Koraput	11
20.	Malkangiri	02
21.	Mayurbhanj	39
22.	Nowrangpur	04
23.	Nayagarh	05
24.	Nuapada	18
25.	Rayagada	10
26.	Sambalpur	51
27.	Sonepur	02
28.	Sundargarh	35
	TOTAL	**914***

*** These stone crushers crush about 10 million tones of boulders per year**

Table 1.11 Districtwise Brick Kilns in Orissa

Sl.	District	No. of Brick Kilns
01.	Angul	01
02.	Khurda	32
03.	Cuttack	32
04.	Jagatsinghpur	03
05.	Sundargarh	18
06.	Sambalpur	09
07.	Jharsuguda	05
08.	Bargarh	06
09.	Dhenkanal	02
10.	Balasore	19
	TOTAL	**127**

Table 1.12 Districtwise Distribution of Rice Mills in Orissa

Sl.	Region	No. of Rice Mills
01.	Balasore	12
02.	Berhampur	03
03.	Cuttack	03
04.	Bhubaneswar	01
05.	Rayagada	54
06.	Sambalpur	145
	TOTAL	**218**

1.9 Mining Environment:

Table – 1.13 provides data on the mineral resources, number of operating mines and the quantity of minerals extracted in 2003-2004.

Table – 1.13 Mineral Resources of Orissa

Sl. No.	Mineral	Location	Resources in Million Tonnes & (No. of operating mines)	Production in Million Tonnes 2003-2004
1.	Bauxite	Koraput, Rayagada, Kalahandi, Bolangir and small deposits in Phulbani, Nuapara, Sundargarh	1733 (5)	4.94
2.	Coal	Angul-Talcher, Sambalpur, Jharsuguda	60987 (245692) (26)	60.20
3.	Iron Ore	Kendujhar, Sundargarh, Mayurbhanj, Jajpur	4177 (91)	34.89
4.	Beach Sand	Ganjam & Puri	82 (1)	0.230
5.	China Clay	Mayurbhanj, Malkanagiri	314 (8)	0.0061
6.	Fire Clay	Cuttack, Sambalpur, Jharsuguda	177 (11)	0.050
7.	Chromite	Kendujhar, Jajpur	183 (18)	2.88
8.	Dolomite	Sundargarh	882 (2)	1.27
9.	Limiestone	Sundargarh, Bargarh, Koraput, Malkangiri	2224 (25)	2.24
10.	Graphite	Bargarh, Sambalpur, Bolangiri, Kalahandi, Phulbani and Rayagada	4.6 (57)	0.034
11.	Manganese	Sundargarh, Kendujhar, Rayagada	116 (19)	0.698
12.	Nickel	Jajpur & Kendujhar	174	-
13.	Soap Stone	-	(4)	-
14.	Pyrophyllite	-	(4)	0.084
15.	Quartz & Quartzite	-	(56)	0.125

As per the latest figures of Ministry of Coal

The State has rich resources with regard to Bauxite, Chromite, Coal, Iron ore, Manganese and Nickel ores, which are respectively about 70%, 98%, 25%, 24%, 35%, 27% and 91% of the total resources of the country. Besides, there is possibility of occurrence of Diamond in Western Orissa, Gold in Keonjhar, Mayurbhanj and Platinum in Jajpur and Keonjhar and Lead & Zinc in Western Orissa. These huge deposits of minerals can be scientifically and planned manner exploited for the development of the State. Considering the rate of extraction, some resources like chromite will be exhaust in less

than 100 years and others will take 350-1000 years. However, efficient management and setting up of industries in the province to produce value added products is required to make the State economically strong.

Out of 336 operating mines, only 172 mines are monitored by the State Pollution Control Board, Orissa. Out of 172 mines, 18 mines are closed and there are 154 operating mines. As per the official record, the State Pollution Control Board, Orissa has given consent for operation to 154 mines. Mining activities involve in excavation of land, loss of top soil, loss of forest cover and biodiversity due to the degradation of surface area. It also affects the natural drainage system and ground water table. There is a report lowering of water table in some mining areas. Mining drainage water caused pollution of water. Air pollution specially due to huge dust generation at the time of mining operation occurs. Since chromite mining and coal mining started in large scale in Sukinda Valley and Angul-Talcher region respectively and is continuing for many years, these areas have been affected badly. Besides, mining activities also have affected the ecology of Keonjhar district due to iron ore mining, Ib valley due to coal mining, Bargarh district due to limestone mining, Bolangir due to graphite mining and areas in Damanjodi region due to bauxite mining. Some measures have been taken for reclamation, rehabilitation and afforestation in these regions. But these restoration processes have not brought back normal situation for sustaining the local ecosystem. There is no mechanism to monitor the restoration process. Satellite imagery may help periodical assessment and future planning. This is an area, which requires policy intervention by the Government for restoration of the ecosystem.

Since, number of thermal power plants and metal-based industries are coming up in the province, there will be pressure on coal mines and iron ore mines. There will be threat to the environment due to the new mining activities.

In view of this, automost care must be taken so that the environmental impact assessment is scientifically done and action be taken for environmental management plan so that the damage to the environment will be minimum.

ENVIRONMENTAL ISSUES

The Environmental Issues associated with industrial development and resource utilization in the State are (1) Land degradation and bio-diversity loss, (2) Loss of forest and productive land, (3) Displacement of people and rehabilitation problems, (4) Resource consumption (5) Environmental pollution of air, water, soil etc. However, Resource consumption and Environmental pollution issues are only discussed in this chapter.

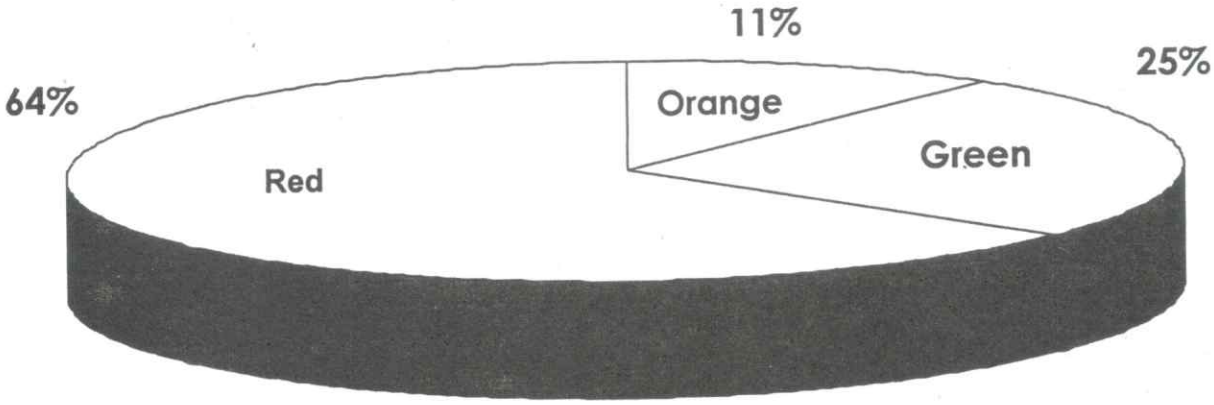
On the basis of pollution potential, the Ministry of Environment and Forests (MoEF), Govt. of India have identified 17 categories of polluting industries in the country and out of these, 12 categories are located in Orissa **(Table-1.14)**. These industries have also been categorized on the basis of their pollution potential as red, orange, green and the industries in Orissa classified accordingly and 64% of them belong to

red category **(Figure-1.1)**. These highly polluting industries are integrated steel plants, aluminium smelters, thermal power plants, cement industries and others which are largely mineral based and are localized in some part of Orissa.

Table-1.14 **Classified under 17 Categories Polluting Industries in Orissa**

Sl.	Sector	No. of Industries			Total
		Large	Medium	Small	
01.	Thermal Power	10	0	0	10
02.	Integrated Steel	2	0	0	2
03.	Aluminium	2	0	0	2
04.	Cement	7	2	1	10
05.	Sugar	4	1	0	5
06.	Distillery	2	0	1	3
07.	Pesticide	0	1	2	3
08.	Chloro-Alkali	1	0	0	1
09.	Dye and Dye Intermediate	0	1	0	1
10.	Pulp and Paper	4	2	0	6
11.	Fertilizer	2	1	0	3
12.	Bulk Drug	0	0	1	1
TOTAL		**34**	**8**	**5**	**47**

Fig:1.1-Classification of Industries



Water Pollution in Orissa:

The Central Pollution Control Board, New Delhi have classified some industries as grossly water polluting when the BOD load from an industry exceeds 100kg/day or if the effluent contain hazardous chemical. Orissa has 16 such industries **(Table-1.15). Table –1.16** give data on current pollution load by the industries in major rivers of Orissa. The total effluent release to river Brahmani at Rourkela amounts to 159840 KLD containing 3950 Kg/day

of BOD load, 10,000 Kg/day of COD load and 582 Kg/day of Oil & Grease. The pollution load to river Brahmani at Rourkela is very high. However, the load gets diluted and again gets loaded with pollutants of 54,000 KLD of industrial effluent at Angul-Talcher. The BOD, COD and Oil & Grease load at Angul-Talcher respectively 440 Kg/day, 1375 Kg/day and 145 Kg/day. Besides, the Suspended Solid (SS) load at Angul-Talcher amounts to 3450 Kg/day. This load gets diluted differently in different seasons and as per the water monitoring data available in the State Pollution Control Board, Orissa, it has not created health hazard till date but careful and constant monitoring is required at many points in the down streams of Rourkela and of Angul-Talcher region. The pollution load in the river Mahanadi at Sambalpur amounts to 736 KLD of effluent with 22 Kg/day of BOD load. The Mahanadi river system again receives 2780 KLD of industrial effluent load at Cuttack with 30 Kg/day of BOD load and 250 Kg/day of COD load. At Paradeep, Mahanadi river system receives 5280 KLD of effluent per day with BOD load of 15 Kg/day, COD load 35 Kg/day and 75 Kg/day of Oil and Grease. The effluent discharge load to river Brahmani is about 24 times more. The BOD and COD load to the river Brahmani is about 66 times and 40 times respectively more than Mahanadi. Besides, these two main rivers, other rivers namely in Orissa i.e. Nagavali, Rushikulya, Budhabalang and others also receive pollution load. River Nagavali receives 35000 KLD of effluent at Rayagada and these effluents have about 1000 Kg/day of BOD load and 8750 Kg/day of COD load. Nagavali river receives more effluent and more pollution load than the entire stretch of Mahanadi river.

However, the pollution load monitoring report of the State Pollution Control Board, Orissa indicates that in down stream of Panposh, Rourkela (Deogaon village) the BOD level is around 3.7 mg/L in the water and the COD level at Sambalpur down stream at Mahanadi river varies from 1.3 – 3.5 mg/L. The BOD load in river Kathajodi, river Kuakhai down streams varies from 3.2 – 3.97 mg/L. Since, BOD has been taken as critical water pollution parameter, these river waters are polluted, which are not suitable for human use without treatment. This BOD level may not be only due to industrial pollution but largely due to human excreta and municipal sewerage. The total coliform count and faecal coliform count are very high in many stretches of these rivers. The fresh water use by the integrated steel plants in huge. The state has now signed MOU with many Companies to increase the steel production to not less than 40 million tonnes per annum. The fresh water demand will be huge (at least 1000 million M^3 for the factories and township)

In view of this urgent planning should be made for impoundment of more water in Orissa rivers, especially in Brahmani and Mahanadi rivers during Monsoon.

Table-1.15 Major Water Polluting Industries in Orissa

Sl.	Name of the Industry	Category	Effluent Recipient Place	Concerned River
01.	NALCO, CPP, Angul (Industrial effluent other than ash pond overflow, ash pond water is reused)	Thermal Power	Nandira Jhor	Brahmani
02.	NTPC, Kaniha (Industrial Effluent)	Thermal Power	Tikira River	Brahmani
02 A	NTPC, Kaniha (Ash pond overflow effluent)	Thermal Power	Tikira River	Brahmani
03.	TTPS (NTPC), Talcher (Ash pond overflow effluent)	Thermal Power	Nandira Jhor	Brahmani
03 A	TTPS (NTPC), Talcher (Ash pond overflow effluent)	Thermal Power	Nandira Jhor	Brahmani
04.	Central Orissa Straw Board	Pulp and Paper	Mahanadi	Mahanadi
05.	Steel Township, Rourkela	Urban Body	Koel River	Brahmani
06.	Fertilizer Plant, SAIL, Rourkela	Nitrogenous Fertilizer	Guradih Nallah	Brahmani
07.	ICCL (CPP), Choudwar, Cuttack	Thermal Power	Birupa	Birupa
08.	IDL Chemicals, Sonaparbat, Rourkela	Explosive	Balijodi Nallah	Brahmani
09.	Rourkela Steel Plant, Rourkela (Coke oven byproduct effluent)	Iron and Steel	Guradih Nallah	Brahmani
10.	Fertilizer Township, Rourkela	Urban Body	--	Brahmani
11.	INDAL Smelter Hirakud (Domestic effluent)	Aluminium Smelter	Mahanadi	Mahanadi
12.	Paradeep Phosphates Ltd.	Phosphatic Fertilizer	Atharbanki Creek	Bay of Bengal
13.	Ballarpur Industries (Sewa), Jeypore	Pulp and Paper	Nallah	Kolab
14.	Jayshree Chemicals Ltd., Ganjam	Chloro Alkali	Rushikulya	Rushikulya
15.	Emami Paper Mill, Balgopalpur	Pulp and Paper	Swapna Nallah	Sona - Budhabalang
16.	Oswal Chemicals & Fertilizer Ltd., Paradeep (Township Effluent)	Phosphatic Fertilizer	Creek	Mahanadi

Table –1.16 Current (2004) Pollution Load by Industries in Major Rivers of Orissa

Sl.	Industry	River	Total Effluent in KLD	BOD load Kg/Day	COD load Kg/day	Oil & Grease Kg/day	S.S. Kg/day	Others per day
01.	**Rourkela**							
	i) Steel Plant	Brahmani	52800	950	4000	582	--	--
	ii) Steel Township		7000	3000	6000	--	--	--
	iii) Fertilizer Plant		100000	--	--	--	--	--
	iv) IDL		40	--	--	--	--	1.2 kg NO_3
Sub-Total			**159840**	**3950**	**10000**	**582**	--	
02.	**Angul-Talcher**							
	i) NTPC, Kaniha	Brahmani	6500	200	1375	65	650	
	ii) NTPC, Talcher		3000	90	--	30	300	
	iii) NALCO		25000	150	--	50	500	
	iv) MCL, Talcher		19500	--	--	Small	2000	
Sub Total			**54000**	**440**	**1375**	**145**	**3450**	
Total Load for Brahmani			**213840**	**4390**	**11375**	**727**	**3450**	
03.	Sambalpur							
	i) INDAL, Hirakud	Mahanadi	736	22	--	--	Small	
04.	Cuttack							
	i) Central Orissa Straw Board		1000	30	220	--	Small	
	ii) ICCL, CPP, etc.		1780		30	--	Small	
TOTAL			**3516**	**52**	**250**	--		

05.	Paradeep							
	i) Paradeep Phosphate		4320	--	--	75	--	--
	ii) OSWAL Chemicals & Fertilizers Ltd.		960	15	36	Small	--	--
Total Load for Mahanadi River			**8796**	**67**	**285**	--	--	--
06.	Rayagada							
	i) J. K. Paper Mills	Nagavali	**35000**	**1000**	**8750**	--	--	--
07.	Berhampur							
	i) Jayashree Chemicals	Rushikulya	**80**	--	**2 Kg/year**	**Small**		

Table – 1.16 A Industry Specific Water Pollution

Sl.	Industrial Sector	Water Pollution Parameters	Type of Effluent Treatment
01.	Pulp and Paper	Colour, BOD, COD, Sodium Absorption Values, S.S	Activated Sludge Treatment Plant
02.	Iron and Steel	PH, Phenol, Cyanide, Heavy Metals, BOD, COD, S.S., Oil and Grease	Unitwise ETP-Coal Chemical-BOD Plant, Rolling Mills-Chemical Treatment Catch Pits
03.	Fertilizer (Phosphatic)	PH, Phsophate, Fluoride	Chemical Treatment Plant Fluoride and Phosphatic removal
04.	Aluminium	Fluoride, Oil and Grease	Ion Exchange, Oil and Grease Trap
05.	Rice Mills	BOD, S.S., COD	Settling Tanks, Sand Filtration
06.	Distillery	BOD, COD, S.S.	Anaerobic, Aerobic Biological Treatment, Biomethynation
07.	Sugar	BOD, COD, S.S.	Activated Sludge Treatment
08.	Chemicals	Heavy Metals, Organic Complex	Chemical Treatment
09.	Sea Food Processing	BOD, COD	Biological Treatment

The BOD level in river Brahmani and river Mahanadi at different points are given in **Table-1.17**. The data indicate that in both the rivers, the water is not suitable for human use without treatment.

Table-1.17 BOD in River Water

River Brahmani

Year	Panposh U/S	Panposh D/S	Rourkela D/S	Bonaigarh	Rengali	Samal
2000	2.9	4.3	3.21	2.9	2.65	2.75
2001	2.2	3.6	2.9	2.5	2.2	2.3
2002	2.3	4.8	3.3	2.3	2.0	1.9

Year	Kamalanga D/S	Kamalanga D/S	Bhuban	Dharmasal	Pottamundai
2000	2.7	4.2	3.49	3.5	3.3
2001	2.5	4.2	2.4	2.3	2.5
2002	2.2	3.7	2.7	2.6	2.3

River Mahanadi

Year	Sundargarh	Jharsuguda	Hirakud	Brajaraj Nagar U/S	Brajaraj Nagar D/S	SBP U/S	SBP D/S	Sonepur U/S	Sonepur D/S
2000	2.9	3.5	2.6	3.0	4.3	3.0	4.7	2.5	3.6
2001	2.1	2.3	2.1	2.1	2.7	2.69	3.8	2.0	3.2
2002	2.11	2.35	1.95	2.32	2.92	2.39	4.04	1.75	3.0

Year	Tikarpada	Narsingpur	CTC U/S	CTC D/S	Kathjodi D/S	Kuakhai D/S	Kuakhai U/S	Birupa D/S	Paradeep D/S
2000	3.0	2.5	2.6	4.2	4.6	3.4	5.0		
2001	2.0	2.3	2.2	3.4	5.4	2.3	3.9		
2002	2.48	1.77	2.36	3.59	4.25	2.59	3.91	2.13	4.95

Air Pollution:

The air pollution is caused due to emissions from industries by automobiles and some other sources. The effect of air pollutants in any locality depends on the level of dispersion depending upon the height of chimney and the wind velocity and direction and other meteorological conditions. Besides, emissions to air also occur in the form of fugitive emissions. Table-1.18 produce data on major air pollution load in different region from industrial sources in Orissa.

Table – 1.18 Major Air Pollution Estimation in Different Regions from Industrial Source in Orissa

Sl.	Area	TSP (TPD) (Total Suspended Particulate)	SO_2 (TPD)	Other (TPD)	Approximate Area (Dispersion Sq. km)	Conc. in kg of TSP per Sq.km.
01.	**Rourkela-Rajgangpur** Integrated Steel Plant-1 Sponge Iron Plants-27 Thermal Power-2	30.2 (13.2% due to Sponge Iron)	45		1000	302
02.	**Ib Valley Area** Thermal Power Plant-1 Refractories-1 Sponge Iron Plant-1	8.785 (3.24% by Sponge Iron)	>52		600	14.64
03.	**Sambalpur Area** Hirakud Area-Aluminium –1 Thermal Power Plant-1	2.80	>25	0.416 Fluoride	200	14 & 2 Kg. Fluoride
04.	**Talcher-Angul Area** Thermal Power-4 Aluminium-1 Ferro Alloys-1 Sponge Iron-1	83.33 (0.15)	>534	0.1 Fluoride	2500	1848
05.	**Paradeep-** Fertilizer-2 Carbon-1	1.0	22.0		200	3.33
06.	**Joda-Barbil Area** Pig Iron/Sponge Iron-13 Ferro Alloys-1 Iron Ore Crusher-63	8.85	2		400	22.12
07.	**Choudwar Area** Ferro Alloys –1 Thermal Power-1	2.25	17.0		150	15.0
Sl.	Area	TSP (TPD) (Total	SO_2 (TPD)	Other (TPD)	Approximate Area	Conc. in kg of

		Suspended Particulate)			(Dispersion Sq. km)	TSP per Sq.km.
08.	**Balasore Area** Ferro Alloys –2 Pulp & Paper-1 Rubber-1	1.0	4		200	5.0
	TOTAL	139.215 TPD	497 TPD	0.516 TPD	Orissa **155707**	0.89 Kg.*

TPD: Tonnes per day

This does not include stone crushing, transport and other sources.

It indicates the air pollution load in Rourkela, Rajgangpur area is due to emissions of integrated steel plants, sponge iron plants, cement plants and thermal power plants amounts to 30.2 tonne/day of Total Suspended Particulate matter (TSP) and 45 tonne/day of Sulphur dioxide. The concentration of TSP is 302 Kg/Sq.km. in the atmosphere. The Talcher-Angul area receives emissions from Thermal Power Plants, Aluminium Smelters, Sponge Iron etc. and the total TSP load is 83.33 Tonnes/day and the Sulphur dioxide emissions load is 462 tonnes/day. The concentration of TSP is 1848Kg/Sq.km. So these two areas are highly polluted. Table-1.19 shows data on SPM, Sulphur dioxide and NO_x in Rourkela, Angul, Rayagada, Cuttack & Bhubaneswar and the data indicate that at ground level and in the air few meters above the ground level the load of pollutants expect SPM is below the prescribed limit of the Central Pollution Control Board. However, SPM level is high and a source for respiratory problems.

Table-1.19 **Ambient Air Quality (AAQ) in some areas of Orissa**

Parameter	Year	Rourkela		Angul		Rayagada		Cuttack	BBSR
		Udit Nagar	IDL complex	Indl. Area	Residen- tial area	Indl. Area	Residen-tial area	Residen-tial area	Residen-tial area
SPM $\mu g/m^3$	2001	198	193	191	129	187	128		
	2002	184	159	288	198	181	121		
	2003	146	174	162	112	153	90	180-260	100-170
SO_2 $\mu g/m^3$	2001	8.7	9.5	7.8	6.2	6.1	9.3		
	2002	7.5	7.2	17.6	14.9	9.5	7.2		
	2003	11.1	3.9	6.0	3.1	6.0	3.9	5 to 30	~2
NO_x $\mu g/m^3$	2001	13.60	12.7	24.8	18.3	30.9	14.6		
	2002		11.4	17.3	14.8	27.7	11.4		
	2003		6.7	12.4	15.8	21.8	6.7	~45	~25

Standard	Residential Area	Industrial Area
SPM	140 $\mu g/m^3$	360 $\mu g/m^3$
SO_2	60 $\mu g/m^3$	80 $\mu g/m^3$
NO_x	60 $\mu g/m^3$	80 $\mu g/m^3$

However, because of construction work and due to stone crushers, the SPM load is high in some areas of the State. The Ambient Air Quality (AAQ) except SPM has not reached alarming stage because the values are below the prescribed limit.

Green House Gas Emission and Acid Rain Potential:

The Green House Gas Emissions and Acid Rain Potential of Iron and Steel, Thermal Power Plants and Cement Plants in Orissa have been estimated from the available data and presented in **Table-1.120.** The data indicate that of the minimum total 40.39 million tonnes of carbon dioxide released by these plants per year and of this total 73.5% are due to the emission of Thermal Power Plants. The Iron and Steel and Sponge Iron Plants contribute 19.5% and Cement Plants about 7% of the total emissions.

Some 12.86 million tones of fly ash are generated in Orissa per year and these are stored in fly ash ponds at Angul-Talcher, Ib Valley, Rourkela etc. There is a real problem of ash disposal and no significant steps have been taken and this will create serious problem in future years.

There is forest loss and consequently loss of canopy cover in forests in Angul-Talcher and Ib valley areas where most of the thermal power plants operate and therefore the Sink factor for absorption of carbon dioxide has not been adequately looked into. This is an area, which requires urgent policy intervention for future years.

Table-1.20 Green House Gas Emission and Acid Rain Potential of Iron & Steel, Thermal Power Plants & Cement Plants in Orissa

Sl.	Plant	Power generation capacity MW	Coal consumption TPD @ 15.50 tonne for 1 MW	SO_2 generation TPD (0.4% Sulphur) in coal	NO_2 generation TPD (0.7% Nitrogen in coal)	CO_2 generation TPD (32% Carbon in coal)	Ash TPD (42% ash in coal)
1.	NTPC, Kaniha	3000	46500	372	1070	54560	19530
2.	NTPC, Talcher	460	7130	57	164	8366	2995
3.	NALCO, Angul	840	13020	104	300	15277	5468
4.	NALCO, Damanjodi	57	884	7	20	1037	371
5.	ICCL, Choudwar	108	1674	13	39	1964	703
6.	INDAL, Hirakud	200	3100	25	71	3637	1302
7.	Ib Thermal	420	6510	52	150	7639	2734
8.	Rourkela Steel Plant	203	3147	25	72	3692	1322
9.	Nav Bharat Ferro Alloys	30	465	4	11	546	195
10.	OCFL, Paradeep	55	853	7	20	1000	358
11.	Birla Tyres, Balasore	25	388	3	9	455	163
12.	Kalinga Iron Works, Barbil	12	186	1.5	4	218	78
13.	J. K. Papers, Rayagada	12	186	1.5	4	218	78
14.	BILT, Jeypore	12	186	1.5	4	218	78
15.	Emami Papers, Balasore	5	78	0.6	2	92	33

16.	Aska Cooperative Sugar Mill	1.32	20.5	0.15	0.5	24	9.0
	Total	**5440.32**	**84320 (30.78 million tonnne per year)**	**675 (0.25 million tonnne per year)**	**1940 (0.71 million tonnne per year)**	**98937 (36.11 million tonnne per year)**	**35414 (12.93 million tonnne per year)**

Industrial Solid Waste:

The industrial solid waste disposal is one of the major environmental issues. These solid wastes may also contain hazardous waste. Mineral based industries generate very high quantity of solid waste. Table-1.21 shows the data of industrial solid waste generated in Orissa. Some 28 million tonnes of solid waste are generated in Orissa and out of these 9 million tonnes are fly ash and about 2-3 million tonnes red mud. These are stored in ash pond and red mud pond respectively which require large land areas and create problem for ground water and in summer times the ash may be air borne and becomes air pollutants for nearby human settlements. Although, there are various avenues to utilize ash but no significant steps have been taken. Ash can be utilized in road construction, brick construction and utilization filling abandoned mines etc. Unless its use is made mandatory, the situation will not improve. Policy interventions urgently required to solve the problem. Table – 1.21A produce data on hazardous waste generated in Orissa and their disposal is also a serious concerned. No landfill site has been developed in the State till date and these require immediate policy intervention.

Table – 1.21 Industrial Solid Waste Generation in 2004 in Orissa

Sl.	Unit	Million Tonne per Year (approximately)	Disposing /Storing
01.	Thermal Power Plants	9.0	Ash Pond (~2500 acre land)
02.	Iron & Steel Plants	1.5	Dumping
03.	Sponge Iron Plants (Char & kiln dust) Ferro Alloys Slag	6.0 0.5	Dumping
04.	Phosphatic Fertilizer Sulphur Muck etc.	5.0	Dumping
05.	Red mud (Alumina Plant)	3.0	Red Mud Pond (~800 acre)
	TOTAL	**28.00 Million Tonnes**	

Table – 1.21A District wise Hazardous Waste Generation in Orissa

Sl.	Name of the District	Hazardous Waste (TPA)			
		Recyclable	Incinerable	Land Disposable	Total
01.	Angul	1340.65	31	12944.76	14316.41
02.	Balasore	1822.8	65.9	82.13	1970.83
03.	Bargarh	57.8	--	1.5	59.3
04.	Bhadrak	213.0	--	1.0	214.0
05.	Bolangir	5.0	3.8	93.44	102.24
06.	Cuttack	39.82	172.52	511.15	723.49
07.	Dhenkanal	322.60	4.15	62.396	389.146
08.	Ganjam	14.01	1.0	1675	1690.01
09.	Jagatsinghpur	110.5	--	19273	19380.5
10.	Jajpur	131.5	--	721.69	853.19
11.	Jharsuguda	431.56	6.5	6625.72	7063.78
12.	Kalahandi	1.8	--	12.0	13.8
13.	Keonjhar	102.35	--	7054.173	7156.523
14.	Khurda	9.8	0.18	7.57	17.55
15.	Koarput	77.5	2.0	22.846	102.346
16.	Mayurbhanj	43.9	--	82.17	126.07
17.	Nabarangpur	1.6	--	6.0	7.60
18.	Puri	--	--	1.7	1.7
19.	Rayagada	943.64	--	--	943.64
20.	Sambalpur	182.75	1.8	2540.4	2724.95
21.	Sundargarh	8450.87	78.2	14,602.98	23,132.05
	TOTAL	14,303.45	367.05	66,318.625	80,989.125

RESPONSE

Air Pollution

From the preceding data presentation and analysis, it appears that the metal industries especially iron and steel industries, thermal power plants, stone crushers and mineral processing industries are the major industries in Orissa to contribute substantially to the air pollution.

Due to the power vested with the State Pollution Control Board, Orissa as per the Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986 and Hazardous Waste (Management and Handling) Rules, 1989, some steps have been taken by the industries for controlling pollution. The highly polluting type open hearth furnace in Rourkela Steel Plant were replaced with LD converters with inbuilt pollution control equipments. The Coke Oven Plants have been rebuilt, which also reduce pollution load to the air at Rourkela. The Sponge Iron Plants are air polluting industries, they have been advised by the State Pollution Control Board, Orissa to install bag filters, ESPs and other control systems to reduce air pollution and observe the standard of 100$\mu g/Nm^3$ emission for particulate matter emission from the kiln. The Thermal Power Plants have also been directed by the Board to install ESPs to control particulate matter emission and to conform the standards prescribed by

the Central Pollution Control Board and State Pollution Control Board. Most of these plants have installed the pollution control equipments. However the operation of these equipments round the clock is perhaps not maintained. The Pollution Control Board does not have adequate technical manpower to check the situation frequently, thus pollution goes on. The State Pollution Control Board, Orissa does not have also the infrastructure facilities including human resources to monitor stack emissions and therefore there is not control and no data available at State Pollution Control Board from their sources on these aspects.

There is really problem of fly ash and red mud disposal in Orissa. As per Thumb rule, 1.5 acre of land is required for disposal of fly ash generated from 1 MW of electricity production. There is a real problem for getting land for fly ash and red mud disposal. The Govt. policy intervention for utilization of fly ash for brick making and its utilization in road making and other uses is very weak and is only recommendary. Policy intervention in this area is urgently required.

The Thermal Power Plants in collaboration with Mohanadi Coal Fields Ltd. (MCL) should find out ways and means for disposal of fly ash in abandoned mine pits and for this, policy intervention is also required at Govt. level.

Some 910 stone crushers operate in the State and none of the stone crushers follow the prescribed pollution control rules for green belt development or site specification. Although the stone crushers are required for the construction work but proper policy intervention has not been made. The concentration of TSP in Angul-Talcher region appears to be maximum (1848 Kg/Sq.km.) followed by Rourkela, Rajgangpur region with 302 Kg/Sq.km. The situation indicates that health hazard problems exist with regard to respiratory disease, traffic accidents etc. The problem of SPM in air in Jajpur due to stone crushers is a serious problem and required immediate intervention by regulating agencies. The threat of acid rain is there. Monitoring of green house gas level and acid rain potential by the regulating agencies should be done periodically and the policy of green belt development and plantation should be strictly followed and should be made mandatory and should start from the day of implementation of the project.

Hazardous Waste Disposal

The industries in the State generate about 81000 tonnes of Hazardous Waste per year in 21 districts. The maximum concentration of hazardous waste pollution at Sundargarh, Jagatsinghpur and Angul districts. This is another pollution problem, which has not been adequately looked into. There is no scientific land fill site for the safe disposal of hazardous waste. Atleast 3 sites should be developed on priority basis and Govt. policy intervention should be done at the earliest.

Water Pollution

Pollution load in river Brahmani is very high at Rourkela and Angul-Talcher zone. The entire stretch of the river Brahmani is not safe for human use.

More pollution load is expected to the river at Duburi in coming years. In view of this, the installation and round the clock running of water pollution control methods should be strictly followed and action taken by the Regulatory Agencies and Govt. The pollution load in river Nagavali and some stretches of river Mahanadi is also a serious concern **(Table-1.15)**. The Regulatory Agencies should look into this and take appropriate action. All the mines as well as industries must install water treatment plants and regulate the water quality before discharge to the river. The data must be fed to the State Pollution Control Board, Orissa on line.

The State Pollution Control Board, Orissa with the assistance from the Central Pollution Control Board is preparing district-wise Zoning Atlas in which environmentally compatible sites for industrialization are identified. There is no Govt. policy to follow the Zoning Atlas provisions strictly. Even, there is no reference to Zoning Atlas provisions in the industrial development plan. The Zoning Atlas of Paradeep and Rayagada two industrialized areas have been completed and other industrial areas should be taken up immediately and the Govt. policy intervention should be made at the earliest.

A details study of pollution carrying capacity of an area specially industrialized areas and proposed industrialized areas must be done on priority basis and it will help the industrial development plan of the State in future. The carrying capacity study will take the potential of forest cover, water bodies and soil to absorb pollutants in a long run basis. The study will also include the seasonal wind direction and dispersion pattern and the leaching properties of pollutants in soil, the surface and ground water resources levels and effect of pollutants on them etc. The study will help to prepare regional environmental management plan. Since the State is rich in mineral resources and mineral processing and utilization plants are highly pollution generating, long term planning should be done on the basis of carrying capacity study and Regional Management Plan. The industries should provide funding for these studies.

Till today the environmental pollution in Orissa due to industries are localized. But there is potentiality of these pollutants reaching other places. The river water quality in many stretches are highly polluted. The water pollution is largely due to urban local bodies but in some of the stretches of the river, the pollution threat from the industries is also significant. Urgent steps to be taken for its control.

ACKNOWLEDGEMENT

Data were taken from the publications of State Pollution Control Board, Orissa and from their office and from other sources. I wish to thank the State Pollution Control Board, Orissa in general and Dr. L.N. Pattnaik, Chairman, Dr. D.K. Behera and Er. N.R. Sahoo in particular for discussion and cooperation.

REFERENCES

Dash. M.C., 2004, Ecology, Chemistry and Management of Environmental Pollution. Mac Millan India Ltd., New Delhi. 323 pages.

Dash, M.C, 2001. Fundamentals of Ecology. Tata McGraw Hill Publ., New Delhi. 525 pages.

Dash, M.C., 2005 (Chief Editor – State of Environment Report, Orissa) State Pollution Control Board, Orissa A/118, Nilakantha Nagar, Unit-8, Bhubaneswar- 12 (in Press).

Dash, M.C., 2005. Orissa Environment Review, Council of Professional Social Worker, Nayapalli, Bhubaneswar (in press).

Dash, M.C., S. Padhi and S. Meher, 2002. Natural Resources Assessment : Endowment, Utilisation and Degradation in " Orissa Development Report", Planning Commission, Government of India, 9-53 pages.

Wild Orissa, 2004, State Wild Life Organization, Forest Department, Government of Orissa, Bhubaneswar – 82 pages

Website of Ministry of Power, Government of India – Performance during the year 2003-04.

Orissa Agricultural Statistics, 2002-03, Directorate of Agriculture and Food Production, Orissa, Bhubaneswar. 62 pages.

State of Environment Orissa, 2005 (in press) Orissa State Pollution Control Board, A/118, Nilakantha Nagar, Unit-8, Bhubaneswar – 12

Economic survey, 2002-2003, Government of Orissa, Planning & Coordination Department, Bhubaneswar.

Environmental standards for Ambient Air, Automobiles, Fuels, Industries and Noise, CPCB, New Delhi, 2000-2005.

SGAT Bulletin
VOL.6,No.2 December 2005 pp.25-30

MINERAL-BASED INDUSTRIES IN ORISSA

Vivek Pattanayak
86.Saheednagar,
Bhubaneswar-751007
Orissa, India

ABSTRACT:

Orissa is endowed with vast mineral resources and has occupied a prominent place in mineral map of India. Mineral exploitation is also materialized since ancient times and Orissa has justified a suitable arena for the development of appropriate mineral based industries. Utilizing its vast natural resources. The paper outlines the history of growth of mineral based industries including sponge iron plants, Ferro-chrome and Charge-chrome plants. Different factors like power situation, influence of the civil society, implementation of environment and forest acts, judicial activism affecting the growth of these mineral based industries in the State are discussed. Future prospects of these industries in Orissa are also highlighted.

Key word: ***Mineral Map, Mineral based industries.***

INTRODUCTION

Rich mineral resource has placed the State of Orissa in a conspicuous place in the mineral map of India, and also of the world. Even from the ancient times exploitation of mines and minerals have brought traders and entrepreneurs from different parts of the globe. In the Greek history there is mention of Soumelpore what we now call as Sambalpur. The merchants used to come there in search of diamond. Hirakud it is said was the place of this business, hence the name. The bed of the river Subarnarekha had gold dust. The river Samakoi of Telkoi promises of gold even today. There is evidence of ancient copper mining near Kuliana in the district of Mayurbhanj.

HISTORY OF GROWTH OF MINERAL-BASED INDUSTRIES

Presence of rich iron ore in Gorumahisani, Badampahad, and Suleipat in the erstwhile princely state of Mayurbhanj brought Tata steel to Jamshedpur now in Jharkhand. Originally, investigation had been made to establish the plant near Rairangpur, but insufficiency of water in the river Khadkei went against the location. In the mid-fifties the Federal Republic of Germany, what used to be called West Germany coming out of the war ravaged economy decided to assist India in establishment of a steel plant in the public sector based on the newly adopted technology called LD converter process emanating from two cities called Lintz and Donawitch of Austria. This steel plant was set up in Rourkela under the

newly formed public sector company called the Hindustan Steel Limited. Around the same two other steel plants came in India-one with the technology from Britain at Durgapur, and other with Soviet technology at Bhillai. The Rourkela steel plant had the best of performance giving pride to Germany. Rourkela became the household name in Germany. Even till today every middle class German professional talks about the success of Rourkela.

In the late fifties with power generation taking place from the multi-purpose Hirakud dam project, bauxite based aluminum plant was based at Hirakud by Indian Aluminum taking advantage of cheap power. Soon after in the south of Orissa in the district of undivided Koraput near Jeypore a small Ferro-manganese plant was put up at the initiative of Mr. Ramakrishna a retired member of the Indian Civil Service along with sugar factory. At Joda in Keonjhar district based on the iron and manganese ores Tisco set up a much bigger capacity Ferro-manganese plant.

The first Orissa Company to set up a mineral based industry was the Kalinga Iron Works Ltd under stewardship of dynamic industrialist Biju Patnaik. In the south of Orissa at Theruvalli in the erstwhile Koraput district, the first technical entrepreneur to establish a mineral based industry was Dr B.D.Panda, a scientist of eminence from USA. It was the Ferro-silicon plant. He followed it up by silicon metal plant and thereafter silicon carbide plant. In the early sixties with establishment of the Orissa Mining Corporation (OMC), and the Industrial Development Corporation (IDC) in the first State public sector, mineral based industries like chrome-chrome at Jajpur Road, and cement plant in Bargarh were established. Meanwhile, the Dalmias had already set up cement plant in Rajgangpur. All these industries had used iron, manganese, quartzite and chromite ores, limestone, and dolomite.

INVESTMENT IN SPONGE IRON PLANTS

Due to shortage of the availability of coking coal, and heavy capital investment needed for integrated steel plant alternative to the blast furnace route was found to produce steel. The electric arc furnace became quite popular. Initially the arc furnace consumed steel scrap, and when there was shortage of scrap the sponge iron was found as a feedstock along with scrap. Using non-coking coal, oil and gas, or even mix of oil and non-coking coal sponge iron could be produced. Import of sponge was the answer, as India had no sponge iron plant. Gas based sponge iron had a problem as its transportation was difficult. It was highly inflammable and susceptible to easy oxidation. After pilot demonstration plant in Andhra Pradesh was successfully tried out with non-coking coal, the Government of India agreed to allow import of technology from Allis Chalmers of USA with 20% oil and 80% non-coking coal. The first such plant was established in Orissa in the Keonjhar district near Palaspanga in the joint sector between the Industrial Promotion and Investment Corporation of Orissa Limited (IPCOL), a public sector promoting and investing company, and a consortium of companies producing steel, based on arc furnace route under the aegis of the Torsteel

Foundation of India. Credit for grant of license goes to Shri Biju Patnaik who as the Union Steel Minister took bold decision to get this technology in spite of prevarication of the Steel Secretary a professional heading the civil service of the Ministry.The single minded zeal of the engineer Dr H.P.Mishra in convincing in the viability of this technology, and the commitment of the professional engineer Dr P.K.Mohanty by his integrity and dynamism in execution, brought this project into being.

Around the same time with successful pilot demonstration of the sponge iron plant at Jamshedpur by TISCO, IPCOL obtained a license to establish another sponge iron plant at Bileipadar near Joda in the Keonjhar district with indigenous technology in joint sector with Tisco.In spite of Tata's name, all India financial institutions made a very detailed appraisal before clearing the project. The credit goes to the eminent engineer-cum-scientist Dr Amit Chatterjee for developing this technology. This was based upon 100% non-coking coal. With scarcity of oil those days this technology came as a boon. Dr Chatterjee should have been duly recognized for his pioneering contribution to the development of this technology. Practical, and pragmatic approach of Shri L.I.Parija who was leading the industrial team of Orissa helped in the timely completion of this project.

CHARGE CHROME PLANTS

During the early eighties there was a climate of investment in Orissa hitherto not experienced in the State. Power shortage was creeping in at that time as a result metallurgical industries based on minerals could not be encouraged. Nevertheless, this climate brought three charge chrome plants amidst other mineral based industries like refractory industries, and vertical shaft mini - cement plants.

IMFA, FACOR, and OMC established charge chrome plants near Chowdwar, Bhadrak, and Brahmanipal respectively. OMC plant was based on the Finnish technology given by Outokoumpo with collaboration with Voist-Alpine of Austria. The OMC project needed funding which was declined by all India financial institutions led by IDBI because OMC Alloys as it used to be called then was a state sponsored project. It was the far sightedness of a young and one of the most dynamic bankers of those times by the name Udayan Bose who was the country manager of the European Asian Bank, which brought syndication of high value foreign currency loans to fund this project. This project ultimately was taken over by Tatas in the early nineties.

CALCIUM SILICIDE PLANT

During that period Ispat Alloys of Shri M.L.Mittal, a pioneer of the steel industry of those times based on electric arc furnace set up the calcium silicide plant in Balasore. He had come to fame then because of success of his steel plant in Indonesia, which was then run by his son Shri L.N.Mittal, the present largest steel producer of the world.

SHORTAGE OF POWER

By this time the State had become power deficit as a result IMFA set up its own captive power plant to support production of charge chrome. No wonder Alumina aluminium complex of National

Aluminium, public sector Company based on the bauxite reserves of Koraput with the technology of Pechiney Ugine Kuhlman(PUK) had to depend upon a huge captive power plant at Angul based on power grade coal from Talcher. This was biggest and most advanced aluminum plant of the time.

SECOND STEEL PLANT

From the time Rourkela steel plant came up, there was an effort to set up a second integrated steel plant in Orissa based on iron ore of the State mostly from the district of Keonjhar available in the Malongtoli, Gandhamrdan, and Daitary area. There was a great frustration in Orissa when the Central government did not support the project at Nayagarh in Keonjhar in 1970 at the foothills of the largest single block of iron ore deposit. Another attempt was made in the early eighties with Davy McKee, the British company for a shore based steel plant at Paradip. The project went into rough weather when the project site was considered for relocation to Daitary.In the early nineties Swaraj Paul the British based Indian businessman wanted to set up a steel plant near what is now called Kalinganagar.Some how it did not materialize as the price of steel did not attract huge investment. In the mid-nineties Tisco made a valiant attempt to establish steel plant near Gopalpur with the full government support. The project could not materialize amidst other reasons on the ground of environment.

INFLUENCE OF CIVIL SOCIETY

The global scenario by this time had changed with regard to large-scale investment in the mineral based industries due to environmental, forest, rehabilitation and aboriginal concerns. Encouraged by the World Bank, IMF, other international financial institutions, and the OECD countries, institutions in the nature of non-governmental organizations (NGOs) had grown. Originally they were intended to check on the State and governmental functionaries and remain as alternative bodies to take social activities. With passage of time with pro-active media, and occasional collusion with political opposition, the NGOs have emerged as veritable power centers in the society. They have practically become stumbling block to every large-scale mineral based industry on the grounds of environment, forest, and aboriginal protection. Some of the social activists are having their agenda of their own. Governments, international funding institutions, and other global agencies are immensely affected by these NGOs. Even G-7 leaders are meeting out side the public gaze it is like the tail wagging the dog. Revolution of the information communication technology with live television, Internet, and international dialing facilities, time and distance has shrunk in the last one decade. There is international nexus of NGOs.What is happening in the remotest part of India is known in the far corner of the West and vice versa. The world is fast becoming a global village. This has advantages and also disadvantages having its impact on the industrial climate. The projects like Utkal, Vedanta, and now POSCO have become the latest victims of this changed scenario.

ENVIRONMENT, FOREST AND TRIBAL COMMUNITY

In the last two decades laws relating to environment, forest, and aboriginals have

become more stringent and transparent. There are institutions under that legal regimen to take care of those matters. There is no place for populism, emotionalism, and sensesationalism. Industry on one hand and interests of environment, forest, and aboriginals on the other hand are not mutually exclusive or antithetical. There can be healthy symbiosis depending upon how one handles the matter. While industrialists, entrepreneurs, and commercial companies should take note of these legal and social developments, media and NGOs should realize that their over zealousness may be hurting the economic and industrial growth. Aborigibals of the present century are highly conscious, and educated and have their hopes, ambitions, and aspirations, and they need no interlopers.

JUDICIAL ACTIVISM

In last few years there has been significant and noticeable manifestation of judicial activism. The courts are filling vacuum left by the executive. Doctrine of the public interest litigation originally developed to protect the poorest of the poor through judicial intervention should not be allowed to become such that it would be difficult to distinguish between what is public interest and what is private interest. Investors of the 21st century should take care this aspect while deciding on establishing mineral based industries. At the stage of execution there should careful monitoring in order to ensure that there is no legal gap.

FUTURE PROSPECTS

Having described the history of development of mineral industries, it is felt there is need to identify what more industrial projects can up in Orissa based on the minerals. Chhatrapur beach sand complex offers excellent opportunities with illiminite, and silliminite. From illiminite one can produce synthetic rutile, titanium dioxide, titanium sponge and titanium metal. Titanium metal has tremendous scope in the defence and space industries. Similarly, from silliminite one can produce aluminum and silicon alloy, which is used in the transportation industry like aircraft and railways.

Mayurbahanj, in particular Rairangpur has vanadiferrous magnetitie. Orissa being a power surplus Sate can encourage a Ferro-vanadium project, which has immense, defense industry potentialities. Similarly Sukinda promises of nickel bearing ore. Ferro-nickel is also a distinct possibility. In the steel manufacture this alloy has good use in particular stainless steel.

POWER SECTOR

Infrastructure of mineral based industries is abundance of quality power. Orissa has huge reserves of coal and promise of oil and gas in future. With power reform in Orissa, there is good institutional framework for power generation, transmission, and distribution. Private generation with foreign company has been done with success. Further encouragement by creating proper climate of investment should be done.

PREPARATORY WORK

In order to support mineral based industries a lot of preparatory work needs to be done by the promotional bodies like IPICOL, OMC, and Directorate of Mines. In the past IPICOL and Mines

Directortae had done investigation, survey, and arranged experiments, which paved the way for Nalco's project.

HUMAN RESOURCE

Recruitment of young mining engineers, geologists, and mineralogists should have to be done for conducting future survey and investigation. The existing human resources available will have to be exposed to newer technology. Field visits in India and abroad will give the scope to have practical knowledge. Participation in seminars, workshops, conferences, conventions, and colloquium in other parts of India and abroad should be encouraged.

CONCLUSION

Mining activities had significant economic impact in tribal areas providing round the year employment supplementing subsisting agriculture. Ancillary gainful business was generated by way of shops, eating places, restaurants, hotels, lodging houses, transport, and other trade like storage etc. The State revenue increased by way of taxes, cess, and other impositions. With mineral based industries, there is first stage of value addition to the raw materials locally raising further revenue and creating scope for ancillaries, and down-stream possibilities.

SGAT Bulletin
VOL.6 No.2 December 2005 pp.31-38

"VALUE ADDITION THROUGH PRODUCTION OF FERRO-ALLOYS – A NEED FOR MINERAL CONSERVATION

H.P.Mishra
Ex-chairman, IPICOL, Bhubaneswar, Orissa

ABSTRACT:

Ferro-alloys constitute one of the important raw materials of the manufacturing of alloys and special steel, because of its properties to increase corrosion resistance to oxidation, hardness, strength at high temperative and abrasion resistance etc. The growth of ferro-alloys industry is thus linked with the growth of steel industry. Ferro-alloys ae broadly classified as bulk ferro-alloys constituting major alloys of Chromium, Mnganese and Silicon and as noble ferro-alloys made up of Molybdenum, Vanadium, Tungston, Magnesium, Aluminium, Ziroconium, and Titanium. This paper highlights details on types of ferro-alloys, manufacturing, processes, market potentiality for both national and overseas prospects.

Key Word: ***Ferro-alloys, corrosion resistance, hardness, strength, manufacturing process, market potentiality.***

INTRODUCTION

Ferro-alloys are essential ingredients used for alloying, refining, deoxidation, desulphurization in the production of different types of steels and hence, ferro-alloy industry forms the backbone of iron and steel in the world. Production of ferro-alloys started in India about 61 years ago with setting up of the first Ferro-manganese plant by M/S TISCO at Joda, Keonjhar, Orissa. After this, with rapid development of the Country's steel industry, demand for Ferro-alloys increased considerably and a number of firms were set-up for the production of different types of ferro-alloys.Today, India has adequate capacity for the primary Ferro-alloys not only to meet the entire demand of the country but also surplus for export. As the quality of ferroalloy affect the steel quality and yield at various stages they have great impact on the profitability of the steel industries. Hence "Value addition" is Essential by Production of Ferro-alloys and Stainless steel with a view to conserve our mineral resources instead of exporting.

TYPE OF FERRO-ALLOYS

Ferro –alloys may be classified as per the carbon content in alloys like low, medium and high carbon ferro-alloys.The most significant and important class of ferro-alloys are low carbon ferro-alloys, which are produced with great difficulty and primarily used in the production of special steels. The other classification is based on the consumption aspects of ferro-alloys.They are (i) basic or tonnage

0972-2173/2005-6-2©SGAT, BHUBANESWAR

alloys and (ii) speciality alloys. The tonnage ferro-alloys are of manganese, silicon and chromium and the speciality Ferro-alloys are of vanadium, titanium, niobium, molybdenum etc.The tonnage ferro-alloys are conventional ones and are being used for a long time, while speciality alloys were developed recently to fulfill the specialized quality requirement of steel technology.

HISTORY OF FERRO-ALLOYS UNITS IN INDIA

The past, present and future of ferro-alloys is linked with the steel production. The planners in India envisaged an ambitious development programme for iron and steel in the early fifties and aimed to achieve a target of 20 million tones of steels within 25 years. Accordingly to make this development possible ferro-alloys industry was set up in late fifties and early sixties.

In India by the year 1963, seven plants; 2 in Orissa,1 in Andhra Pradesh ,2 in Karnataka and 2 in Maharastra were established. These plants had 18 furnaces and had a total installed capacity of approximately 130 MVA monthly for ferro-manganese.During 1966-67,10 more furnaces were added with combined capacity of 143 MVA.This period saw emergence of IMFA ,IDC of Orissa ,Nava Bharat Ferro-alloys , Sandur metal and Ferro-alloys plant and Moharastra Electromett Ltd. In addition to increased capacity for ferro-manganese ,they aimed for Silicon and Chromium alloys. After 1979, three more new plants viz.OMC Charge chrome and Ispat Alloys in Orissa and VBC ferro-alloys in Andhra pradesh came up.

The Indian ferro-alloys is more than four decades old, and produces bulk and noble ferro-alloys. Though this industry is not as old as the steel industry, its capacity has increased substantially from humble start in the fifties, meeting the requirement of the steel industry in the country. The growth of ferro-alloy industry has stepped up, much more than the expected level. It has a lot of potential to increase its exports in the near future.

India has been bestowed with adequate resources of all basic raw materials required for the production of manganese, silicon and chromium alloys .Most of the ferroalloys units have come up in the six states of Andhra pradesh, Karnataka, Mandhya pradesh, Maharastra, Orissa and West Bengal, mainly due to availability and/or proximity of the raw materials. Ferro-alloys is a power intensive industry. The total connected load of the industry has grown almost 8 to 9 times from 130 MVA in the mid sixties to over 1000MVA as on date. With the result, the installed capacity of the industry is 2 million tones of bulk and noble ferro-alloys. Capacity of manganese alloys is around 814,000 tonnes, ferro-silicon 204,000 tonnes and ferro-chrome / charge chrome about 625,000 tonnes and noble ferro-alloys viz.ferro-molybdenum, ferro-vanadium,ferro-tungsten, silicon-magnesium, ferro-titanium, ferro-phosphorous etc around 50,000 tonnes. Production and exports of different ferro-alloys is highlighted in Table-1 & Table- 2.

Table-1. Production of ferro-alloys

A. Bulk Ferro Alloys

(Qty. in Tonnes)

Product	2003-04	2002-03	2001-02	2000-01	1999-2000
HC Ferro Manganese	232327	225137	201406	169269	127455
MC Ferro Manganese	9287	5339	2798	342	7461
LC Ferro Manganese	6774	6200	2420	751	1500
Silico Manganese	380316	304212	235730	276008	232611
Ferro Silicon	68844	81955	76209	67349	36286
HC Ferro Chrome /Charge Chrome	525824	379328	301109	381879	313803
LC Ferro Chrome	0	1200	1000	0	0

B. Noble Ferro Alloys

Product	2004-05	2003-04	2002-03	2001-02	2000-01	1999-2000
Ferro Aluminium	5917	5169	2000	1743	1510	0
Ferro Molybdenum	2864	2949	3114	2152	1881	1693
Ferro Silicon Zirconium	76	40	50	50	0	0
Ferro Boron	69	50	0	0	0	0
Ferro Vanadium	826	769	914	644	674	735
Ferro Tungsten	66	76	159	60	25	25
Ferro Titanium	512	252	157	155	0	0

Table-2. Export of ferro-alloys

(Quantity in Tonnes)

Product	2004-05	2003-04	2002-03
H.S Ferro Manganese	20099	11467	31003
Silico Manganese	72818	62131	59539
Ferro Silicon	1278	1016	275
HC Ferro Chrome/ Charge Chrome	293681	177628	90710
Ferro Silico Magnesium	1357	1530	1078
Ferro Titanium	4	-	-
Ferro Aluminium	23	-	-
Ferro Silico Zirconium	1	-	-
Total	389261	253772	182605
Export Earnings	Rs. 14297 million	Rs. 6872 million	Rs. 3480 million

Production of high carbon ferro-chrome / charge chrome is in increasing trend from 3,13,803t in 1999-2000 to 5,25,824t in 2003-2004 followed by silico manganese from 2,32,611t in 1999-2000 to 3,80,316 in 2003-2004. Production of High carbon Ferro manganese shows increasing trend from 1,27,433t in 1999-2000 to 2,32,327 in 2003-2004. Ferro silicon shows a trend from 56286 in 1999-2000 to 68844 in 2003-2004. But other ferro-alloys have shown decrease in trend in their production. So also Production of noble ferroalloys show a marginal increment from total quantity of 15,594 in 2003-2004 to 17422 in 2004-2005.

Year 2001-02 had witnessed the lowest ever prices in the history of ferroalloys. Indian Ferroalloys industry being globally uncompetitive due to high power cost had had been the worst hit. There was not only cut bock in production, some units were even closed down. In mid 2002, conditions began to improve, driven by higher carbon / stainless steel production, and hence demand of ferroalloys. Global ferroalloy market was all the way of significant improvements. During second quarter of 2003 the market further improved with a renewed demand scenario reinforced by, positive future forecasts based on 'China Focter'. In fact the forecasts were based on 6 to 8% GDP growth of 2 to 3% of developed countries. This increased capacity utilization of ferroalloy units in India and restored of closed units. Cumulative production of all ferroalloys in the country from 0.9 million tonnes in 2001-01 increased to about 1.5 million tonnes in 2003-04 and export also has been doubled. There came new came new green field projects and expansions. Though this trend has been continuing there are many problems for sustainable growth of this sector.

Table-2 indicates export trend of ferro-alloys. The industry recorded exports during 2004-2005 of 3,89,261 tonnes registering an increase of 53.39% over 2,53,772 tonnes during 2003-2004. There is an increase of 108.05% of export realization of Rs. 14297 million during 2004-2005 against Rs. million during 2003-2004

As the electric power is the major source of raw materials in ferro-alloy making, these ferro-alloy industries are facing a lot of problems due to high power tariff in our country. When ores are available in plenty not less than half of the international prices.Other constraints have been the increase in cost of imported coke, higher cost of transportation in the country & frequent increase in cost of diesel.

METHODS OF MANUFACTURE

The Ferro-alloys produced by the following methods.

1) Blast furnace method

2) Electro-Thermic method

3) Alumino –thermic method

The choice of the above method for production of a particular ferro-alloy on various factors like, (i) Quality of the ferro-alloys produced (ii) Availability and cost of raw materials (iii) Reducing agent and (iv) Electric power

BLAST FURNACE METHOD

The blast furnace method is followed for production of high carbon ferro-manganese, ferro-phosphorus and low grade ferro-silicon. Use of indigenous coking coals with high phosphorus as reducing agent in the high phosphorus content in the ferro-alloys produced (0.5 to 6.6%), for which this process has very limited use under Indian conditions. In China, ferrovanadium is produced by blast furnace route.

ELECTO-THERMIC METHOD

Most of the tonnages Ferro-alloys are produced by Electro-thermic method. In both blast furnace and electro-thermic methods carbon serve as the reducing agent. Electric smelting is however more flexible since all kind of reducing agents, ore fines and coke breeze are used in this method. Ferro-alloys produced in the blast furnace or electric furnace contain up to 6-8% carbon depending upon the chemical affinity for carbon. Normally low carbon Ferro-alloys are produced in a series of smelting operation carried out in special electric furnace, which is consumable and costly.

METALLO-THERMIC METHOD

The Metallo-thermic process of Ferro-alloys production depends on reduction of oxide ore with aluminium or silicon using exothermic heat of reaction for smelting purpose. The metallo-thermic technique is now -a-days adopted for the production of carbon free Ferro-alloys like ferro-molybdenum, ferro-vanadium, ferro-niobium, ferro-titanium etc.

SOME RECENT DEVELOPMENTS IN FERRO-ALLOY PRODUCTION

In order to increase the production of ferro-alloy minimizing the energy consumption, it is essential to (i) use high grade raw materials (ii) to adopt better furnace design , durable refractory lining and efficient operation (iii) to utilize ferro-alloy scraps and recovery of alloy values from the slag and rejects and (iv) to develop new technology. In recent years, all over the world various R& D work have been taken up in these lines. Further, special types of ferro-alloys like those of refractory metals and rare earths , are also being developed.

A new ferrochrome production route with higher production capacity was developed and commissioned at the Tornio Works of Outokumpu. This new process was specially designed to process soft and friable lumpy ores which was subsequently smelted in a closed electric furnace. In this route, besides increase in production, there was substantial decrease in energy consumption.

A process was developed by Kawasaki Steel Corporation where preproduction of chromium ore in a fluidized bed reactor using a hydrocarbon instead of oil, was used. The behaviour of melting, reducing, foaming and dripping of chromite in a packed coke bed was examined and the viability of the smelting reduction process was established. However, the pilot scale results have to be examined prior to any commercialization.

Shcherbin et al. have carried out some laboratory scale studies for producing low carbon ferrochrome.They have found that the rate of carburization of

ferrochrome when in contact with the oxides of carbon is quite considerable. In a view to manufacture low carbon ferrochrome one can use highly calcined lime having a carbon dioxide content of less than 2 pct, unlike the previous practice where this gas content was used to be 3 to 5 pct. In this manner it has been possible to produce ferro-chrome having a carbon content of not more than 0.019 pct.The highly calcined lime can be used for producing medium carbon ferrochrome.

For producing manganese alloy , preheating and pre-reduction of the smelting furnace charge ,has been carried out successfully on bench scale. Because of the encouraging results, Outokumpu did carry out pilot tests at its Metallurgical Research Centre in 1983 in order to optimize the conditions for scaling up the process.

Recently, a number of developments for producing ferronickel from lateritic ores, have been made in Japan. Studies on concentrating nickel in lateritic ore up to 50-60 percent with a low nickel content by segregation process has been reported to be successful. As the process takes place below 950°C, compared to about 1600°C in the conventional smelting process, A 25-30 percent energy savings is expected on commercial scale.

There is a reported production of ferronickel on 2200 tons Ni per month scale at Hyugu smelter in Japan by rotary kiln and electric furnace. The development made in the areas are (i) improvement in ore sizing (ii) substitution of heavy oil and anthracite by bituminous coal, pelletisation of rotary kiln dust and (iii) energy saving in electric furnace.

A process for producing ferronickel by direct reduction of garnierite ore has been developed by Nippon Yakin Kogyo Co. Ltd. , at their Oheyam Works. In this process, crude ferronickel can be produced by a low energy cost using a rotary kiln after pretreatment of the raw materials and this crude ferronickel can be used as the raw material in the AOD stainless steel making process. A simplified mathematical model has been developed for the production of ferronickel from lateritic ores by the electric reduction furnace process (ERF Process) and the same has been applied satisfactorily at the plant of Larco at Larymna in Greece.

In recent years, with the development of plasma generating systems and the design and fabrication of large size plasma furnaces, various efforts are being made to produce metals and alloys by using such facilities. Plasma furnaces are being used for direct reduction of iron oxide, chromite, manganese oxide, ilmenite etc. to produce the metals and their alloys. Plasma systems are also used for dissociating metalhalides, in slag refining as well as in various gas phase reactions.

The installation and commissioning of a (500 lb) 220 KVA DC transferred arc plasma furnace at the Mineral Resources Research Centre of the University of Minnesota. The furnace is based on a hallow electrode design with a 10 cm graphite cathode and tilting lip for sample pouring.

In early seventees, SKF Steel started a long range research and development programme to produce metal sand alloys by applying plasma technology. As a result of these efforts, it has been

possible to develop commercial processes for producing iron, steel and ferro alloys. Simultaneously they have also developed plasma generators in the range of 1 to 10 MW[14].

In New Zealand, plant studies have been made to produce ferro alloy by plasma as alternative to fossil fuels and electrical energy. These include the production of ferrovanadium from New Zealand Steel Works slag; treatment of steel plant dusts, ferrosilicon, enrichment of titanium value in ilmenite etc.. The Council for Mineral Technology has embararked on a programme to produce ferro titanium containing 30 to 40 pct. Ti, and also Ti-Al-Fe alloy from a high titania slag by using D.C.transferred arc plasma system.

FUTURE OUTLOOK:

Ferro-alloys represent a vital input for producing all types of steel. Development of newer technology and industrial usages result in greater efficiency in ferro-alloys utility. Indian ferro-alloys industry is also regarded as an important player in the international market. Mineral exploration and development has projected the demand for ferro-alloys to a tune of 6.7 Million tonnes for 2006-2007 which can be met by the country provided the power constraint is solved.

CONCLUSIONS

1. During 1950 to 1970, our industrial development was in its infancy and to meet our foreign exchange requirement. Iron ore, chrome ore etc. were exported. In the subsequent period the ferro–alloy and sponge iron industries were setup to add value. In this century the metal price in International market has gone up substantially and therefore the conversion of semi to finished product is extremely important from National point of view.

2. The mineral like chrome ore and nickel ore are non renewable assets and our country has got limited reserve. Therefore it is very important on our part to make judicious use keeping in view our long term requirement. For this purpose chrome ore or chrome alloy export to be limited and all efforts should be made to convert charge chrome to stainless steel and special steel to meet domestic and export need.

3. Beneficiation plants to upgrade our medium and low grade chrome ore and nickel containing chrome ore overburden should be installed for charge chrome and ferro nickel production. The charge chrome and ferro nickel are basic input for stainless production.

4. Value added items are to be produced for meeting domestic demand and export with a view to conserve our mineral resources.

REFERENCES

Kar P"Future of Ferro alloy making in Orissa, proc.National Seminar on Ferro-alloy making, 25-26 Feb 1983, Bhubaneswar pp 17-34.

Sundaresan T.S.Steel World, Feb2002.

Poshine .S.K.S, Banerjee B.R. & Patnaik S.K.Ferro-alloy industry in India, Proc.National Seminar on Ferro-alloy Making, 25-26 Feb.1983, Bhubaneswar 3-16.

Vohtola,M;Hankaniemi,Outokumpu;Steel Making Proceed .Conf. Washington D.C.,U.S.A. 6-9 April,1969(1986), 75.Hamada, T;Takada, Y; Katayama, H;Pyrometallurgy Conf. Proc., IMM London , 21-23 Sept(1987)

Sh-Cherbin, A.N. ,Ostrovskie,Ya .l., Bushnev. G.F.,and Mezyakaev , G.V.,Stal.1,Jan(1989),47

Relander.J.,Krogerus.H.,andMygri,J;Steel Making Proc., Washington, D.C., 6-9 April, 69(1986),19.

Ishii,K.,Pacific Metals Proc. Intl . Seminar on Laterite,Tokyo,14-17 Oct.(1985),IMM,Lond. 19(1-4) May (1987), 15.

Ogura,T.,Kuwayama, K.,Ono. A and Yamada, Y; ibid (1987), 189.

Watanabe, T.,et al.,Intl J. Mineral Processing May(1987) ,173.

Angelopoulos G.N.,Pavion S.H. and Papamantellis , D.C.,Erzmetall, 42(3), (1989),107.

Gauvin,W.H.,Dronet, M.G. and Munz, R.j. , J.Met, 39(12),Dec. (1987) ,14.

Reid, K.j.,Moore, J.J.,Murawa, M.J. and Girgis ,N.M.,Steel Making Proceedings ,69,6-9 April, 1986.

Skogberg, J.,Santen, S.O. and Herlitz , H.G.;ibid , 13.

Slatter, D., D.,Barcza, N.A.,Curr.T.,Marke.K.U.,and Mc Rae . L.B.,MINT EK Rev.-6(1987),47.

Rozolimo,P and Ancut, R; Metallurgia (Bucharest),40(3),March (1988) 127.

Soylemezoglu,S., Thomas, C.W. 1987 Australian Conf. On Materials for Industrial Devewlopment (Conf. Proc.) Christ Church,New Zealand 24-26,August (1987) ,201.

IDCOL reports on expansion of Fe-Cr plant at Jajpur Road.

SGAT Bulletin
VOL.6,No.2 December 2005 pp.39-45

Environment and Mineral Development

S.K. Sarangi
Managing Director
Geomin Consultants (P) Ltd.

INTRODUCTION

Mineral resources are finite, replenishable, non-renewable and form the yardstick to evaluate the economic strength of a nation. Thus, optimal utilization, conservation and scientific exploration of this noble resources play a vital role in strengthening the economic growth of the nation. India's mineral resources and prospectivity ranks high in global context with bauxite of 2926 mt., chromite of 179 mt; iron ore at 13435 mt, manganese ore at 295 mt, limestone at 170459 mt, graphite at 159.27 mt., and coal resources at 234 billion tonnes. Ongoing explorations adopting improved and newer technologies shall definitely add to the present mineral resources. Minerals, with their multiple uses play an important role in affecting every fact of human lives and it is difficult to imagine the growth of the civilization without proper mineral development. The mining industry in India happens to contribute more than 2.5% of GDP which was only 0.56% after independence. This reflects increasing production level of minerals.

In a view to have a commendable growth in the mining industries and to attract investment and adoption of newer technologies, Govt. of India amended the National Mineral Policy in 1993 and also amended the Mines and Minerals Development and Regulation Act 1957 to allow induction of foreign technology and investment both in exploration and mining. Recently Govt. of India has also constituted several committees to further amend and modify the mineral policy to bring cohesiveness in the mineral development.

Mineral developments are site specific and to bridge the gap in demand and supply of minerals it is needed to develop more mineral based sites to increase the production. Nevertheless the environmental attributes affected due to site specific mining activities pose a serious challenge to the society to maintain harmony of any developmental activities with the protection of the environment. The ever increasing awareness in the country for the protection of environment to restore ecological balance in the mining areas have demanded to enforce various Acts & Rules, the prominent of which applicable to mining activities are i) Mines and Mineral Development & Regulation Act 1957 with subsequent modifications, ii) Mineral Concession Rules 1960 iii) Mineral Conservation & Development Rules 1988, 2003, iv) Environmental (Protection) Act 1986; v) Environment (Protection) Rules 1986, vi) The Water (Prevention & Control of Pollution) Rules 1974, 1975 , vii) The Water (Prevention & Control of Pollution) Cess Act 1977, viii) The Water (Prevention & Control of

0972-2173/2005-6-1©SGAT, BHUBANESWAR

Pollution) Cess Rules 1978, ix) The Air (Prevention and Control of Pollution) Acts & Rules 1981, x) Indian Forest Act 1927 , xi) The Forest Conservation Act 1980, xii) The Wild life (Protection) Act 1972, xiii) The Hazardous Waste Management Act 1989 and xiv) EIA Notification 1994, 1997, 2000, 2001, 2004. The enactment of these acts are mainly made with a view to harmonise the developmental activities with the environmental systems. This has prompted to conduct studies for preparing Environmental Impact Assessment Report for any development activities.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The prolific environmental impacts likely to be caused due to mining activities are described as follows:

i) Degradation of land: Mineral production through adoption of appropriate mining technologies shall cause land degradation for both opencast and underground mines.

ii) Air Pollution : Mining and allied activities like drilling, blasting excavation, transportation etc., shall generate dust to increase the particulate level in the atmosphere.

iii) Water Pollution: Mining disturb the hydrological regime of the areas.

iv) Noise & Vibration : Drilling, blasting, transportation, running of different heavy machineries shall increase the noise level and also can cause ground vibrations affecting the nearby structures.

v) Waste Generation: Mineral production process is likely to generate huge quantities of wastes that pose a problem in its management.

vi) Deforestation : Most of the mineral resources are locked in the forest and its winning over shall naturally affect the forest growth causing deforestation.

vii) Ecological Disturbance: Mining operation lead to changes in the local floral and faunal habitat.

The above mentioned discussion never say that the mining activities are only creating environmental hazards. Mineral development, being site specific has to be undertaken in a scientific manner to minimize the environmental degradation.

In a view to establish corrective measures to minimize the environmental degradation one has to undertake different processes like screening, scooping and consideration of alternative measures needed for EIA which would assist in formulating a suitable Environmental

Management Plan (EMP). The implementation of EMP in the proper perceptive shall help in achieving sustenable mineral development with a negligible disturbances in environmental domains. The components to be studied include Air Environment, Noise Environment, Water Environment, Biological Environment, Land Environment and Socio-economic and Health Environment. On scooping of these components applicable to the specific project activities a scientific model for effective EMP can be visualized. These studies need to be approved by the competent state and central govt. authorities undergoing different process formalities as has been highlighted in Annexure-I. Various organizations regulating the cumbersome processes of obtaining environmental approvals are listed in Annexure-II.

MINING SCENARIO

Although the country has plenty of this noble mineral resources, Indian mining is at cross roads due to several impediments including globalization and international competition, infrastructure bottlenecks, environmental and socio-economic safeguards. Global competitiveness and the Indian Mining Industry do not attain its proper prospects mostly due to lack of adequate infrastructural facilities.

In India more than 20000 mineral deposits and 64 minerals are being exploited. The total value of mineral production excluding atomic minerals at Rs. 69583 crore in 2003-04 increased by 4% from the previous year. So far about 8872 mining leseas are existing covering an area of about 6.24 lakh hectares out of which 3177 mines are in operation. This includes 575 mines belonging to fuel minerals, 574 to metallic minerals and 2028 mines to non metallic minerals. Production of these minerals do have a direct relationship on its consumption pattern and thus creates avenues for the establishment of various mineral based industries. The current boom in the prices of mineral commodities is aiming to achieve more and more productions to meet the demand. In the background of the growth rate of above 8% of Indian economy during 2003-04, the index of industrial production for mining sectors record a growth of about 5%.

The effective management of mineral resources has to be closely integrated with the strategic development pertaining to their consumption and utilization through several mineral based industries. Important mineral based industries of the country with production capacity are outlined in Table – I ; which projects the consumption pattern of the mineral resources.

Although the mining industry contributes significantly to the economic development of the country but nevertheless it is restricted for its visible and not so visible impacts on the environment. The issues those confront the optimal growth of the mining industry are varied and the principal issues need to be managed are;

i) Implementation of newer exploration technologies to improve the mineral resource base
ii) Adoption of environmental friendly mining technologies

iii) Management of socio-economic disparity in the mining belt
iv) Reclamation and restoration of closed and abandoned mines

v) Optimal waste utilization and its disposal
vi) Ensuring afforestation programme to restore bio-diversity of the mining belt

CONCLUSION

The current boom in the utilization of mineral substances in the global context it is definite that there will be an increasing growth trend of mineral industries for time to come. Future mineral development and environmental protection have played a major role in formulating country's policies and procedures for the mineral development. However, based on UN conference on human environment in 1972, environmental awareness is developed in the country with a constitutional sanction through 42nd amendment in 1976. Since then various environmental Acts, Rules, Notifications, Amendments are enacted to preserve and protect the environment. Nevertheless all developmental activities needed for the upliftment of mankind should not be ignored in the alibi of environmental protection rather an integrated approach should be practiced to develop a coadjutant relationship between environment and development. In order to achieve a perfect balance between the developmental activities and the environmental systems, the responsibility and limitations of the regulatory agencies, project proponent and the public should be properly defined and codified to promote a realistic and pragmatic approach to the implementation of the project.

Be nice, good and kind to minerals.

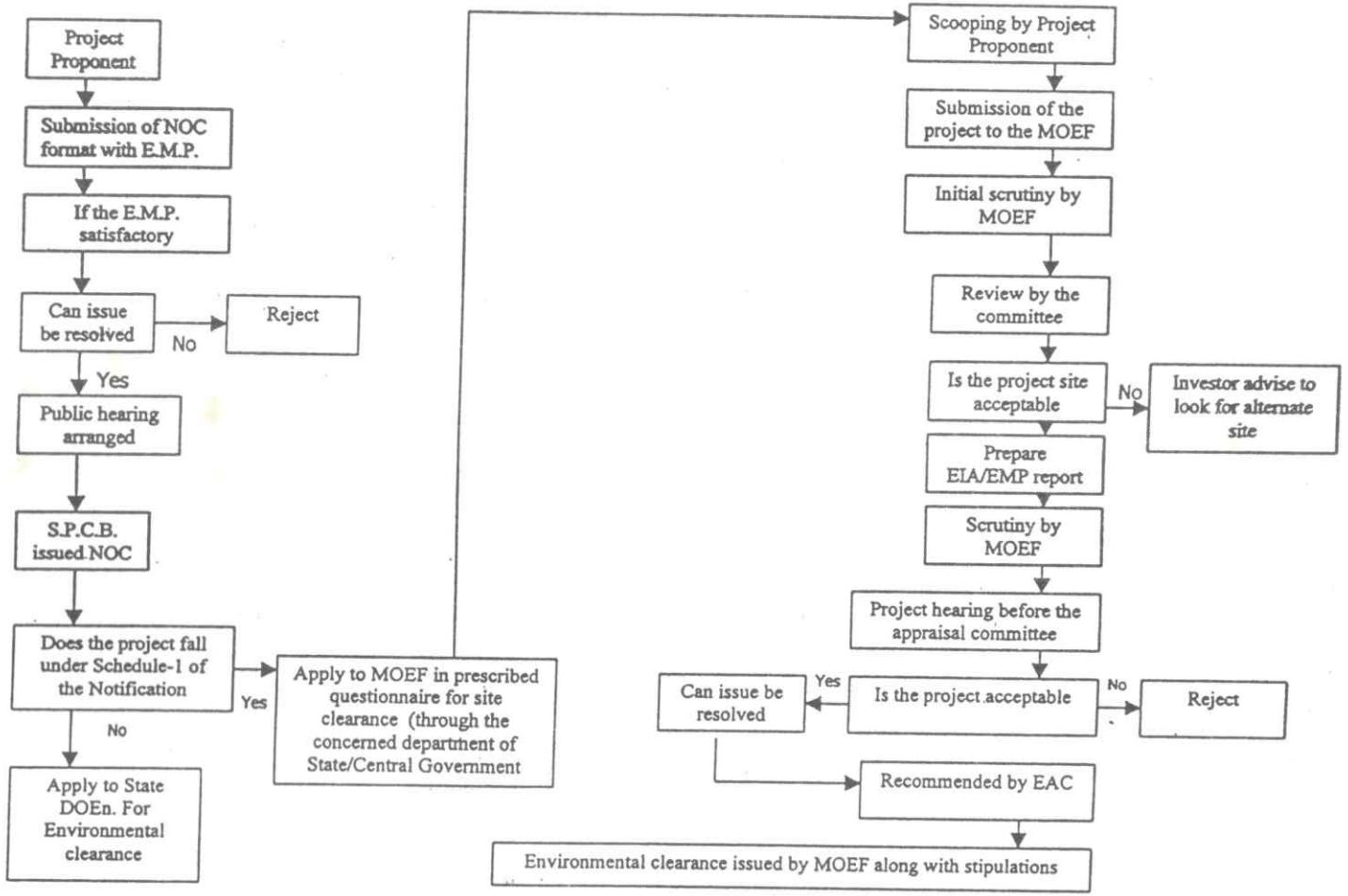
Table-I : Capacity & Production of Important Mineral Based Products

Mineral Based Product	Unit of quantity	Installed capacity	Production	
			2001-02	2002-03
Ferrous Metals				
Pig Iron	1000 tonnes	4833	4071	5285
Sponge Iron	1000 tonnes	7046	5660	6908
Finished Steel	1000 tonnes	N.A	31630	33671
Ferro Alloys				
Ferro Chrome/ Charge Chrome	1000 tonnes	625	301	379
Ferro Manganese	1000 tonnes	530	207	237
Silico Manganese	1000 tonnes	N.A	236	304
Ferro Silicon	1000 tonnes	204	76	82
Non-Ferrous Metals				
Aluminium	1000 tonnes	875	636	689
Copper (refined)	1000 tonnes	462.5	544	583
Lead (Primary)	1000 tonnes	36	38	39
Zinc (Ingot)	1000 tonnes	260		

Source: ***Indian Mineral Year Book, Indian Bureau of Mines, 2004***

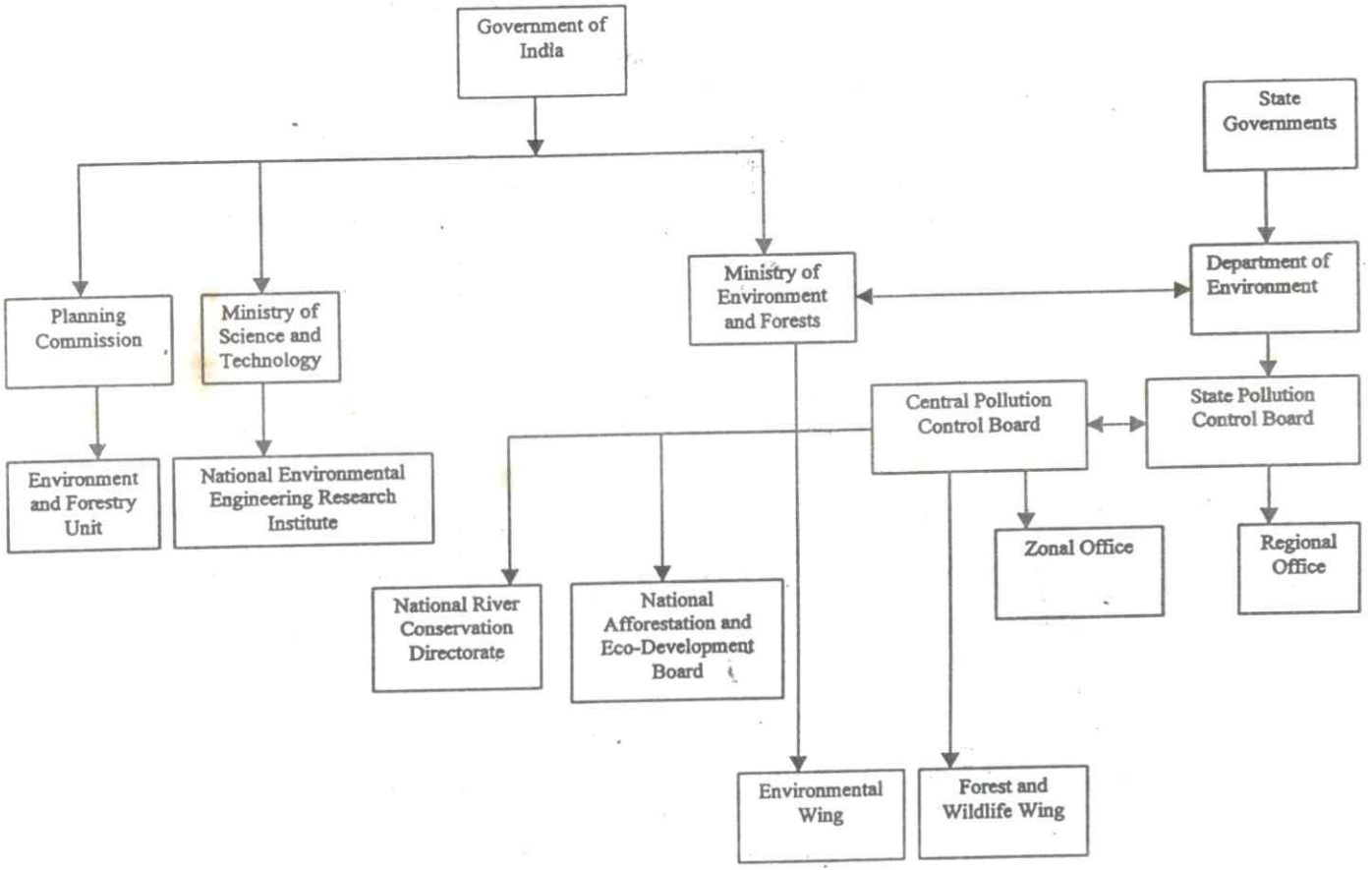
FLOW CHART
OBTAINING ENVIRONMENTAL CLEARANCE

Annexure - 1



Annexure – 2

The organisation of the environment sector in India



SILVER JUBILEE
LECTURE SERIES

SGAT Bulletin
VOL.6, No.2 December 2005 pp.45-51

IRON & STEEL INDUSTRY IN INDIA AND THE REST OF THE WORLD

Amit Chatterjee
Advisor, Tata Steel

INTRODUCTION

The steel industry in India had an early beginning. By setting up The Tata Iron and Steel Company at Jamshedpur in 1907, Jamsedji Tata pioneered this industry almost 100 years ago. Very early, Tisco made steel rails to British specifications. In World War II, British tanks were called Tatanagars – since the steel was made in Tatanagar (then the name for Jamshedpur). After Independence, India continued its efforts to gain control on iron and steel production. HSL (now SAIL) plants came up as PSUs.

In 1954, large integrated steel plants in Rourkela, Durgapur and Bhillai came up followed by the Alloy Steel Plant at Durgapur in 1960. The visionary behind this was the late Prime Minister Jawaharlal Nehru. He considered steel plants to be temples of modern India. Then there was a gap until Vizag was set up in 1990. This was soon followed by liberalization of the Indian economy which resulted in many private players getting into steel. All this is not surprising because India has always been considered a potential Steel Centre since India has high grade iron ores

RAW MATERIALS

For sustaining production of iron and steel, access to raw materials is a must. The world has 150,000 million tonnes of iron ore with an average of 47% Fe. Along with Ukraine, Russia, China, and

Austrailia, India accounts for about three quarters of the total. It should be noted

that India's iron ore is of high quality, e.g. it is far superior to that of China. In fact,

Chinese ore of such a low grade that by itself, it is unsuitable for iron making.

Another vital raw material for iron making using the BF route is coking coal. The world has total proven coal reserves exceeding 1 trillion tonnes and half of it is hard coking coal. The largest reserves are in USA (23% of the world reserves), former Soviet Union (23%) and China (11%). Today, China is the world's leading coal producer followed by USA. India's reserve is only 7.6% of the world and out of this very limited reserves, coking coal is only 15%. Coal is without doubt the biggest bottleneck and maximum cause for concern for classical iron and steel production in India based on blast furnaces. Even the total non coking coal available would be insufficient for smelting Indian ore.

Though India apparently has substantial non-coking coal reserves, its quality is not always upto-the-mark. However, one advantage is that the non-coking coal reserves are well distributed, which is not the case with coking coal.

0972-2173/2005-6-2©SGAT, BHUBANESWAR

Summarizing the raw material scenario, it can be stated that India has a major advantage over China in terms of rich iron ore, but this advantage is negated by the limited availability of poor grade coking coal. Therefore, India appears to be a potential country where alternative ironmaking processes based on either non-cooking coal or natural gas could find favour. The natural gas scenario in India is changing all time with more gas being found e.g. the recent findings in the Krishna Godavari area. Further, neighbouring countries like Bangladesh / Iran also have natural gas, which is not used by them and could be made use of.

Russia, Iran and Qatar have almost 60% of the world's natural gas. India and China have relatively small amounts in relation to these giants.

TECHNOLOGIES

Use of alternative technologies which are eco-friendly is a global trend. The world has adopted direct reduction based on coal and natural gas in a very big way in recent years. The world's sponge iron production has increased from 1 million tonnes to 52 million tonnes in the last 30 years. Between the years 1970 to 1990, the increase in sponge iron production was very pronounced, rising from 0.79 to 17.68 million tonnes. However, after 1990 the rise has been more gradual, though still on a steady climb.

The increase in DRI production in India from 0.2 mt in 89-90 to over 8.0 mt last year to give an astonishing CAGR of 45% in the first 10 years. Orissa's contribution to the initiation of the DR industry in India needs to be commended. Keonjhar was the District where IPITATA and OSIL began in the mid 80s and I personally had the privilege of being involved. At that stage, sponge iron was an unknown commodity, quite different from today, when with great pride we can all celebrate that India is now the largest producer of DRI in the world having produced just over 8.0 Mt out of the global production of 52 Mt last year.

India's growth in alternative iron making technologies has been truly remarkable and over the last 20 years. The growth in the DR industry has been more than 3 times that of the rest of the world. Along with direct reduction, India has also adopted Smelting Reduction and the largest Corex Plant in the world is in JVSL. Smelting Reduction like Hismelt are also under consideration for adoption in India. In my view, for small scale liquid iron production, the Russian Romelt process holds tremendous promise. NMDC has just given up plans to install a 1000 tpd Romelt plant in Chattishgarh.

PRODUCTION

The world crude steel production increased for the sixth consecutive year. It passed the 1000 mt mark for the first time and reached 1050 mt. This was 8.7% or say around 84 mt higher than 2003. China's crude steel production increased by 22.5% and reached 270 mt. China's growth was much higher than rest of the world; a trend over the last 3-4 decades during which, China has been a leader.

One interesting point to be underlined is that the world steel production is moving from NAFTA, EU and Japan to the developing regions. In 2003, the BRIC countries produced 36% of the world

steel -- 346 mt out of 964 mt. It is important to note the expected change between 2002 and 2015. The predominance of India, China and other Asian countries over America, Europe, Japan, etc is obvious.

Even in future, the steel production in Asian countries would continue to grow at a rate higher than what was the case in 2003 and 2004. In traditional steel producing countries like Japan, with sluggish GDP growth rates, the growth in steel production has been as low as 2.7%. And this situation is likely to continue. In 2005, with GDP growth rates of 7.9% in China and 6.5% in India compared with only 2.5% in the EU and 3.7% in USA, the growth in steel in Asia in preference to the West is ensured.

In between the years 1990 and 2003, the emergence of demand in Asia needs to be underlined. Steel demand in entire Asia has shown substantial increase, e.g. China from 9% to 26%, and Korea 3% to 5%. China has used the opportunity to a large extent and closed the demand supply gap. However, whether India will be able to follow this is still a question mark.

One of the reasons for this is the poor steel consumption in India. India's per capita consumption of finished steel is only 32 kg compared with the world average of 140 kg. Such a low consumption figure primarily arises because India's rural population of 70% has still remained totally oblivious to the multifaceted uses of steel. Is now the time for steel consumption in India to "explode" now that even the Govt. has enunciated rural oriented policies?

It needs to be appreciated that the growth rate in GDP in the Asian countries has been far higher than that of the world in general. Here again, China is the leader with growth rates of over 7-8%. India's GDP growth rate has recently been excellent at around 6.0%, and perhaps time is now ripe for India to jump on the Asian band wagon. While China will continue to lead, India should logically soon occupy the 2nd position.

Given the background, it is not surprising that India is attracting world renowned steel majors like BHP-Billiton, Posco, Nippon Steel, Arcelor and many others. All of them are considering substantial investment in the steel business in India in the next few years. Let us not think that this is happening by chance – they are all coming to India because this makes business sense.

Arcelor for examples is moving to attractive areas outside EU. India is the most preferred country, even ahead of China in terms of raw materials and expected growth rate. Investment in India from world steel majors like Arcelor therefore is quite logical.

The existing steel producers in India are also in the process of substantial expansion and it is clear that at least 30-35 million tonnes will be added by them in the next 5 years. SAIL has planned Rs 25,000 crore expansion to increase capacity from 11 to 20 mt by 2012. Tata Steel is adding 3.4 mt at Jamshedpur by 2008 and is aiming for 10 mt steel production at Jamshedpur by 2015. Further, Tata Steel is proceeding with a 6 mt intergrated steel plant at Duburi in Orissa. Vizag (RINL) has plans to go from 3.5 Mtpa to 10.2 Mtpa by 2010. Bhusan Steel is investing Rs. 3000 crore

for producing HR coils in Orissa. To cater to import/export of steel products and raw material, ports like the Dharma port are being developed, but more needs to be done on infrastructure. Tata Steel is playing a role even in this area given the Gopalpur experience where the port became an impediment to the realization of a dream.

Many of the relatively new players like Essar, JVSL and JISCO as well as old members like Durgapur Steel have also announced substantial capacity increase plans. Essar has proposed for 4 Mt. expansion, along with 6 Mt. pellet plant in Orissa. JVSL is enhancing slab steel capacity from 2.5 Mtpa to 3.8 Mtpa by investing 1270 crores. JISCO is targeting a capacity of 10 Mt by 2010. Jindal Stainless Steel has planned a 1.6 Mtpa integrated stainless steel plant. Durgapur Steel is also aiming to increase its capacity to 3 Mtpa from the present level of 1.86 Mtpa. Downstream cold rolling companies like Bhusan Steel are also getting into the production of hot/cold rolled strips. Orissa is the major centre of activity and I repeat that this is only the beginning. However, a clear strategy has to be religiously adopted in order to sustain this trend.

Today, the global steel industry is witnessing: geographic relocation of demand growth, structural supply-side changes, shifting trading patterns including the emergence of China, increasing product commodification including branding, low and volatile pricing prospects, endemic capacity creep, and all out efforts at reducing costs to remain competitive. It can be said that without restructuring in the steel industry, the future downturns will be worse than anything in the past and this is something India and Orissa must be prepared to face.

In 2004, the global steel production was 1050 million tonnes crossing the 1000 million mark for the first time but, days of quick growth are now over. This is because the steel industry is a difficult sector requiring high capital investment, has to compete for market share with alternative materials, there is high fragmentation in this industry, the exit costs are phenomenal, and at the same time, many bankrupt companies exits which need more and more capital for survival for e.g. Indian Iron. Any new plants coming up today when the times are good, must anticipate down turns in future. This is a critical factor.

The percentage of world market controlled by the top five companies is less than 15% in the case of steel. For iron ore it is over 80%, and for automotives it is 60%.

India is today the 8th largest steel producer having overtaken Brazil in the last couple of years. Traditional steel producing nations like Japan, USA, Russia and Germany are not adding capacity. The remarkable growth is essentially in Asia, particularly China and Korea. India is poised to join the race.

It is to be appreciated that in the late Forties, India and China each produced around 1 million tonnes of steel per year. Today, China is by far No. 1 in the world steel league and India occupies the 8th position. It is important to consider how such a large gap was created in 50 years and whether this gap can be bridged in the near future.

INFRASTRUCTURE

Coming to infrastructure, China scores over India in terms of electricity generation and transmission and distribution losses. Some indices like the total rail route are in favour of India. It is for India to make full use of such advantages.

Infrastructure has a direct impact on industrial production. Therefore, besides steel, China is also way ahead of India in the production of petroleum, cement and fertilizers. When it comes to automobiles, the figures are similar and, in fact, India is expected to overtake China in the coming years.

Growth in iron and steel would need support from knowledge, particularly in science and technology. Today, there are 200 National Laboratories; 1300 R&D Units employing 325,000 people; and 196 Universities producing 200,000 S&T personnel each year. In fact, science and technology manpower in India in 2003 was 5 million, which was one of the highest in the world. We can rightfully claim that basic knowledge infrastructure is in place for major growth. However, other infrastructure needs beefing up.

The growth of a set of countries at a blistering pace has given rise to BRIC i.e. Brazil, Russia, India and China. These four countries could dominate the world in 20 years time. By then, India would compare favourably with the rest of the world in terms of Oil demand, Stock Market Capitalisation and Number of Cars. All these are positive indicators for steel. Again, I would like to reiterate that in 2003, the BRIC countries produced 36% of world steel --346 mt out of 964 mt of the world and this higher share of BRIC countries will further increase in the years ahead.

The BRIC countries will be the major source of growth as evident from the graph showing the three important growth indicators for any economy i.e. Oil Demand, Market Capitalisation and No. of cars. China and India would emerge as the world's No.1 and No.2 Car Markets in 15 years displacing USA from this position.

Many of you may be familiar with Michael Porter's diamond framework of competition. In terms of input conditions like availability of high grade iron ore and sufficient technical manpower, India more than fulfils Porter's criterion. The same is the case as far as the demand scenario is concerned. With the automobile and related industries growing at such a fast rate in India, another of Porter's conditions is being fulfilled. What is required at this stage is the adoption of a proper strategy. This would consist of non-coking coal and natural gas based DR and SR based small scale steel production supplementing bulk production using the BF-BOF route. EAFs in which DRI as hot metals are charged will help to distribute the steel production centres.

ENVIRONMENTAL ISSUES

A more disturbing picture emerges when the total carbon dioxide is considered. The total emission picture is quite alarming. Highly industrialized countries like the United States, Japan, and Germany have either less than or similar figures as India and China. Carbon dioxide emission in China is next only to

the US and India is in the fifth position. The future of steel production in India is likely to be limited by this factor. A penalty on carbon dioxide in the steel industry is already being considered by the European Union to the extent of USD 200 / t of steel made.

The Kyoto protocol will soon become effective. Global climate policy will further constrain and complicate decision-making in the steel business. The world average of 1.6 tonnes of CO_2 per tonne of crude steel reflects mix of integrated and electric arc furnace production. EAF steelmaking does not seem much superior when electricity generation is included, but pollution abatement will definitely cost more in ISPs. Only major evolution of technology can lower energy required per tcs. Room for energy reduction in developed countries like EU, USA, Japan, etc. is very less. The case in India is quite opposite.

Abatement of pollution will be critical for the future growth in steel production in India. We have not made a very promising beginning and a multiplicity of small coal based sponge iron plants, induction furnaces and re-rolling mills have not so far paid adequate attention to the environment. The Bankura-Asansol area in Bengal, Adityapur in Jharkhand and the Barbil areas in Orissa have become extremely polluted in the last 3-5 years. This is most disturbing. Environment protection requires intense capital expenditure and if this is avoided for short term gains, WTO and other governing bodies may impose restrictions on the trade of Indian steel. Substantial increase in production will then be in jeopardy. This is a major concern unless addressed vigorously day-in-day-out. My only appeal to Orissa is to "BE VIGILANT".

Tata steel is making handsome profits and in this situation, the possible growth business for Tata steel have been carefully studied. It has been concluded that the possible areas of growth are: steel (low cost production, high quality, niche markets, etc.), stainless steel, ferro-chrome, thermal coal, iron ore, titania, e-commerce and remote business services.

CONCLUSIONS

We have a rich heritage in the field of iron and steel. India is blessed with high grade iron ore. Despite this, our steel consumption is abysmally low. Given our iron ore reserves, excellent quality of technical manpower, relatively low labour cost, excellent GDP growth, emerging trend of growth in steel in this part of the world, and so on the Indian steel industry should grow significantly in the years ahead provided a proper strategy is adopted. It is suggested that the use of alternative reductants like non-coking coal and natural gas should be our strategy to extract iron from India's rich iron ore reserves in States like Jharkhand and Orissa. Of course, infrastructure will have to keep pace, but infrastructure can be put in place through government as well as private participation - a beginning e.g. in power generation is already discernible. One area which could be a major deterrent is environmental protection and we in India need to be extremely conscious of guarding ourselves against penalties by world regulatory bodies. Stringent environmental demands may be the biggest deterrent to expansion in steel.

The future of steel is bright and India will be amongst the world leaders. China will continue to be ahead but India will go through a major growth phase. India and China will soon be a force beyond comparison as the Asian hub of world steel (accounting for 35% of the total

production/demand). By 2015, India will have a population of around 1500 million. To be a world power, which is the vision of our leaders like President Kalam, the per capita steel consumption has to reach at least 80 k.g. Therefore, it follows that India must produce 120 million tonnes of steel by 2015. This is four-fold growth in steel production over the next 10 years may appear slightly far fetched today, but India has the ability to reach this target. In fact, the dawn in the fortunes of the Indian steel industry is already visible. The target of 120 million tonnes by 2015 can be reached if the attention is given to the technology, infrastructure and overall steel policy. Orissa will find a rightful place in India's steel map. 35-40 mtpa steel from Orissa alone is possible. Tata steel will definitely play a role in Orissa's future plans, as it has done all along. As a technocrat, my only appeal is that we must: **'protect the future by not pushing the present so far that sustainability of steel production becomes a question mark.'**

SGAT Bulletin
VOL.6, No.2 December 2005 pp 52-60

ENVIRONMENTAL AND DEVELOPMENT CONFLICT RESOLUTION IN CONTEXT TO INDUSTRIAL DEVELOPMENT IN ORISSA

Dr. Bishnu P. Das

Former Engineer in Chief Adviser,
Dept. of Water Resources, Orissa
Expert Consultant FAO, UN

INTRODUCTION

Water is the primary input for food production and its sustainability has to be imperative. Water is a precious gift of Mother Nature that is to be maintained in its natural form. Though 97.5% stays in the oceans, and the balance 2.5% fresh (snow, surface and groundwater), 0.26% of the total amount of fresh water is enough to meet the requirement of this globe. The annual renewable fresh water supply in the world is about 50,000 Billion Cubic Meter (BCM). Corresponding figure for India is 1969 BCM, which is about 4% of the worlds supply. The per capita annual availability of water in India, which is about 2200 cubic meters (m^3) , is much lower than the world average, of about 8500 m^3. this compares with 2420 m^3 per year for China, 9900 m^3 per year for USA, 19500 m^3 per year for the former USSR. Considering that scarcity of water is occurring with development, India National Water Policy (April, 2002) categorically states "Water, as a resource is one and indivisible: rainfall, river waters, surface ponds and lakes and ground water are all part of one system. Australia bulk of which is arid his become prosperous uses water efficiently because "Australia in the words of a biologist, by far the smallest, the flattest, the driest, the least fertile and climatically the most unpredictable continent in the world."

The availability of annual renewable fresh water some selected countries are:

Name of the country	In BCM
Brazil	7000
Russia	5500
Canada	3000
China	2800
Indonesia	2750
USA	2700
Bangladesh	2600
India	2200
Venezuela	1500
Myanmar	1000
Colombia	1000
Zaire	800
Japan	800
Pakistan	700
Nigeria	500

Regarding per capita water availability Canada leads with 90000 m^3 followed at 55000 m^3 where as china and India the two most populated countries have only 1850 and 1780 m^3 per capita. It appears that India is relatively comfortable in respect of over all water wealth as

compared to other countries. However, the reality is something different.

Owing to high rate of population growth , the national per capita annual availability of water, which was 5300 cubic in 1955, has presently come down to 1780 cubic meters. The average per capita availability of water in Brahmaputra basin is as high as 18000 cubic meters whereas it is less than 380 meters in some of the east flowing rivers of Tamil Nadu.

Water for Food, Sector Vision for 2025 AD analyzed by World Water Vision, March 2000 in World Water Forum 2 project the following for India.

- Population will grow from 6 billions to 8-9 billions.
- Food requirement will about double the present lwevel.
- Arable land 1500 Mha.
- Some wasteland, becomes arable, some rain-fed receives irrigation. Globally, irrigable area rises from 260 Mha to +400 Mha. Rain-fed area may remain about same coverage.
- Water use parameters a re: Agriculture: Muncipal: Industrial: 70:15:15 for the world, whereas for India it is 85:8:7.

National Water Policy for India dictates the basic principals for water related development

- National Water Policy was adopted in September, 1987 and modified in 2002.
- In the planning and operation of systems, water allocation priorities should be broadly as follows.
- Drinking water
- Irrigation
- Hydro-power
- Ecology
- Agro-industries and non-agricultural industries
- Navigation andothe uses.

Total Water Requirement o India estimated by the National Commissionof Itegrated Water Resources Development Plan (NCIWRDP).

Projected

In BCM

Sl. No.	Category	Year 2010		Year 2025		Year 2050	
		Medium	High	Medium	High	Medium	High
1	Irrigation	536	556	688	734	1008	1191
2	Domestic	41.6	61	52	78	67	104
3	Industries	37	37	67	79	81	116
4	Energy	4.4	5	12	13	40	44
5	Inland Navigation	-	-	4	4	7	7
6	Flood control	-	-	-	-	-	-
7	Afforestation	36	33	67	67	134	134
8	Ecology	693	5	10	10	20	120
9	Evaporation	36	733	942	1027	1422	1681
Total		693	733	942	1027	1422	1681

In conformity with national policy and for food security, irrigation development received highest priority as plan schemes until the 6th Five Year Plan. Irrigation infrastructure development has resulted in impounding 200 BCM in large / medium reservoirs and around 50 BCM in small storage leading to creation of 95 Mha of irrigation potential. Abstraction of 630 BCM of fresh water is currently for all uses. Irrigation is the largest withdrawal at 83%. Total utilize withdrawal is 1100 BCM out of the overall availability of 2200 BCM.

Water uses in India	%
Irrigation	83.0
Drinking / Muncipal	4.5
Industry	3.0
Energy	3.5
Others	6.0

ENVIRONMENTAL IMPACT OF DEVELOPMENT

For creation of imagination potential by dams has resulted in emerging fresh water scarcity, which is global issue of utmost importance. As population and associated water demand increases need of aquatic environment and other uses is becoming critical. What is often lacking is the understanding that planning environment water allocation means striking the right balance between allocating water for direct juman use (for agriculture, power generation, domestic purposes and industry) and indirect human use (Maintenance of ecosystem goods and services). Agriculture and industrial effluents need a very high diluting flow. Environmental flow assessment for every basin if now mandatory adopting integrated water management(MW).

Few example of global environmental degradation that have occurred creating serious imbalance in freshwater for nature are:

Area Sea in Central Asia
Colorado River Delta
Indus Delta

Aral Sea: An Ecological Disaster

At the beginning of the 20th century the total area of irrigated lands was around 1 million ha (Mha). With further construction of major reservoirs on Amu-Darya and Syr-Darya the irrigated areas of the Syr-Darya alone rose to 3.2 Mha by 1975. this requires about 50 km^3 y^1 of water, which exceeds the natural annual runoff. During 1911-1960 annual average discharge was 56 Km^3. during 1981-1989 annual discharges ranged between 0.9-95 Km^3 . dying of the Aral sea has been accompanied by profound and in reversible degradation of ecological system. Salinity has increased from 10.2 ppt (1961) to 30 ppt (1991). Leading to extinction of fresh water species. Deltaic wetlands, which covered 8 lakh hectares in 1960 is now reduced to around 1 lakh hectares. Fish catch has declined from a peak of 44,000 (1950) to zero today. Due

to dam construction migration of fish is severely hindered. It is estimated that in the irrigation canals alone 5 million young fish perish annually.

COLORADO RIVER DELTA

Colorado river has basin 6,32,000 Km^2. terminal 32,000 Km^2 in Mexico is the deltaic region, which is considered the most critical arid wetland in North America. 70% in the tail of the basin is extremely arid and receives precipitation of 80 mm or less annually. Massive irrigation development of 7,50,000 has offered beyond 1930 by major dams, Hoover and Glen Canyon. Delta extent consequently got reduced to 600 km^2 of remnant wetlands from 7700 km^2 (1900). The sediment load decreased from 10,000 ppm to 200 ppm (1975). Tidal action in delta now removes more material than the river replaces. Desert condition prevails here with 38^0 C temp. over 5 months. Precipitation is 54 mm with evaporation of 2046 mm annually. Highly productive and diverse eco-system in delta is now ecologically threatened. Colorado water is over allocated as legally apportioned (paper water) is more than actual flow (wet water). US Bureau Reclamation says, "there is no other river in the western hemisphere that has been the subject of as many disputes of such wide scope".

DEVASTATION OF INDUS DELTA

Indus Delta, 5^{th} largest in the world, shapes 563 Km of the entire coast of Sind. Due to impoundment and abstraction at Bhakra dam in India, Tarbela & Mangala dam in Pakistan, annual freshwater flow, which was 150 MAF and annual silt flow to the delta of 400 Million Ton (1950) has decreased to 20 MAF and 36 Million Ton (currently). Assuming Vision 2025 program for Pakistan is implemented, the out flow would drop to 10 MAF or lower. Mangrove habitat has been lost from 2630 Km^2 to less than 1000 Km^2 due to increasing salinity from 10-15 ppt to 45 ppt. Fish depletion has occurred almost 50%, causing loss of US$ 300 Million annually from export earning. Agricultural loss has been considerable due to salinity increase andlack of flooding. Drinking water shortage has devastated delta population of 2.26 Million. Lakes and wetlands have dried up converting sweet water lakes to saline water lakes.

ENVIRONMENTAL DAMAGES IN INDIA

Several large in Mahanadi, Godavari, Krishna, Cauvery, Ukai and Brahamani for water resources development have altered downstream flows spatially and temporally affecting the ecosystem. For Cauvery less than 10% of basin water now flows to the sea. The Rajasthan canal has all the usual troubles to which a desert irrigation system is susceptible. Uneven water distribution, wasted water, poor drainage, dust storms and an epidemic of water hyacinth have occurred. According to the governments own records, water levels around the canal have been rising an average of three feet a year, bringing with them salinity, mosquitoes and malaria.

Because Indian rivers highly seasonal water abstraction causes greater environment change. In addition to massive abstraction for irrigation, industry takes away considerable freshwater and returns poor quality water. Statistics tell 36.3% of the total value

added to raw materials through manufacture by industries of India comes from Maharastra & Gujarat, which were the first to industrialize. Today they are the two most polluted states because there is hardly any flow in the downstream reaches where pollutants are discharged. According to a recent survey conducted by the CPCB although about 85% of the total number of large and medium water polluting industries in the country have effluent treatment systems, their performance in most cases is found to be far from satisfactory.

INDUSTRIAL WATER NEED OF INDIA

For projection of demand of water for the next 25-50 years, the industrial growth rates as observed from the Ninth Plan were adopted for working out the future production figures of various industries. Based on this, the water requirement works to about 70 BCM and 103 BCM for the years 2025 and 2050 respectively. The category wise details of water requirement are given in Table. The water consumption figures are considered to be maximum demand and there is likely to be a lot of technology upgradation with the use of water conservation practices by way of low cost no waster technologies. The National Commission, therefore, recommended adoption of lower figures viz. 67 BCM for the years 2025 and 2050 respectively.

WATER FOR INDUSTRIAL DEVELOPMENT IN ORISSA

Reserves of major minerals in Orissa such as: Chromite, Nickel, Bauxite, Iron-ore and Coal are 98.39%, 91.84%, 59.53%, 27.99% respectively of the total deposits in India. Total annual iron-ore production in India is around 150 MT. India produces about 40 MT crude steel. For Orissa massive industrial massive industrial expansion particularly for producing steel to the tune of 50 Million Tonne annually over the next 25 years are the action plan of the Government of Orissa. An important issue is ensuring availability of not only freshwater for industrial use but also enough flow in the rivers to dilute the pollutants to protect the aquatic ecosystem.

Projected water requirement for various sectors of Indian industries

Sl. No.	Category of Industry	Water Requirement m^3/t s/yr/yr	Waste water Generation on m^3/t	Water Requirement Mm^3/yr	Water requirement Mm^3/yr	Water Requirement Mm^3/yr	Water Requirement Mm^3/yr
1	Integrated Iron & steel	22.00	15.00	2626.58	3829.10	6012.60	12035.10
2	Smelters	82.50	65.00	11.70	16.76	32.31	44.35
3	Petrochemicals & Refinery	17.00	13.00	21.34	23.47	37.76	55.61
4	Chemicals-Caustic Soda	5.50	1.00	8.03	8.65	12.67	19.07
5	Textile & Jute	200.00	150.00	4863.02	8153.72	36701.40	46923.50
6	Cement	4.50	NA	418.00	599.50	1777.50	3370.50
7	Fertilizer	16.70	3.50	147.51	220.11	1105.09	1192.75
8	Leather Products	30.0	28.00	30.12	1244.65	93.08	147.83
9	Rubber	6.60	5.00	2,66	3.04	6.41	9.54
10	Food Processing	6.80	NA	848.76	991.76	9442.76	12298.32

11	Inorganic Chemicals	200.00	4.00	96.80	165.44	3346.00	615.20
12	Sugar	2.20	0.40	36.21	46.20	334.40	636.90
13	Pharmaceuticals	25.00	NA	104.75	124.00	276.15	429.15
14	Distillery(Req. per 1000 liters)	22.00	12.00	3939.76	6357.20	318.00	5203.92
15	Pesticides	6.50	5.00	3.78	6.67	4.82	8.38
16	Paper & Pulp	200.00	175.00	852.50	1259.50	10240.00	19490.00
17	General Engineering	2.20	175.00	1271`.38	1433.20	27.82	55.63
	Total			15282.90	24482.97	68768.77	102535.75

Mineral Reserves in Orissa & in India, 2001-02			
Name of the Mineral/Ore	Reserve in Orissa	Reserve in India	Percentage to all India reserve
Iron ore	3567	12745	27.99
Chromite	183	186	98.39
Coal	51571	240750	24.11
Bauxite	1733	2911	59.53
Nickel	270	294	91.84

Bulk of the industrial establishment existing or contemplated in Orissa lie in Brahmani basin starting with Rourkela Steel Plant and ancillary industries, Anugul-Talcher industrial complex and Kalinga Nagar complex at the delta head above Jenapur. The mega steel plant of POSCO planned at Paradeep is projected draw water from Mahanadi barrage at Cuttack.

Under the auspices of the International Commission on Irrigation and Drainage (ICID) a comprehensive assessment of the water resources of the Brahmani basin has been made regarding the yield and needfor a vision year 2025. this study is meant to provide guidelines for Country Policy Support Programme (CPSP) for India. The author was Task Manager for the Brahmani basin study.

The summary of the water balance study of Brahmni is as follows:

Current Water Balance		
Sl. No.	**Incoming**	**In Mcum**
1	Precipitation	52724
2	Import from Mahanadi basin	400
3	GW Depletion	Nil
	Total	
	Outgoing	
4	Percolation to Ground	5170
5	Natural Et @ 750 m.m. (inclusive forest)	29452
6	Additional Et from Command	
6.1	Major / Medium 144000 Ha @ 0.5m	720
6.2	Minor Flow 67500 ha @ 0.04m	270

7	Add 70% for loss of Sl. No. 6.1 & 6.2	693
8	Et from Swamp	400
9	Evaporation from Reservoir	936
10	Domestic $ Industrial us inclusive of evaporation	548
Total		**38189**

Water Balance 2025		
Sl. No.	**Incoming**	**In Mcum**
1	Precipitation	52724
2	Import from Mahanadi Basin	400
3	GW Depletion	Nil
Total		**53124**
	Outgoing	
4	Percolation to Ground	5170
5	Natural Et @ 750 m.m. (inclusive forest)	29452
6	Additional Et from Command	
6.1	Major/Medium 5,00,000 ha @ 0.5m	2500
6.2	Minor Flow 1,3,000 Ha @ 0.04m	520
7	Add 70% for loss of Sl. No. 6.1 & 6.2	2144
8	Et from Swamp	500
9	Evaporation from Reservoir	1200
10	Domestic & Industrial use inclusive of evaporation	1366
Total		**42822**

WATER DEMAND AND WASTEWATER GENERATION

The data of consumption of water currently for major industries in the basin and the generated wastewater is shown in table below.

Sl. No.	**Name of the industry**	**Products**	**Water Consumption KLD**	**Wastewater Generation KLD**
1	Rourkela Steel plant	Iron & steel	265580	120,000
2	Rourkela Steel plant	Fertilizer CAN	28807	7920
3	Fertilizer Corporation	Fertilizer (Urea)	45,883	16608
4	NALCO-Smelter Unit	Aluminium	5066	4900
5	NALCO-Captive power Plant	Electric Power	135,000	90,000
6	ORICHEM Ltd.	Sodium Dichromate Basic Chromate Sulphate Yellow Sodium Sulphate	170	10
7	Talcher Thermal Power	Electric Power	13227	6483
8	Talcher Super Thermal Power Plant, NTPC-Kaniha	Electric power	137099	52080
		Total	**630832**	**298,001**

Industrial Water Consumption in Brahmani Basin, Proposed by 2025

Name of the Industry	Products	Water consumption KLD	Wastewater Generation KLD
MESCO Iron Steel Ltd., Duburi	1.0 T Iron	84840	40078
MESCO Kalingan Steel Ltd., Duburi	4.5 MT	193200	91268
Bhusan Steel	3.0 Iron & Steel	229200	108274
Neelachal Steel Ltd.	2.5 Iron & Steel	175200	82764
Brahamni Steel, Duburi	1.0 Iron & Steel	84840	40078
ORNID Steel	1.0 Iron & Steel	16800	7936
Kalinga Power	4 X 250 MW	336000	158726
Other Steel Plan	3.0 Iron & Steel	288000	136051
Ancillary Industries		45840	21655
Sub Total	**16 MT of Steel**	**1453920**	**686832**

Sl. No.	Industrial Water Use	Consumption (in Mcum)
1	Current consumption of Water by major industries	322.441
2	Future demand	530.681
3	Add 15% of (1&2) for other developments in the basin	127.968
4	Add from Jharkhand & Chhatishgarh (I.s)	300.00
	Total consumption	**1281.09**
	Return water from industries @ 47% (-)	**602.11**
	Net consumption	**678.98**

The above projected consumption of 679 Mm^3 for industries is the net figure whereas the gross withdrawal would be and irrigation expansion from the resent 0.25 Mha to 0.8 Mha (2025), the terminal flow to the estuary at Bhitarkanika is likely to reduce to 10,000 Mm^3 from the present level of 18,000 Mm^3 . A correct analysis of the environment flow need of Brahmani river fight from Panposh to Bhitarkanika is necessary following current modem methodology. This study must receive he highest priority considering that the livelihood almost 1 Million population in Brahmani delta is dependant on good quality water at the Brahmani delta head.

WATER CONSERVATION IN INDUSTRIES

Water conservation measures in industries should include:

- Review of alter production process and technologies from consumption point of view;
- Ensuring sound plant maintenance practices and good house keeping, minimizing spills and leaks;

- Optimization of treatment to achieve maximum recycling. As water and wastewater treatment costs go up, recycling will begin to pay.
- For medium & large industries, where use of processed or recycled water is permissible, use of fresh water should not allowed.
- For industries located near the coast, use of seawater with or without treatment may be considered in lieu of fresh water.

WHERE TO GO FROM HERE: ISSUES FOR DEBATE

Is there enough water in Mahanadi and particularly in Brahmani for the ecosystem or the environmental flow, which has not been assessed. Need of Bhitarkanika mangroves have to be realistically assessed, considering the drawal for Rengali command of 200,000 ha by 2015. Water need for the proposed POSCO plant 12 MT (ultimate) has to be allocated from the ricer reach with assured water. Present Industrial Policy of Govt. of India is to take away water intensive industries from water scarce rivers.

Global EWR expressed as a percentage of long-term mean annual river runoff

EWR estimates obtained by any method may not be considered without a reference to some negotiated or prescribed ecosystem conservation status. The higher this status, the higher the required EWR will be. Some earlier studies suggested that 10 per cent of MAR is the lowest feasible limit for EWR as it corresponds to a severe degradation of an ecosystem, while 60 to 100 per cent of MAR represents an "optimal range". Other sources suggested that "the probability of having river falls from high to moderate when the hydrological regime is less than two-thirds of the natural".

CONCLUSION

The overall availability of water in Brahmani where bulk of industrial expansion in Orissa is to take place has been presented. Although Brahmani is a surplus basin now, with massive expansion of irrigation and industries the river will just be able to handle the entire need of **Food, People and Nature** in the future provided integrated water management and rigorous pollution and zero effluent mechanism are enforced. The geologists and geoscientists have a major role in ensuring that mining, industrial processes and even agriculture are carried out in an eco-friendly manner.

SGAT Bulletin
VOL.6, No.2 December 2005 pp 61-62

TSUNAMI AND ITS AFTEREFFECTS

Padmshree S.Z. Qasim

Formerly Director, National Institute of Oceanography

INTRODUCTION

Tsunami owes its name from the Japanese word 'tsu' means harbour while 'nami' means wave.

A lot has been said and reported in the media after tsunami devastation which occurred on 26 December 2004.

Since that time many seminars, discussions, symposia and conferences have been held in India giving the various types of details. However, the questions which has largely remained unanswered is what have we really learnt from the tsunami disaster?

Before the calamity, the word tsunami was unheard of even by the educated people, let alone the common man.

Even people like us, who have been involved with ocean research for a major part of life, knew about tsunami largely occurring in the Pacific Ocean, where an efficient warning system (TWS) has been in existence with its coordination centres in Hawaii and Alaska.

DEVASTATIONS CAUSED BY TSUNAMI

Unprecedented damage to life and property.

Nearly 3,00,000 persons have been reported to have lost their lives in countries bordering the Northern Indian Ocean.

Damage to infrastructure and property amounts to billions of dollars.

The intensity of 26 December 2004 tsunami was 9.3 on the Richter Scale — the second highest ever recorded. The Great Chilean Earthquake which occurred in 1960 had a magnitude 9.5.

Casualties were highest in Indonesia followed by Sri Lanka, India, Somalia, Myanmar, Malaysia, Maldives, Tanzania, Scychelles, Bangladesh, Kenya, Singapore and South Africa. It had its epicentre at the northern Sumatra in a small town known as Aceh-Banda.

CAUSES OF TSUNAMI

Undersea Volcanic eruption, landslides etc.

Result of deformation of the ocean bed caused by tectonic activity.

The Sumatra-Andaman Earthquake was caused when the India Plate moving at the rate of 5 cm per year collided with the Burma Plate.

The time of its occurrence was 6:29 A.M. IST. It lasted for about 10 minutes, when most of the major earthquakes last for a few second.

The time when the killer waves of 10, 20 or 30 metres reached the shores was 9:00 A.M. Thus the time in between was 2.5 hrs. interval. Thus when large areas of the sea floor get elevated or subsided, tsunami is created. The sea floor violently shakes displacing a very large volume of sea water.

PREVIOUS RECORDS OF TSUNAMI IN THE INDIAN OCEAN

According to Dr. T.S. Murty — a world renowned expert on tsunami, only two earlier records are worth noting.

A quake of 8.1 intensity on the Richter Scale occurred in the Andaman Sea on 26 June 1941 and the other of 8.27 magnitude hit the Makaran Coastal ridge on 27 November 1945 which extended up to Karachi and below.

The entire Andaman and Nicobar area is seismically active. The only active volcano in the Indian Territory is on Barren Island.

POST TSUNAMI INITIATIVES

Rapid action by the Government of India the Prime Minister Dr. Manmohan Singh paid a visit to the devasted areas of Tamil Nadu and Andaman Islands and announced relief measures.

At the Annual Session of the Indian Science Congress, he made a strong reference of tsunami and constituted a high-powered committee to recommend remedial measures on natural disaster management.

Tsunami Summit Meeting in Jakarta in which world leaders of many countries participated.
The UN Secretary General Kafi Annan played a key role.

About 4 billion dollars were collected for relief measures.

On February 21, 2005, while inaugurating the 32nd Conference of ESCAP of WMO at Bangkok, Shri Kapil Sibal, the Minister of S&T and Ocean Development announced that an effective Early Warning System was necessary.

EARLY WARNING SYSTEM

Identification of the most vulnerable points (8-10 in the Indian Ocean) and the deployment of Bottom Pressure Recorders with Radio buoys to sense slightest tremour at the sea bottom and transfer it to the satellite which in turn transfer the information to the shores for early action.

Installation of 50 tride gauges to monitor sea level changes.

Updating of the existing Seismic stations.

Measurements of surface current an waves by at least 10 radars.

Installation of deep sea current meters moored at strategic points.

Linking the Indian Ocean Warning System with the Pacific Warning System DOD has been made the lead agency with an initial allocation of Rs.125 crores to complete the work within 30 months.

SGAT Bulletin
VOL.6, No.2 December 2005 pp 63-65

CHANNEL IRON ORE EXPLORATION IN THE PILBERA REGION, WESTERN AUSTRALIA

H.J. Garlick
Mackay Schnellmann (P) Ltd,. Perth, Australia

INTRODUCTION

In view of the global iron ore scenario, the present topic seems to be befitting. The discovery and detailed exploration of these iron ore resources shall no doubt augment the existing resource status of iron ore. The address highlights the importance of iron ore production to Australia and West Australia in particular. In 2004, the iron ore mining industry in Western Australia continued to play a pivotal role in the State's export-driven economy.

Record sales of US$ 4.7 billion dollars were made in 2004 on volumes of 217 Million Tonnes with 43% of sales being exported to China, 35% to Japan, 12% to South Korea, 5% to Taiwan and 5% to Europe.

These booming conditions were also reflected in record iron ore exploration expenditures for 2004 of US$ 78 million dollars. An increase of 97% on 2003.

For Western Australia's economy, iron ore exports represent about 22% of the States total mineral and petroleum sales of US$ 21.6 billion and about 11% of Australia's total mineral and petroleum sales of US$ 43.5 billion.

The picture in short is pretty rosy at present reflecting high demand coupled with record iron ore prices.

The most important iron ore production zone in Australia centred in the Pilbara region of Northern Western Australia. Here large reserves of high grade iron ore, the ability to produce metallurgically acceptable fines and lump ores and sound infrastructure in the form of captive rail links and port facilities underpins the region's iron ore production of some 210 million tonnes per year.

Although there are new producers waiting in the wings, at the moment iron ore production is currently controlled by two operating companies. The first is Rio Tinto and Robe River who collectively operate some eight mines and share rail haulage links to the ports of Cape Lambert and Dampier. In 2004, iron ore production from these mines was 121.2 Mt.

The second operating company is BHP Billiton which operates 5 mines and owns rail haulage link and ship loading facilities at the port of Port Hedland. In 2004, iron ore production from these mines amounted to 89.3 Mt.

Although most of the producing mines exploit Proterozoic primary iron ore, two mines are based on the exploration at Channel Iron Deposits at the mines of Yandicoogina and Marillanna Creek situated some 130 kilometers north-north-west of the town of Newman.

0972-2173/2005-6-2©SGAT, BHUBANESWAR

GEOLOGICAL SETTING: CHANNEL IRON DEPOSITS

The distinctive characteristic of Channel Iron Deposits is that they were deposited in palaeo drainage systems developed during tropical climatic phases of the Tertiary Period. The source of iron rich sediments which make-up these deposits was the Proterozoic primary iron mineralization which was exposed at the time on the Tertiary landscape.

Over time, the ancient rivers responded to fluctuations in their base levels either as a result of the lowering of sea level or due to uplife. This allowed for thick accumulations of iron-rich sediments to occur.

Towards the end of their development, the palaeo drainage systems became more mature and slow moving in response to a raising of their base level and ultimately they became silted up in response to drier climatic conditions.

This evolution of the Palaeo drainages led to the preservation of iron deposits in the Tertiary channel ways which were also enriched in iron by reducing conditions prevailing in slowly circulating ground waters.

At the end of the depositional phase, the Channel Iron Deposits were buried by loosely consolidated younger deposits of no interest from the point of view of their iron ore potential. In the Pilbara region, these sediments belong to the Oakover Formation and are important in so much as they have effectively capped and preserved from erosion the underlying Channel Iron Deposits until recent waves of erosion have partly exposed the Channel Iron Deposits for our discovery and exploitation.

CHARACTERISTICS OF CHANNEL IRON DEPOSIT

The characteristics of the Channel Iron Deposits can be described as fine grained pisolitic iron ore composed of goethite and limonite. Productive parts of these deposits contain up to 58% Fe. with low levels of contaminates as silica, alumina and phosphorous. A thickness averaging 8m is common in productive areas although some of the deeply incised palaeochannels within a deposit may contain up to 20m of material.

EXPLORATION FOR CHANNEL IRON DEPOSITS

Exploration for Channel Iron Deposits needs to be conducted bearing in mind that the deposits are palaeo alluvial in origin and are developed in the vicinity of mineralized bedrock sources.

An understanding of the geomorphological evolution of the search area is also very important. This is well illustrated in the Pilbara where recent waves of erosion have exhumed parts of the Tertiary Channel Iron Deposits. Presently, in areas were modern drainage has deeply incised the landscape, remnants of channel iron deposits are now exposed as a flat-lying capping on isolated hills or mesas. Sometimes, aligned mesas of this type point to the trend line of the palaeo drainage which may be traced at lower elevations to areas where channel iron deposits are preserved intact under overburden.

In other areas, modern drainage lines have eroded the flanks of channel iron deposits. In these areas escarpments or cliff lines of channel iron deposits are exposed which may be capped by younger Oakover Formation sediments.

However, perhaps the most prospective search areas are those where inverted topography exists. In these areas, quite prominent chains of rounded hills formed of Oakover Formation sediments cap former trend lines of underlying Channel Iron palaeochannels. For these areas, the former Tertiary palaeochannels containing channel iron deposits are now preserved almost intact by the protective thin covering of younger sediments. Modern drainage lines are developed along the flanks of these chains of hills or ridges which can expose portions of the underlying channel iron deposits. Clues to the origin of the iron-rich sediments includes the occurrence of fossil or petrified wood which is commonly found near the base of a channel iron deposit and clearly discovery of fossil wood helps the explorer know that he has found a channel iron formation unit.

EXPLORATION METHODOLOGY

The exploration approach followed was to have a geomorphologist and remote sensing specialist familiar which channel iron deposit formation to interpret aerial photographs and landsat satellite images of the search area.

The purpose of the study was to interpret the search area for potential channel iron target areas for subsequent ground truthing, mapping and sampling. This exercise defined priority areas where inverted palaeo topography was believed to exist, or where potential channel iron deposits were predicted to be exposed against a background of unprospective areas of exposed bedrock.

There then followed a reconnaissance ground truthing survey which was helicopter supported. Each target area was briefly visited to see whether the remote sensing interpretation was valid and grab samples of any iron-rich material was collected described and analysed for Fe, Al_2O_3,SiO_2, P, S, TiO_2, MnO, MgO and LOI.

The results of this survey led to the further selection of main areas for more detailed survey work involving geological mapping and sampling. Mapping of the selected priority areas was carried out at a scale of 1:10,000 and rock samples were collected for analysis. Rock samples weighed between 3 – 5 kg. each and these were collected either as chip samples on rock faces or as representative grab samples. For each sample site a representative specimen sample was also collected for future reference.

CONCLUSION

Orissa is well endowed with iron ore reserves and so one can guess there is little pressure at the moment to expand its resource base. However, when conducting future iron ore survey work it would be worthwhile to consider the potential of the area under consideration not only for primary iron ore mineralization but also for the occurrence of secondary mineralization in the form of channel iron deposits.

SGAT Bulletin
VOL.6, No.2 December 2005 pp 66-70

VULNERABILITY OF INDIAN SUBCONTINENT TO EARTHQUAKE AND TSUNAMI DISASTERS

N.K. Mahalik
Formerly Professor& Head Geology Dept, Utkal University
C/73, H.I.G. Baramunda Housing Board Colony
Bhubaneswar-751003
Email: mahalik_nk@yahoo.com

ABSTRACT:

During the first five years of the 21st century (2001-2005) India has witnessed three major earthquake related disasters e.g., the Bhuj earthquake of 26th January 2001 in which 20,000 people died, the Sumatra Tsunami on 26th December 2004, a global event, in which 3 lakhs people died including 10,000 in India and the Muzaffarabad earthquake of the 8th October 2005 in which about 80,000 people died in Kashmir. These are great human tragedies which have shaken the Indians. While the Bhuj earthquake is an intra-plate event, the other two relate to plate boundary convergence between Indian and Eurasian plates.

The paper discusses the scientific basis of these events and the future vulnerability of Indian sub-continent to earthquakes and tsunami.

Keywords: Earthquake, Tsunami, Plate tectonics, Convergent plate boundary, Sumatra-Himalaya- Mediterranean plate boundary, Intra-plate earthquake.

INTRODUCTION

Various natural hazards e.g., earthquake, tsunami, cyclone, flood, landslide etc have been affecting the earth's environment and human society at different times and at different places. They threaten the existence and comfort of the human society. Natural hazards were earlier there, now they are operating and would come in future. With development of science and technology, the society tries to understand more about their occurrence and behaviour so that proper methods and techniques could be employed to mitigate their impact.

EARTHQUAKE

Earthquakes are common phenomena which occur most often irrespective of time and place. They are most feared amongst all natural hazards as they strike suddenly without any prior indication and create devastation to life and property. They are as yet not predictable, hence prior warning to people is not possible. Earthquakes are not killer by themselves, but houses in which they reside, kill them. During an earthquake poorly designed and built houses collapse, sometimes associated fire hazards, kill the residents. Earthquakes, away from human settlements, however

big, are of no consequence to human society.

What Happens When Earthquakes Strike:

Depending on the severity of earthquakes several things could happen such as ground shaking, collapse of man made structures, fire hazard, deformation of ground, landslide, land subsidence, temporary dams, floods, ground fracture and tsunami if earthquake occurs beneath the sea.

WHY AN EARTHQUAKE

The earth is not an inert body. A variety of forces operate on it from outside and from within. Vertical and horizontal loads continuously act within the crust leading to development of strain in rocks. As the rocks suffer more and more strain, they fail and the strain energy is released through a variety of shock waves such as P, S, and L which shake the ground and an earthquake is felt. The epicentral area is most shaken and its impact decreases away from the epicenter.

MEASURING AN EARTHQUAKE

The severity of an earthquake is expressed either by its intensity or by its magnitude. Intensity relates to human experience of the shock waves, damage to different types of man-made structures and its impact on land and sea.There are two intensity scales e.g., modified Mercali scale (MMS) and Medvedev, Sponheur and Karnik (MSK) scale of 12 divisions each, for example Feeble, Slight, Moderate, Moderately strong, Strong, Very strong, Destructive, Ruinous, Disastrous, Very disastrous, and Catastrophic.The Magnitude M of an earthquake expresses the energy released during an earthquake. The energy released from an earthquake of magnitude M+1 is about 30 times the energy from an earthquake of Magnitude M.

Size of an Earthquake Versus Devastation

The size of an earthquake need not be related to amount of devastation. A smaller size earthquake could be more destructive than a high magnitude earthquake. For example:

Latur earthquake 1993, M=5.5 to 6.5 10,000 dead
Morroco earthquake 1960, M=5.7 12,000 dead
Sumatra E.Q.28.3.2005 M= 8.7 not much of damage
Japan E.Q. 20.3.2005 M=7.0 very little damage

FACTORS AFFECTING DEVASTATION

As has been shown above, it is not the magnitude alone which is cause for devastation to human society. The other factors are : the depth of focus of the earthquake, the shallower the focus the stronger is the impact; the size of human settlement and population; the quality of construction; nature of foundation; the time of day at which earthquake strikes, for example, in the dead of the night when most people are asleep earthquake causes more deaths; weather condition outside, for example, if it is snowing outside there is more casualty; hilly terrain could produce landslide which would add to devastation.

TSUNAMI

Tsunami are devastating sea waves at a coast formed by large sea bed earthquakes, volcanic activity or submarine sediment movement

disrupting huge volume of sea water above the point of disturbance. The energy disturbing the sea water creates tsunami waves which moves for long distances of several thousands of kilometers from the source of disturbance. In open sea, these waves have amplitude of around 50 cm, wave length of 100-200 km and jet like velocity of 500-800 km/hr. The period of the waves is around 15-30 min. When these waves approach coast they loose velocity and gain amplitude and become ferocious. They pounce upon the coast and create untold devastation to life and property. Tsunami waves come in pulses. When the wave moves out the sea bed is left bare for some distance into the offshore.

WORLDWIDE DSITRIBUTION OF EARTHQUAKE AND TSUNAMI

Mapping of epicenters of earthquakes and tsunami sources have indicated some well defined areas in which EQ and Tsunami occur frequently. These are as follows:

The Pacific rim from New Zealand through Papua New Guinea, Philippines, Japan, Kamchataka Island, Auletian Island, to western Coast of North and South America. These areas show occurrence of frequent large earthquakes, tsunami and volcanic activity. It is known as Ring of Fire.

The Sumatra-Himalaya-Mediterranean Arc: This belt is associated with frequent earthquakes and volcanism like the ring of fire. Tsunami occur in the marine sector between Andaman and Sumatra.

Mid Oceanic Ridges: Small to moderate earthquakes and volcanic activity frequently occur along well defined areas within Atlantic, Pacific and Indian Oceans. These are known as mid oceanic ridges.

These specific belts of earthquake, volcanic activity and tsunami are nicely explained by the Theory of Plate Tectonics.

PLATE TECTONICS

It is believed that the earth's upper rigid surface (lithosphere) consisting of the crust and a part of the upper mantle are made up of a few distinct segments (plates) sitting over a relatively viscous asthenosphere. The lithosphere is about 70-200 km thick. The plate boundaries are active zones around which plates move. This tectonic movement of plates explains many of the earth's well defined features and events. There are as many as seven major plates and several minor plates. The major plates are: the Pacific plate, Eurasian plate, North American plate, South American plate, African plate, Antarctica plate and the Indo-Australian plate. Based on tectonic activity three types of plate boundaries have been differentiated, such as: (1) Spreading axis or divergent plate boundary in which two plates move away from each other and this movement gives rise to sea floor spreading, formation of oceanic ridges and incidence of moderate earthquake and volcanic activity. (2) convergent plate boundary : Here two plates move towards each other in which one subducts under the other and gets consumed in the Mantle. This process gives rise to major earthquakes, volcanic activity and tsunami. Major mountain ranges like the Himalayas are formed in this type of movement. The Pacific rim

and the Sumatra-Himalaya-Mediterranean arc are areas of convergent plate movement.(3)Transform fault: These are transverse faults across spreading axes and movement along such faults produce minor earthquakes and volcanic activity. Most of the earthquakes, volcanic activity, tsunami, fold mountain ranges, continental dispersions and unions are believed to be due to plate tectonic movements.

INTRAPLATE MOVEMENT

Plate movements at the plate boundary is believed to have some impact within a plate itself.They give rise to intraplate movements along weak zones within the plate which result in incidence of earthquakes. Gujrat earthquake, Latur earthquake and Jabbalpur earthquakes are result of intra-plate activity.

EARTHQUAKE AND TSUNAMI IN INDIA

Fig 1 depicts the earthquake and tsunami scenario in India.The Indian subcontinent is fringed by a convergent plate boundary to its north and east. It is believed that the Indian plate is moving north and eastward towards the Eurasian plate. Along the Himalayan belt it has a continent-continent convergent relation while to the east it has a ocean-continent subduction activity.The development of Himalayas and the Tibetan plateau out of the Tethys sea is due to the continent-continent convergence associated with major earthquakes on either side of the boundary.The Quetta earthquake (1935),Muzaffarabad earthquake(2005), Kangra earthquake (1905), Bihar earthquake (1934) and Assam earthquakes (1897,1950) were results of this movement. This process continues and major earthquakes would visit the Himalayan terrain in any time from now It is however difficult to predict when and where it would strike. Similarly the subduction of Indian plate below the Burma plate around Sumatra-Andaman sector will be visited by volcanic activity, earthquake and tsunami in this part of the Indian Ocean rim. It would affect India as it affected the Chenai and Kerala coast during the last Sumatra tsunami (December'2004).

INTRA-PLATE EARTHQUAKES IN INDIA

Besides the convergent movement of the Indian plate towards the Eurasian plate, intra-plate movement within the Indian plate has given rise to many devastating earthquakes such as Gujrat earthquakes of 1819, 2001, Jabbalpur earthquake of 1997, and Latur earthquake of 1993. Many more events would visit India, specifically along the seismo-tectonic active areas within the Indian plate, such as the western coast and the Central Indian Rift Zone.It is difficult to predict the exact location and time.

In the absence any prediction for earthquake and tsunami, Indians must be prepared to meet such hazards and take measures to mitigate its impact. They must build their houses well with aseismic designs. Coastal zone management is equally important to protect people from tsunami. It would be wise to have very less human activity within one kilometer of the coast. Protection and development of mangroves along the coastal tract would go a long way to protect people from the ill effects of tsunami.

ACKNOWLEDGEMENT

The author wishes to thank the Society of Geoscientists and Allied Technologists for giving him the opportunity deliver a lecture on Earthquake and Tsunami in the celebration of its silver jubilee year.

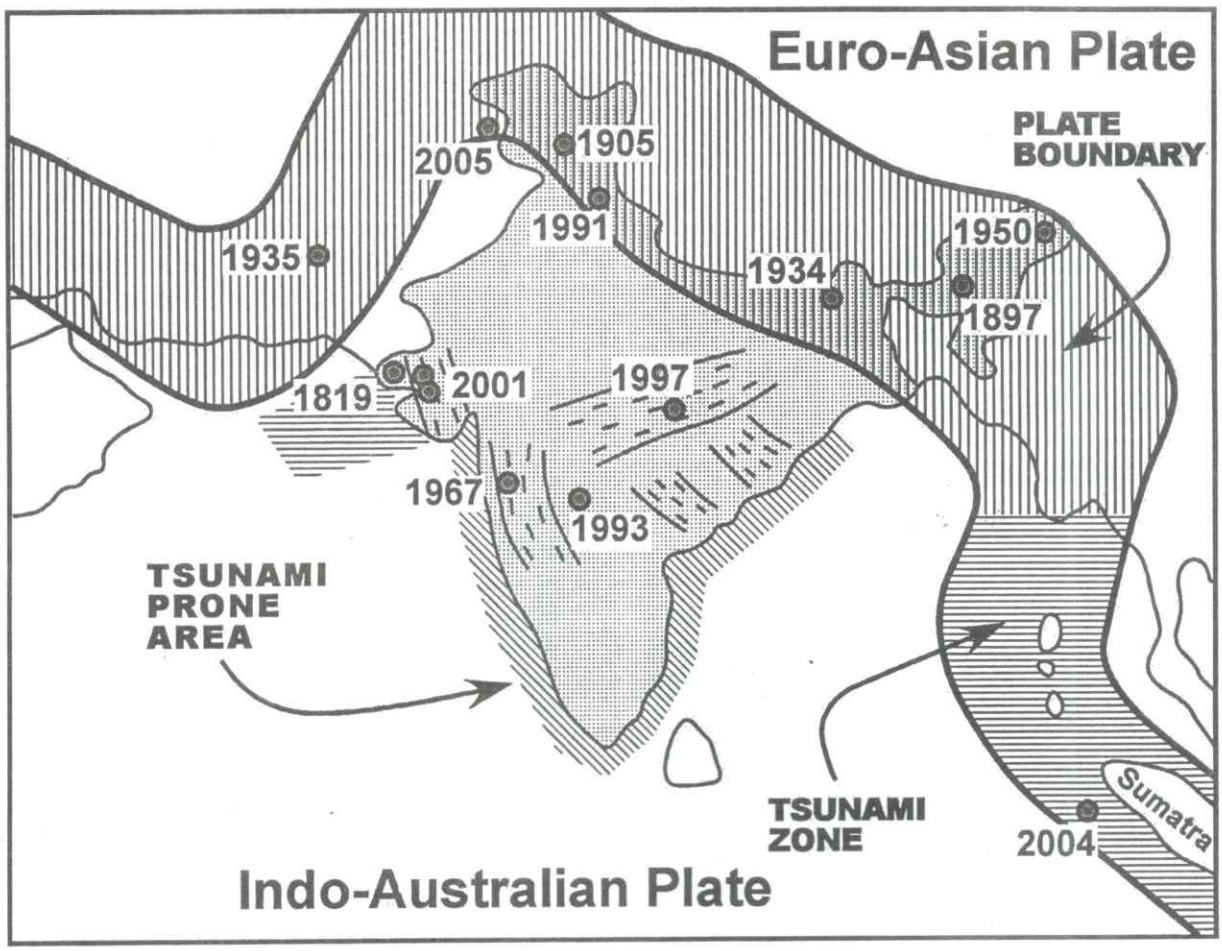


Fig.1 Earthquake and tsunami prone areas around Indian subcontinent.

SGAT Bulletin
VOL.6, No.2 December 2005 pp 71-77

MINING OPPORTUNITIES IN CONGO

Dr. S.K. Sarangi
Managing Director, Geomin Consulants (P) Ltd.
267, Kharvela Nagar, Bhubaneswar – 751 001

BACKGROUND

Democratic Republic of Congo covering a geographical area of about 23.45 lakh Sq. Km is located at the centre of Africa and shares 9165 Km of borders with nine countries (Fig-1). Congo comprises of a coastal plain in the West; a central basin, plateaus in the north, north-east and south and a mountainous terrain in East, South-East and West. It experiences predominantly tropical weather with a long dry season. Congolese forests represent 45% of African forest with main species as Afromosia, Ebene, Wenge, Iroko, Sapelli, Sipo, Tiana, Tola, Kambala and Lifari etc.

Congo is considered by all means a geological paradise having plenty of mineral resources like Copper, Cobalt, Zinc, Diamond, Iron, Manganese, Gold and Oil. But due to shortage of development capital the mining industry could not be developed successfully. However, some new mining contracts have been approved recently which combined with high mineral and metal prices could improve fiscal position and GDP growth of Congo.

2. GEOLOGICAL SETTING:

The continent of Africa is made up of a vast stable crystalline basement of Pre-Cambrian age. Superimposed on this basement are largely flat-lying cover successions along East. North and West coasts with sediments of Mesozoic and Tertiary age deposited in marginal marine basins. The Precambrian basement can be divided into large masses or cratons as Kalahari, Congo and West Africa. They are separated from each other by a number of mobile belts active in late Precambrian and early Palaeozoic times.

The Congo craton occupies a large part of central southern Africa, its oldest rocks occur in Tanzami province, an area of granitic basement and greenstone belts similar in structure to the Rhodesian province. Two younger belts of metamorphic rocks, the Ubendian and Toro belts represent mobile belts active about 1800 million yeas ago. Another distinctive but younger mobile belt is Karagwe – Ankile belt which runs NE-SW for atleast 1500 Km. from Uganda to Zambia. It was active 1400 – 1000 million years ago and suffered several periods of deformations.

A number of well defined mobile belts became established in the continent in late Precambrian times known as Mozambique belt; the Katanga belt. The Katanga belt is a broad curved zone of late Precambrian orogenic activity which passes through the copper belt of Zambia and the mining district of Katanga. The rocks forming the Katanga system are a

thick succession of shallow water sediments upto 10 Km thick. The copper deposits are sulphide ores lying mainly with tuffaceous shale horizons. The copper bearing rocks have only suffered low grade metamorphism but towards the center of the mobile belt, metamorphism is of high grade. Activity in this belt ceased around 570 million years ago, with the intrusion of mantled gneiss domes, reactivated in the final stage of orogenic cycle.

The West Congo belt is sedimentary succession similar to Katanga system which runs N-S for 1000 Km. along west side of Congo craton. The orogenic activity in all these belts had ceased by about 500 million years ago and by this time the whole continent of Gondwana land with Africa at its core had become a single stabilised craton encircled by zones of continuing mobile belt activity.

3. MINERAL RESOURCES:

An eminently mining country, Congo is the centre of numerous exploitations of most diverse metals in a multitude of mines and quarries. The deposits are distributed over Precambrian massifs bordering to the south, east and north-east, a vast sedimentary central basin. From south to north, diamantiferous exploitations of Kasai, few copper deposits (Tshiniama, Lubi), the copper bearing arc of southern Shaba (Katanga), rich cobalt and uranium deposits in Kalwezi, Likashi, Kambove, Shinkolobwe and Lubumbashi and Zinc, Copper and germanium deposits in Kipushi are encountered. The province of Kivu, enclosing the region of Maniema is rich in tin deposits often accompanied by Columbia-Tantalite. In the north of Congo there are famous gold exploitations of Kilo-Moto. At the western extremity of the country to the west of capital Kinshasu, the lower Congo encloses a few deposits of zinc and lead (Kusu-Sengi).

Principal mineral resources of Congo are indicated as follows:

SOUTHERN SHABA

- Kabolela - black shinning reniform masses of heterogenite
- Kakanda - mammillary pseudomalachite, green crystals of libethenite and pink cobaltiferous calcite.
- Kalongwe - copper and uranium deposits
- Kambove - fibroradiated plancheite incrusts and rosuttes and centimetric crystals of carrolite.
- Kamiaba - pink to brown almandine garnets
- Kamoto - carbonate of copper and cobalt, uraniferous mineralization
- Kamoya - Association of copper silicates
- Kasompi - Deposit of rare earth minerals
- Kipushi -Association of secondary minerals of zinc, lead and copper.

Primary mineralization is rich in Germanium.

- Likashi -Native Copper
- Ludjiba - Copper
- Luishya - Kyanite with secondary minerals of copper
- Luiswishi - Mineralisation with copper and uranium
- Mashamba - Copper minerals.
- Mindigi - Heterogenite deposits
- Meesa - Copper minerals
- Musonoi - Uranium selenites
- Shinkolobwe - Uranium deposits

Kivu

- Bengo Biri - Wolfrum
- Kobokobo - Beryl & Columbite rich pegmatite of which a zone is mineralized in Uranium.
- Lueste - Carbonatite
- Maya-Moto - Bismuth minerals
- Mwenga - Auriferrous distict
- Messaraba-Munkuku - Cassiterite

4. OPPORTUNITY & FACILITIES FOR ECONOMIC GROWTH:

Sparsely populated in relation to its area Congo has vast potential of natural resources and mineral wealth. Nevertheless it is one of the poorest countries in the world with per capita annual income of about $98 in 2003. After having undergone many poor performances from 1990 to 2001, the economy of Congo has definitely begun to be good with growth rate of 3.5 % in 2002. Evolution of the Gross National Product (GNP) and of the GNP/inhabitant for 1999 to 2003 is appended below:

	1999	2000	2001	2002	2003
GNP Growth Rate	-4.30	-6.90	-2.10	3.50	5.00
GNP Growth / Inhabitant	-5.00	-7.50	-11.80	0.80	0.70
Population (Millions)	50.40	52.10	53.50	54.90	56.40
Population Growth Rate	3.40	3.40	2.70	2.70	2.70

Source: Central Bank of Congo.

In a view to relunch the economic activities, some important decisions have been made by the Government, the most important of which are as follows;

- The liberalization of the Economy
- The adoption of a floating exchange rate regimes
- The promulgation of an interesting investment code, a mining code, a

forestor code, a labour law adapted to the country realities

- The reduction of the internal tax rate
- The co-operation revival with the International Financial Institutions.
- Structural changes in the domains of justice and Public Administration

Sectoral details on mineral and metallurgic production Energy Production and Goods handling in the harbours are outlined to visualize the economic growth rate of Congo.

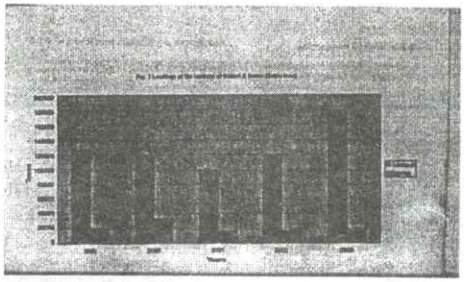
Mineral & Metallurgic Production

	Units	1999	2000	2001	2002	2003
Copper	Tons	32.195	30.821	37.845	27.359	9.871
Cobalt	Tons	2.308	3.738	11.637	11.865	2.389
Zinc	Tons	--	214	1.014	828	4.886
Diamond	1000 Carats	20.116	16.006	18.198	21.694	27.112
Raw Gold	Kilos	207	69.3	18.9	26.5	1.7
Petroleum	1000 Barrels	8.650	8.459	9.380	8.425	9.246

Source: Central Bank of Congo.

Production of Energy

	1999	2000	2001	2002	2003
Electricity 1000 Mwh	5.010	5.813	5.798	5.937	5.980



Evolution of Goods handling in Matadi & Boona Ports

5. INVESTMENT CODE:

In a view to set an iniciative investment policy to attract potential investors, Congo lunches its new investment Code (Law No. 04/2002 of February 21, 2002) . The salient features of the new code are;

- The institution of a single system for all investments
- The creation of ANAPI a National Agency for the Promotion of Investment
- The simplification and speeding up of licence procedure
- All the investors both nationals and foreigners are submitted to the same conditions.
- The introduction of notion of direct foreign investment for any share 10% of capital by the foreigners.
- The respect of the protection regulation of the environment
- The training of national personnel with technical and specialized functions and those of supervision and of responsibility.

6. MINING CODE: (Law No. 007/2002 of July 11,2002)

The interest shown by some reputed international mining companies in Congo has been as a result of implementation of new Congo Mining Code in 2003. The prospecting, exploration, exploitation, processing, transportation and sale of mineral substances are governed by the present code. The code has defined the role of the State and the distribution of jurisdiction. The State will ensure the development of the mineral substances. Its principal role is to promote and regulate the development of the mining industry by the private sector. Pursuant to the provisions of the present code the President of the Republic has jurisdiction over the enactment of the Mining Regulations; classify declassify or reclassify the mineral substances as mines or quarry products; declare an area as a prohibited area for mining activities; declare a mineral substance as a 'reserved substance'. The President shall exemine the above powers by Decree made on his own initiative or on the proposal of the Minister after having obtained the opinion of the Geological Department or Mining Registry. The exercise of the powers conferred on the President can not be delegated. Pursuant to the provisions of Mining Code the Minister has jurisdiction over granting and refusal of mining and/or quarry rights; the cancellation of mining and/or quarry rights; the authorization of the expert of unprocessed ores; the creation of artisanal exploitation zones; the granting and withdrawal of approval for authorized traders for the purchase of artisanal exploitation products, the reservation of deposits to be submitted for tender; the acceptance or refusal of the extension of a mining or quarry title; the setting up of restricted access areas, the approval of mine and quarry agents. Pursuant to the provisions of the Code of Governor of the Province has jurisdiction over the issuing of traders cards for artisanal exploitation products and the decision to open quarries. The mining registry is a public entity with legal status and financial autonomy under the supervision of Mines and Finance Ministers. The Mining Registry is responsible for registering the application for the granting of mining and/or quarry rights; the mining and/or quarry rights granted or refused; cases of withdrawal, cancellation and expiry of mining or quarry rights; transformation and lease of rights and securities on mining assets. It is also in charge of the processing of applications for mining and/or quarry rights. The geology Directorate is responsible for the promotion of the mining sector through basic geological research, the compilation and publication of information about geology and also the publication and dissemination of the said information. The Geology Directorate issues its opinion in the event of classification of mineral substance, opening and closing down of artisanal exploitation area. Directorate of Mines is responsible for inspecting and supervising mining activities with regard to safety, health, work procedures, production, transport, sale and social matters; compiling and publishing statistics and information about the production and sale of products from mines and quarries. Article 17 to 22 provides rules for prospecting and Article 23 to 38 provides rules for mining application and article 39 to 49 provides rules for processing grant of mining applications.

7. FORESTRY CODE:

Congo has about 135 million hectares of natural forest representing 45% of those in Africa. These forests hold a wide variety of plant and animal species making them a major asset for the country's development. It is fully or partially protected and managed in a system of protected areas and other management units comprising 8 national parks, 57 hunting reserves, 3 biosphere reserves, 117 forest production reserves, 3 zoological gardens and 3 botanical gardens. Various policy frameworks under National Forestry Action Plan have been implemented to conserve these forests on a priority scale not only for socio-economic development but also for the conservation of biological diversity and the regulation of climate.

Congo's mining sector is observed to be an important contributor to the growth of National Economy. As has been highlighted it has abundant natural resources including copper, cobalt, cadmium, industrial and gem quality diamonds, gold, silver, zinc, manganese, tin, germanium, uranium, radium, bauxite, iron ore, coal, hydropower, petroleum and timber. However, the country's main source of income is derived from the exploitation of mineral and hydrocarbon resources. It has also abundant hydro electric power resources. Exploitation of these resources is playing vital role in the development of manufacturing industries including diamond, copper and zinc mining, mineral processing, cement production, textile and footwear manufacturing, food and beverage processing.

Democratic Republic of Congo : An Introduction

Location	:	Central Africa
Area	:	2.345 M. Sq. Km.
Independence	:	June 30, 1960 (From Belgium)
Capital	:	Kinshasa
Population	:	58 million
Language	:	Official- French National Language – Lingala, Swahili, Kikongo, Tsiluba
Literacy	:	65.5% in French
Annual Growth Rate	:	2.99%
Geographic Position	:	It shares 9165 Km of borders with nine neighbouring countries. It is limited by

- The Atlantic Ocean, the Cabinda and Republic of Congo in the West.
- The Central African Republic and The Sudan in the North.
- Uganda, Burundi, Rwanda and Tanzania in the East
- Zambia & Angola in the South.

Land Form & Vegetation: Comprises four geographic regions

- A coastal plane in the West
- A Central Basin composed of plains and hilly plateaus.
- Plateaus in North, North-East and South where the vegetation is composed of savanats and strips of forests.
- Mountains in the East, South-East and West.
- Vegetation is characterized by dense forest

Weather : It has four different types of weather

- Tropical weather in Eastern Province, Equator, North areas of Maniema, Bandundu and of two Kasia.
- Tropical humid weather in northern parts of Eastern Province, Equator, Bas Congo, in the Central areas of Bandundu, the two Kasia and North of Katanga.
- Tropical weather with a long dry season (Souther areas of Bandunda the two Kasia and Katanga)
- Coastal Weather (in the west of Bas-Congo)

Congo – A Multipotential Land

- One of the biggest markets in Africa with its 60 millions of consumers.
- A large territory which is appropriate to agriculture and mining.
- It has large range of mine

• Bauxite	- Ben Congo
• Coal	- Katanga
• Columbite -Tantolite	-Northern & Southern Kivu Maneima and Katange.
• Copper/Cobalt	- Katanga
• Diamond	- Eastern & Western Kasia, Bandundu, Equator and Eastern Province.
• Tin	- Katanga, North & South Kivu, Maneima.
• Iron Ore	- Western Kasia, Eastern Province, Katanga.
• Manganese	- Katanga, Bas Congo.
• Gold	- Eastern Province, North South Kivu, Equator, Maneima, Katanga, Bas Conge.
• Methane Gas	- Kivu lake
• Oil	- Coastal basin of Moanda, Central basin, Ituri.

SGAT- AN EVENTFUL 25 YEARS

1. The Society :

With a view to promoting mineral development activities, geoscientific studies, mineral research and highlighting the role of geoscientists, mining, metallurgical and mineral process engineers in economic development of the country, a group of geoscientists, mining and metallurgical engineers holding responsible positions in the Government, Universities, research organisations, mining companies decided to create a forum for interaction and communication. Thus materialised the formation of SOCIETY OF GEOSCIENTISTS AND ALLIED TECHNOLOGISTS (SGAT) on November 2, 1980. The Society has been registered under Societies Registration Act. The Society has its headquarters at Bhubaneswar, the capital city of Orissa State in India.

As on November 2005, its membership has increased to 590 including 15 international members from U.S.A., Brazil, Australia, Kazakhstan and Canada representing more than 100 different organisations involved in activities like mineral explorations, mining, mineral beneficiation, metallurgical industries, processing and downstream sectors, research institutions, mineral and metal trade, mineral administration, statutory authorities, environment management etc. SGAT also has four institutional members.

The year 2005 is being celebrated as Silver Jubilee Year.

2. Activities of the Society :

2.1 Seminar & Work shops :

The Society has so far organized more than 30 Symposia / Seminars / Workshops on following topics :-

- Problems and Prospects of Mineral Utilisation (1981)
- Remote Sensing Techniques in Mineral Exploration (1982)
- Development and Utilisation of Coal Resources (1983)
- Mineral Industries and Environment (1983)
- Mineral Development during the Seventh Plan (1984)
- Small Mineral Deposits (1985)
- Geology, Exploration and Development of Graphite Resources (1986)
- Raw Materials for Refractories and Cement Industries (1986)
- Raw Materials for Sponge Iron making (1987)
- Approach to Mineral Development during the 8th Five Year Plan (1988)
- Geology and Mineral Resources of Orissa (1989)
- Chromium and Nickel (1990)
- Sampling of Geological Materials (1991)
- Dimension and Decorative Stones (1992)
- Iron Ore 2000 and Beyond (1993)
- Gemstones (1993)
- Guidelines and Procedures for clearance of Mining Projects from Forest and Environment angles (1994)
- Adequacy of Mineral Exploration inputs and compatibility of the current

Mining Legislations for Mineral Development (1994)

- Manganese – Ores & Alloys (1995)
- Strategy, Tools and Laboratory facilities for Diamond and Gold Exploration (1996)
- Interactive Meet on Raw Materials for Iron & Steel Making (1996)
- Clearance of mining Projects from Forest and Environment angles -Procedures, Ground Realities and Constraints (1997)
- Infrastructure in Mineral Development (1997)
- Status of Education, training and R & D in Geosciences and Allied disciplines (1998)
- Developments in Underground Metal Mining Practices (2000)
- Reclamation and Rehabilitation of Mined out Areas (2001)
- Utilisation of Mine waste and marginal grade Ores / Minerals (2001)
- Value Addition in Mineral Industry (2002)
- Assessment and Management of Water Resource (2003).
- Strategy for Development of Iron ore resources of India for Iron making and export (2004)
- Vision – Mineral Development 2020 (2005)

Delegates from South Africa, Australia, Japan, Austria, UK, Brazil, Singapore, France, Jurymani, U.S.A. and many developed and developing countries participated in these seminars.

Besides above, the Society has also frequently conducted discussions and interactions on various issues related to mineral development, mineral legislations and prevailing issues of concern and also offered its views, suggestions and recommendations to the State and Central Govt. authorities.

2.2 Publications :

The Society initially published News letters and continuing publication of biannual Bulletins (SGAT Bulletin) since 1998.

The Society brought out the first ever comprehensive treatise on GEOLOGY AND MINERAL, RESOURCES OF ORISSA in 1995. A revised and updated edition was published in the year 1998. An updated and revised edition is going to be published.

On an assignment given by the Orissa State Government, the Society prepared a Blueprint of Mineral Development in Orissa during the decennium, 1997-2007 in September 1997.

A book in Oriya written by Prof. G.B. Mishra, former Professor Mining Engineering IIT, Khargapur on the subject "**KHOLA KHANI PRAJUKTIVIDYA** " was published by the Society for helping the local workers in the Mines.

2.3 Awards :

a) Prof. Dr. B.K. Sahu received the Society Medal in recognition to his contribution in the mineral development in the year 1981.

b) Subsequently the society instituted **SGAT Award** in the **year 1994** to be presented to the persons for their outstanding contributions in field of geoscientific studies and investigation, mining and metallurgical engineering, mineral beneficiation, mineral development & planning. :

The awardees are

Year	Name
1994	Shri M.G. Rao
1995	Shri M.K. Pujari, Ferro Alloys Corporation (FACOR)
1996	Dr. R.K. Sahu, RRL, Bhubaneswar
1997	Dr. R.N. Mishra, Geological Survey of India (GSI)
1998	No Awards
1999	No Awards
2000	Prof. Dr. N.K. Mahalik, Bhubaneswar
2001	Dr. M.M. Mukherji, Geological Survey of India
2002	(i) Prof. Dr. B.B. Dhar, New Delhi (ii) Prof. Dr. M.C. Dash, Bhubaneswar
2003	Dr. B. Sengupta, IIT, Kharagpur
2004	Prof. Dr. S.K. Nath, IIT, Kharagpur

c) **Sitaram Rungta Memorial Award** was initiated in 1998 being promoted by Rungta Mines Ltd. Chaibasa. The recipients are :

1998	Shri P.S.R. Reddy, RRL, Bhubaneswar
1999	Dr. M.K. Dhar, NMDC, Hyderabad.
2000	Dr. G.V. Rao, RRL, Bhubaneswar
2001	Shri B.S.S. Rao, NMDC, Hydrabad
2002	Dr. Ravi Bastia, Reliance Industry Limited, Bombay
2003	Dr. S.K. Biswal, RRL, Bhubaneswar
2004	Dr. B. Das, RRL, Bhubaneswar

d) Since 1999, Society instituted Best Paper Award promoted by Prof. Dr. Kula C. Mishra to the authors of the best article published in its Bulletin and the recipients are :

Year	Name
1999	Dr. G.V. Rao & Shri R.S. Shartar, RRL, Bhubaneswar
2000	Shri R.N. Jena, Nalco
2001	Shri S.Das, CGWB
2002	Dr. W. Maejima, Japan
2003	Dr. B.R. Nayak, NML, Jamshedpur
2004	Shri S. Mahala, RWSS, Govt. of Orissa, Bhubaneswar.

e) In order to honour the eminent persons having significant contributions in development of mineral sector, the Society Instituted **SGAT Lifetime Achievement Award in 2001**. The recipient of the awards are :

I. **Dr B.D. Panda**, Chairman IMFA group of Industries (2001)

II. **Dr. P.K. Mohanty**, Vice-Chairman Orissa Sponge Iron Ltd., (2003).

III. **Dr. S.K. Tamotia,** Director,Visa Steels Ltd, (2005)

IV. **Prof. S. Acharya,** former Vice Chancellor,Utkal University,(2005)

V. **Shri B.K. Mohanty,** Former Director Mining & Geology, Govt. of Orissa(2005).

2.4 Special Guest Lectures

Since inception, Society has been regularly organising Guest Lectures, interactive meets and discussions on various scientific and technical subjects of interest inviting eminent scientists, technocrats and administrators etc.

In honour of the founder President, **Sri K.S. Mohapatra Memorial Lecturers** are being organised by inviting guest speakers since last 5 years. The speakers are Dr. B.D. Panda, Sri P.C. Hota, Dr. S.K. Tamotia, Sri N.K. Choudhary, Padmabhusan G.L. Tandon, and Dr. Ravi Bastia.

2.5 Environment Awareness Programmes :

With a view to inculcate consciousness about large scale destruction of forest cover, degradation of environment, pollution of water sources and the need to take urgent remedial measures, SGAT has been conducting Environment cum Mineral Awareness Programme (EMAP), every year since 1995, in the mining areas involving students of Higher Secondary schools. These programmes also highlight the importance of minerals in the nation's economy. Zonal competitions organised every year in ten important mining zones of the State to select the respective winner team from each zone to participate in the final event / state level EMAP Programme at Bhubaneswar. During the event the participants are exposed to various environmental activities undertaken in the of mining areas. The winners and all participants are given prizes and gifts respectively and also certificates.

The programme is continuing successfully. During 2005, SGAT is also organising similar programme at Jorhat involving students from North Eastern States.

2.6 Mineral Development Quiz :

With the objective of updating the students pursuing PG courses in Geosciences and Degree courses in Mining, Metallurgy, Material Science, Mineral Engineering, about recent finds and developments and innovations in these disciplines, SGAT has been conducting Mineral Development Quiz on regular basis since 1995. REC Rourkela, IIT Khargapur and ISM Dhanbad have been the major winners so far. This programme has also been organised in REC, Rourkela and in ISM Dhanbad.

2.7 Mineral Development Activities :

In order to foster development activities, Society Invites Ministers and Bureaucrats responsible for mineral administration for discussions, during which society presents before them the views of various industrial and mining stake holders including that of the Society, so that they can take appropriate decisions in the interest of the mineral development.

2.8. Interaction with Authorities & Stake holders:

SGAT has effective interaction with both Central and State Government authorities and different mining stake holders on different bunring issues of the mining & mineral development activities. Such interaction meets are conducted by SGAT at Barbil Zone and Sukinda chromite belt involving regulatory authorities and the mining stake holders. The recommendations have been given due consideration in formulation of legislations governing grant of mineral concessions and environmental protection, mineral policy, development of infrastructural facilities, research projects,

creation of educational facilities and institutions.

2.9 **State Mineral Policy :**
Society was constantly pursuing with the State Govt. authorities for the formulation and adoption of State Mineral Policy. As a result Govt. of Orissa has constituted a committee to prepare the Mineral Policy on 24th January 2002. Society, represented by the President and Secretary constitute part of the Committee. Society has taken active participation in several discussions made by the Committee and a draft State Mineral Policy is formulated.

3. **Recommendations :**
Suggestions and Recommendations in brief, rendered by SGAT during seminars are highlighted as follows.

- In the year 1981, Society recommended to both the State and Central Governments for (i) Undertaking development of infrastructure (ii) Augmenting explorations to establish additional resources and new discoveries and creating an exclusive cell for analysis of market trends; to achieve long term mineral development.
- Highlighting the benefits of application of Remote Sensing Techniques in land use, forestry, agriculture etc. besides mineral exploration, Society recommended the State Government in 1992 to develop necessary facilities in the State. Orissa Remote Sensing Application Centre (ORSAC) has subsequently been established at Bhubaneswar.
- Indicating extensive coal resources in Orissa, Society in 1983 recommended for a separate company under Coal India Ltd. With headquarters in Orissa for development of these resources. Mahanadi Coalfields Ltd. (MCL) has subsequently been established at Sambalpur to take care of coalfields in Orissa. The suggestion for Talcher-Sambalpur rail link has been taken care which is now operational.
- In 1984, after discussing environmental issues in Mining sector, Society indicated that mines are not the only reason for loss of forest and explained that its share in this loss is quite insignificant compared to other human activities. Simultaneously the mines were also advised to take care of environmental issues collectively and give stress for forest conservation and afforestations.
- The problems of developing small deposits and small mines are highlighted in 1985 recommending various solutions to the Government for rendering necessary support for its fruitful development.
- Government was requested for development of infrastructure, R&D support for upgrading and promotion of beneficiation and crucible making units for exploitation of graphite recources.
- During year 1986, when the State experiences rapid growth of mini cement plants, Society recommended for assessing the resource potential of limestone for development of cement units,

particularly in Koraput, Bargarh, Malkangiri districts and development of rail links to the deposits.

- Assessing the future growth potential of sponge iron sector, the Society recommended in 1987 for reassessment of required high grade lumpy hard iron ore for future planning and also development of small mines exclusively for these industries.
- Society recommended for taking steps to start air borne surveys for mineral exploration in potential areas with foreign collaborations. Subsequently these surveys have been carried out in the State.
- Society highlighted the potential of Chromite & Nickel in the state, and suggested for reassessment of chromite resources particularly its continuation at depth and development of technology for underground mining. Suggestion for preservation of Nickel ores present in the waste / over burden of chromite mining for future extraction is now being implemented.
- Assessing the potential of dimension and decorative stones (Granite) available, the Society in 1993 advised the Government for promotion of industries for processing of the granite considering export potential and also for developing technological inputs in mining and extracting. rough blocks. Recommendations are given to identify the suitable areas of and assessment of resources for exploitation of dimension stones.
- Society in 1993 recommended for formulation of a Gem stone policy in the state to restrict illegal mining for the establishment of lapidary units and development of Gemstone Mining in organised sector. All the recommendations have been implemented.
- Society also recommended for reassessment of Iron ore potentials in the state in view of the recent developments in technology for best utilisation of low to marginal grade ores. SGAT also advised for immediate infrastructure development in the mining sections.
- In various seminars & workshops Society also recommended for development of laboratory facilities for Diamond, Gemstones and Gold Explorations.
- During 1994 and 1997, the Society interacted with various regulating authorities of the State and Ventral Government implementing forest and environmental status for mining industries and the following suggestions are made.

i. Provisions of FC Act should not be imposed for grant of PL and mineral exploration. Obtaining site clearance from environment point of view is now not required for PL and mineral exploration areas may not be insisted upon.

ii. Identification and allotment of nonforest land for compensating afforestation

shall be the joint responsibility of concerned Forest, Revenue and Mining authorities. Degraded forest may be diverted for this purpose which has so far been made applicable to different Public Sector organisations.

iii. Recommendation for forest clearance accorded by the MOEF for the entire lease term has now been accepted.

iv. The recommendation for powers to the RCCF (central) for diversion of forest lands up to 20 hectares through State Advising Committee has now been enforced which has been recently revised to 40 hectares. The recommendation for having separate committee for mines in MOEF has been implemented but a single committee for both forest and environment for mines has not been considered so far.

v. No action has been taken so far with respect to paying compensatory afforestation charges in instalments during the subsistence of the lease based upon actual area utilised has not been considered.

vi. The suggestion made for preparing mineral map super imposed with forest areas have not been fully prepared..

vii. The suggestion for small mines limited to 20 hectares to get relief from EIA studies have not been accepted.

vii. The concept of regional EMP and cluster mining approach for better environment management of mining areas has not been implemented so far.

There have been suggestions for conduct of additional explorations, reassessment of resources including low grade ores and wastes etc.; implementing scientific development in plant process, technology utilisation of waste and bi-products, reassessment of water resources, recycling of waste water, zero discharge system etc.

4. Issues of Concern

4.1 Various important issues concerning development of mineral sectors in the state are brought to the notice of the State Government during interactions and discussions. The major issues of concern are placed below:

i) Formulation and adoption of the State Mineral Policy.

ii) Infrastructure Development in the mining sectors.

iii) Hasselfree processing of Forest & Environment proposals to obtain timely approvals.

iv) Conducting additional explorations, helping to reassess mineral potential as per UNFC norms.

Society is constantly persuing these issues with the government and different authorities/Deptts., for rapid growth of mineral sectors. SGAT is also trying to remove different misconceptions restricting proper mineral development in the alibi of environmental protection and socio economic development through deliberations with the regulating authorities. The prime objective of the Society (SGAT) is to create congenial environment for achieving over all development of the mineral sector – a vital need for augmenting economic growth of

the country. SGAT embark supports from regulating and regulatory agencies for the purpose.

The following is the list of the office bearers responsible for upbringing the Society to its present status.

Presidents	**Period**
Shri K.S. Mohapatra	1981-1991
Shri S.K. Mohapatra	1991-1993
Shri B.K. Mohanty	1993-1999
Prof. Dr. S. Acharya	1999-2005

Vice President

Dr. B.D.Prusti	1981-1983
Shri B.K. Mohanty	1981-1991
Shri V.S. Baliga	1983-1985
Prof. S. Mishra	1985-1987
Md. Fassiudin	1989-1993
Shri R.N. Padhi	1991-1993
Shri G.S. Khuntia	1993-1995
Dr. R.N. Mishra	1993-1999
Prof. G.B. Mishra	1997-1999
Shri S.N. Padhi	1995-1997
	1999-2003
Dr. R.C. Mohanty	1999-2005
Sri A.D. Baijal	2003-2005

General Secretaries

Prof. Dr. S. Acharya	1981-1991
Prof. Dr. N.K. Mahalik	1991-1995
Sri G.B. Mahapatra	1995-2001
Dr. S.K. Sarangi	2001-2005

Treasurers

Prof. Dr. N.K. Mahalik	1981-1989
Sri R.N. Padhi	1989-1991
Dr. S.K. Sarangi	1991-1997
Shri K.C. Pradhan	1997-2003
Shri R.C. Samal	2003-2005

Joint Secretaries

Shri G.B. Mahapatra	1981-1989
Shri R.N. Padhi	1981-1989
Dr. S.K. Sarangi	1989-1991
	1997-2001
Shri G.H. Khuntia	1989-1991
Shri S.S. Patnaik	1991-1997
Shri M.V. Rao	1991-1997
Shri R.C. Samal	1999-2003
Shri R.C. Moharana	2001-2005
Shri N.R. Patnaik	2003-2005

New Members

1 **Mr. Viswanath Nidagal**
Project Manager
BHP Billiton
Level 7, Fortune Towers
Chandrasekhapur
Bhubaneswar – 751 023

2 **Shri Pradeep Chandra Sahoo**
Chief, Joda
Tata Steel, Mines Division, J.C.O.
Post: Joda-758034
Dist : Keonjhar
Orissa.

3 **Shri Mihir Kumar Malla**
Geologist
Hindalco Industries Ltd.
Cant Road, Lohardaga,
Jharkhand- 835302

4 **Shri Ajit Kumar Panda**
Manager (M&G)
Orissa Industries Ltd. (ORIND)
Lathikata (Rourkela)- 770 037
Sundergarh
Orissa

5 **Dr. S. Mohan Rao**
Head (Ferro Alloys & New Business)
R & D, Tata Steel
Jamshedpur-831007

6 **Sri K.B. Biswas**
Executive Engineer
Central Ground Water Board
Bhujal Bhavan, Khandagiri Square
Bhubaneswar – 751 030

7 **Dr. Debasish Biswal**
Director, Kalyani Laboretories
Plot. No. 244, Bomikhal
Near Devraj Bidyapitha
Bhubaneswar

8 **Shri Vivekananda Pattanayak**
86, Saheed Nagar
Bhubaneswar – 751007

9 **Shri Jiban Mohapatra**
Chief Manager (Environment)
Plot No.211
Second Lane
Aerodrome Area – 751020
Khurda – 751020

Corrigendum to Directory of Members – 2005

SL No.	Mem. No.	Name & Address	SL. No	Mem. No	Name and Address
74	031	**Shri Gangadhar Dani** Former G.M. (Geology) Orissa Mining Corporation Sambalpur Road Gandhi Nagar At/Po/Dist-Bolangir Tel. 91-6652 – 231758 (R)	84	035	**Dr. Jagada Nanda Das** Former Director of Geology Block- C/013 Basant Park Appartment Forest Park Bhubaneswar – 751 001 Tel. 91-674 – 255058585 (R)
143	260	**Shri Nila Ratan Jena** Former DGM(Gelogy), OMC N/4132, IRC Village Nayapalli Bhubaneswar – 751 015 Tel: 91-674 -2550006	343	401	**Dr. Raj Kishore Paramguru** Scientist Regional Research Laboratory Bhubaneswar – 751 013 Mobile: 91-9437063408

422	497	**Dr. P.V. Rao** C/o- Mr. G. Venkateswarulu Ramalayam Street Post – Tanguturu Dist – Prakasam Andhra Prasdesh – 523 279 Drpvrao2002@yahoo.uk	420	170	**Shri Mandavilli Gajapati Rao** A – 10 Sidhratha Appt. 22, Santosh Nagar Colony Mehdi Puram Hyderabad – 500028 Tel: 91-40-23513432 (R)
538	474	**Shri Lalit Kumar Tewari,IFS** E-72, Type – V Nibediata Kunj Sector – 10 R.K. Puram New Delhi – 110 022	446	427	**Sri Pravakar Rout** Consultant Tata Steel Fortune Towers 2nd Floor Chandrasekharpur Bhubaneswar – 751 002 Tel. 91674 – 2393016
328	410	**Dr. R B. Panda** Reader, Env. Science Fakir Mohan University Balasore			

News about Members

- Sri M.V. Rao, Council Member of the Society is elected as President, Utkal Chamber of Commerce and Industry for 2005-2006 term.

- Dr. S.K. Sarangi, General Secretary of the Society is elected as Vice President (II) in the National Council of Mining Engineers Association of India. He is also elected as President, Indian Institute of Mineral Engineers, Bhubaneswar Chapter.

- Sri Bhagabati Prasad Mishra, Council Memer of the Society got superannuation as Jt. Director, Geology, Govt. of Orissa on 30th September 2005. Society wishes him a peaceful retired life.

- Dr. Radha Prasad Das, Member of the Society got superannuation as Director, Regional research Laboratory, Bhubaneswar on 31st October 2005. Society wishes him a peaceful and active retired life.

- Dr. R.B. Panda, Member of the Society has joined as Reader in Dept. of Environmental Science in Fakir Mohan University, Balasore.

- Dr. P. V. Rao, Member of the Society left Tata Steel on 1st November 2005 to take one important assignment in Central Africa.

- Dr. S.K. Sarangi, General Secretary of the Society visited Congo from 28th September to 8th October 2005 on a Geological Assignment to assess copper and cobalt resources around Lubumbasi and Kalwezi areas of Congo.

- Dr. P.K. Prusti, relinquishing the charges as Member Secretary, Orissa State Pollution Control Board has joined as Senior Scientist in the Department of Environment, Govt. of Orissa.

- Sj. D.K. Sahni, President & CEO of IMFA, Group and member of the society is elected as president, Federation of Indian Minerals Industries for the term 2005-2007.

Submission Of Papers For Sgat Bulletin

(Guidelines to Prospective Authors)

Research papers, review articles, short communications, announcements and letters to editors are invited on topics related to geosciences, viz, mineral exploration, mineral characterization and beneficiation, mining, materials science, metallurgy, mineral industry and trade, mineral economics, environment, education, research and development, legislation and infrastructure related to mining, mineral policy and mineral development planning.

Submission of manuscript implies that it is original, unpublished and is not being considered for publication elsewhere. Two copies, complete in all respects (with copies of figures and tables), are required to be submitted. Originals tracings of figures and tables should be enclosed separately. Each manuscript must be accompanied by a computer diskette (floppy) containing the electronic version of the text. Electronic files of figures, if available, should be submitted in a separate diskette. In each case, the details of software and type of equipment used should be clearly indicated.

Journal Format: **A-4 size**

Language: English

Manuscripts

Manuscripts should be typed in double spacing with wide margins on one either by electronic typewriter or computer (size 12 point Times New Roman font). The title page should include the title of the paper, name(s) of author(s) and affiliation(s). The title should be as brief as possible. An informative abstract of not more than 500 words to be included in the beginning. Not more than 5 key words are to be listed at the end of the abstract. Text of research papers and review articles should not exceed 4000 words. The short communication is for quick publication and should not exceed 1200 words.

Headings

Different headings should be in the following format.

(a) Title: Centrally aligned, bold, capital
(b) Author(s): Centrally aligned, short name, bold, first letter of all words capital followed by communication address (Not Bold)
(c) Abstract: Left aligned, bold
(d) Key words: Left aligned, bold
(e) Primary heading: Left aligned, bold, capital
(f) Secondary heading: Left aligned, first letter of each word capital
(g) Tertiary heading: Left aligned, first letter of first word capital
(h) Acknowledgements:Left aligned, bold, first letter capital
(i) References:Left aligned, bold, first letter capital
(j) Figure Caption: Left aligned, first letter of first word capital, below the figure
(k) Table Caption:Left aligned, first letter of first word capital, at the top of the table

Illustrations

All illustrations should be numbered consecutively and referred to in the text. They should confirm to A-4 size and carry short captions. Lettering inside figure should be large enough to accommodate upto 50% reduction. One set of hard copy of all figures (either tracing in ink or laser prints) should be provided in a separate envelope marked "Original Figures". Photographs should be of good quality with excellent contrast, printed on glossy paper. Colour photos are acceptable, provided the author(s) bear the cost of reproduction. Figure captions should be provided on separate sheet.

Tables

Each table must be provided with a brief caption and must be numbered in order in which they appear in the text. Table should be organised within A-4 size and should be neatly typeset for direct reproduction. Tables will not be typeset by the printer, so their clarity and appearance in print should be taken into account while the author(s) prepare(s) them. Use of 10 points Time New Roman/Arial Font for table is recommended.

References

(a) References in the text should be with the name of the author(s) followed by the year of publication in parenthesis, i.e. Patnaik (1996); Patnaik & Mishra (2002); Nayak et al. (2001)

(b) Reference list at the end of the manuscript should be in alphabetical order, in the following format: Sehgal, R.K. and Nanda, A.C.(2002) Paleoenvironment and paleoecology of the lower and middle Siwalik sub-groups of a part of North-western Himalayas. Jr. Geol. Soc. Ind, vol. 59, pp. 517-529

(c) Articles from the books should follow the format given below:Windley, B.F. and Razakamanana, T. (1996) The Madagascar – India connection in a Gondwana framework. In:Santosh, M. and Yoshida, M. Eds.) The Archaean and Proterozoic terrains of South India within East Gondwana. Gond. Res. Group Mem. No.3, Field Sci. Publ., OSAKA, pp. 25-37

(d) Books should be referred to as:Sengupta, S.M. (1994) Introduction to Sedimentology. Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi, 314 pp.

Submission of manuscript

Manuscripts strictly confirming to the above format should be mailed directly to Editor in his mailing address available in the bulletin. Manuscripts not conforming to the format of the journal will be returned.

All the manuscripts conforming to the standard format of the bulletin will be reviewed by specialist referees before publication.

Printed, edited and published at Bhubaneswar by Dr. S.K. Sarangi, General Secretary for and on behalf of the Society of Geoscientists and Allied Technologists (SGAT), 267, Kharavela Nagar, Bhubaneswar – 751 001. Printed at Reproprint (P) Ltd., N-5/49, IRC Village, Bhubaneswar – 751 015.

ISSN 0972-2173
RNI Regd. No: ORIENG/2000/2296