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Research article

Study of air quality around Dubuna, Keonjhar, India in the Eastern limb of Iron ore Horse shoe belt

Hemanta Sahoo and P.Behera

Post Graduate Department of Geology, Utkal University, Bhubaneswar-751004, Odisha
E-mail: purnananda.behera@gmail.com

Abstract

Malongotoli-Dubuna-Kalimati -Joda area comes under the district of Keonjhar and is well known for iron-manganese mines in the Horse-Shoe belt of Odisha -Jharkhand states. Since last decade the mining activities have reached its ultimate peak due to rapid growth in indigenous iron and steel industries and heavy demand of iron ore and its fines. Export of iron ore fines (0-5mm size) has created a new concept of mining in old dumps and its beneficiation process through screening. Rampant mining has severely polluted the area putting a tag of environmental degradation in the entire area. Air, water, and soil have been polluted. Six locations were chosen between Joda and Malongtoli and the air quality was monitored by collecting samples from the study area. The air quality analysis revealed significant changes in all these monitoring stations over a small period of time. In all these locations the SPM and RSPM level has reached above the CPCB standards of 200 micrograms/m^3.Similarly, the selected trace elements analysis of air deposited dust also indicate higher level of concentrations in most of the locations. Intensive study is required to find the probable cause of such pollution and its environmental impact in Malangotoli area, in future.

Key words; Environment, Pollution, Air, Malangtoli , Dubuna, Iron ore mine.

Introduction

Iron ore is the most important economic ore minerals and the horse-shoe-belt of Jharkhand and Orissa is the prominent source area in India for this ore deposit. The history of mining goes back to the year 1904 when P.N. Bose [1] discovered Iron Ore Deposit in Gorumahisani and Badampahad area. Extensive works on Iron ore belt has been done by Dunn and Dey (1942)[2] , Acharya (2002) [3], Acharya (1984) [4] ,Mohapatra et al. (2008) [5] , Cameron (1982)[6] , Fox(1924) [7] , Chakrabarty and Majumdar (1992) [8], Banerjee (1974) [9] , Dhar (1993) [10], Gross (1973) [11] , Goldich (1973) [12], Johns (1934) [13], Mishra et al. (2006) [14]. Stanley et al. (2004) [15] , Spensor and Percival (1952) [16] . Detailed work on Iron Ore deposits in Keonjhar district was been carried out by

Krishnan (1937) [17] . Significant contribution on geology, structure and genesis of Iron ores of Orissa was made by Saha [18] , Sarkar and Saha (1962) [19] , Chakraborty [20] and Majumdar [21].
Bonai-Keonjhar belt of Orissa has been classified as two stratigraphic units within a volumetric sedimentary sequence. The lower of the two sequences is known as Bonai Iron Formation and is classified as the lake superior type, while upper formation is accompanied by Manganese mineralization, appears to be of the Algoma type(Gross,1973) [11] .

Subramanyam et al. (1987) [22] carried out sediment contamination studies in Ganga basin. They concluded that heavy metal accumulation in the basin is due to anthropogenic source and their presence in mobile fraction of sediments pose environmental hazard. Enormous work has been done by State Pollution Control Board, Bhubaneswar Orissa on the Environmental Impact Assessment and management plan of Joda-Barbil area. The Statistical Handbook details these facts apart from giving an overview of the development and other ongoing activities in this district (Govt. of Orissa 1997, District Statistical Handbook 1997) [23]. Other researchers who have contributed a lot to the Iron ore belt include, Roy and Venkatesh (2009) [24], Singh and Chowdhury (1999) [25], and Panda and Barik (2010) [26].

However, very little work has been done by researchers on the EIA of iron ore belt except some consultancy agencies engaged by individual mine owners for the continuance of the mines.
The present paper pertains to the air quality study within a span of two years at six locations in Dubuna-Malangtoli area of the Iron ore deposit.

Study area

Barbil is situated in the northern part of Odisha. It is surrounded by Singhbhum district of Jharkhand in the north, Jajpur district in the south, Dhenkanal and Sundargarh districts in the west and Mayurbhanj and Bhadrak districts in the east. It is bounded by the latitudes of 22^0 7'to 22 ^{0} 12'N and longitudes85 ^{0} 24' to 85 ^{0}40''E. It lies at an average elevation of 477 m from the mean sea level (M.S.L.). The study area stretches about 30 km from Joda in north to Malangtolli in south. Malangotoli block comprises the group of Iron ore deposits spread over an area of about 20 sq km. The area is featured in Survey of India toposheet no. 73G/5 and bounded between the latitudes 21^o40' and 21^o53' N and longitudes 85^o15' and 85^o27'E. It occupies the eastern half of the southern closed end of the NNE-SSW trending horse shoe shaped group of iron ore-bearing hills in the northwestern part of Odisha. The field investigation was conducted during 1963-68 by Mathur and his colleagues of Geological Survey of India. The block was named after a small village Malngtoli situated in the central part of the area. The total reserves of the ore in various deposits in the Malangtoli block works out to be about 608 million tonnes. Out of this 307 MT are likely to be present in workable zones of these deposits and from which about 164.7 million tones of lump ore with average Fe content of 63.81% is expected to be recoverable. The Malangotoli block has not been excavated while most of the working mines are confined between Joda to Bamebari- Kalimati and Dubuna area.(Fig.1).

Materials and Methodology

In the study area six air monitoring stations with monitoring instruments were installed at a height of 10m above the ground level to record the wind speed, direction, relative humidity and temperature. The monitoring stations were selected in such a way that they remained free from obstruction as per the guide lines specified under IS8829. Cloud cover was recorded by visual observation. Rainfall was monitored by using rain gauge. Representative air samples were collected from the study area at six locations and these samples were tested for their air quality analysis .The monitoring of air samples was carried out from April 2009 to December 2011.The parameters monitored were Suspended Particulate Matter (SPM), Respirable Particulate Matter (RSPM), SO_2 (sulphur dioxide), oxides of Nitrogen (NO_x) , ground level ozen concentrations (O_3) and Carbon monoxide. The monitoring was carried out twice a week during the study period. SPM and RSPM were monitored on 24 hourly basis while SO_2 ,NO_x were monitored 4 hourly basis and the result were reported on 24 hourly basis.

The Sampling and analysis of ambient air quality was carried out as per the procedure detailed in IS-15182(Indian standard for ambient air quality parameter). Some standard trace elements were studied for the dust samples collected by air quality analyser..

Results and discussion

The results of air quality analysis have been shown in table-1 for the year 2008 and 2009 in table-2. The trace element studies were done from the samples collected from air quality analyser and data are shown in table-3 and table-4.

From the data reflected on Table1and Table- 2, it is observed that SPM and RSPM levels are much higher than the permissible limit at the all six locations where as the other parameters like SO_2, NO_x and CO etc. are less than the permissible limit as per the prescribed standard. In places, the SO_2 is found below the detection limit. The trace element analysis suggests that the air dust containing hazardous trace elements are well within permissible limits having no danger to human life at present.

Conclusions

The data studied and recorded in Tables reveal that the SPM values of 638.70, 613.15, 521.18, 510.76, 593.99 and 495.43 $\mu g/m^3$ at locations L- 1 to L-6 and RSPM concentrations are 259.60, 249.22, 211,83, 207.60, 241.43 and 201.37 $\mu g/m^3$ at locations L-1 to L-6 in the study area which is much higher than the permissible limits where as SO_2, NO_X and CO are well within limits. The SO_2 content is negligible. Concentration of trace elements in the dust samples is below danger level at present.

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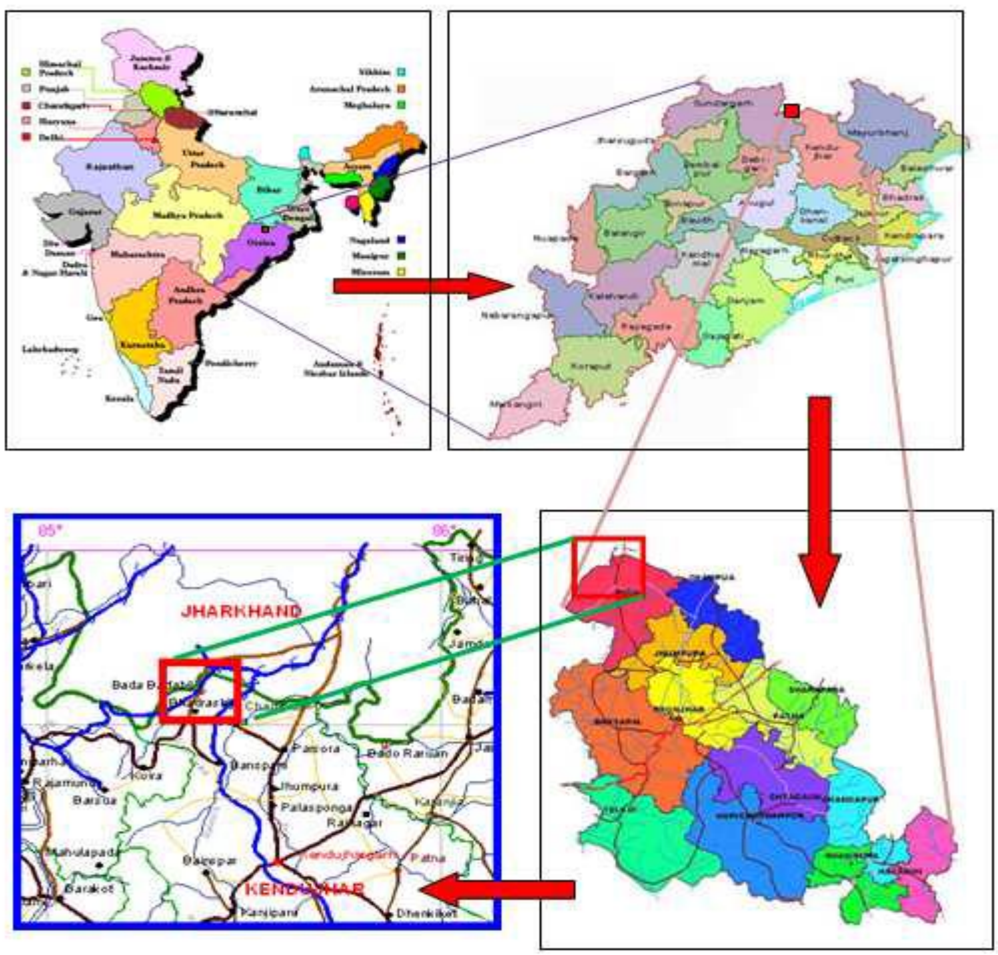

Fig 1: Study area shown on the figure

Table 1: STUDY OF AVARAGE AMBIENT AIR QUALITY ANALYSIS (2008)

Sl No.	Parameters	Reporting unit	IS:15182	L1	L2	L3	L4	L5	L6
1	SPM	µg/m^3	200	638.70	613.15	521.18	510.76	593.99	495.43
2	RPM	µg/m^3	100	259.60	249.22	211.83	207.60	241.43	201.37
3	SO2	µg/m^3	80	4.90	4.70	4.00	3.92	4.56	3.80
4	NO_x	µg/m^3	80	28.70	27.55	23.42	22.95	26.69	22.26
5	CO	µg/m^3	4	0.28	0.27	0.23	0.22	0.26	0.22

Table 2: STUDY OF AVARAGE AMBIENT AIR QUALITY ANALYSIS (2009)

Sl No.	Parameters	Reporting unit	IS:15182	L1	L2	L3	L4	L5	L6
1	SPM	µg/m^3	200	619.54	594.76	505.54	495.43	576.17	480.57
2	RPM	µg/m^3	100	251.81	241.74	205.48	201.37	234.19	195.33
3	SO2	µg/m^3	80	4.75	4.56	3.88	3.80	4.42	3.69
4	NO_x	µg/m^3	80	27.84	26.73	22.72	22.26	25.89	21.59
5	CO	µg/m^3	4	0.27	0.26	0.22	0.22	0.25	0.21

Table-3: Ambient air quality Analysis (Trace elements)

Parameter	BIS standard	Location-1				Location-2			
		April08	Sept.08	April09	Sept.09	April08	Sept.08	April09	Sept.09
Fe	$	1.270	0.991	1.194	0.096	1.0922	0.9393	1.0376	0.8923
Mn	$	0.280	0.218	0.263	0.212	0.2408	0.2071	0.2288	0.1967
Pb	1	0.120	0.094	0.113	0.091	0.1032	0.0888	0.0980	0.0843
Cd	$	0.027	0.021	0.025	0.020	0.0232	0.0200	0.0221	0.0190
Cu	$	0.150	0.117	0.141	0.113	0.1290	0.1109	0.1226	0.1050
Zn	$	0.270	0.211	0.254	0.204	0.2322	0.1997	0.2206	0.1897
Ni	20	0.017	0.013	0.016	0.013	0.0146	0.0126	0.0139	0.0119
T	$	0.207	0.161	0.195	0.157	0.1780	0.1531	0.1691	0.1454

Table-4: Ambient air quality Analysis (Trace elements)

Parameter	BIS standard	Location-3				Location-4			
		April08	**Sept.08**	**April09**	**Sept.09**	**April08**	**Sept.08**	**April09**	**Sept.09**
Fe	$	0.913	0.886	0.867	0.868	1.280	1.005	1.242	0.975
Mn	$	0.201	0.195	0.191	0.191	0.282	0.222	0.274	0.215
Pb	1	0.084	0.082	0.078	0.080	0.121	0.095	0.117	0.092
Cd	$	0.019	0.019	0.018	0.018	0.027	0.021	0.026	0.021
Cu	$	0.108	0.105	0.100	0.103	0.151	0.119	0.147	0.115
Zn	$	0.194	0.188	0.181	0.185	0.272	0.214	0.264	0.207
Ni	20	0.012	0.011	0.011	0.011	0.017	0.013	0.019	0.013
T	$	0.142	0.138	0.132	0.135	0.209	0.164	0.202	0.159